FDM 10-15-1 Glossary

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The list of terms that follows is representative of those used by public works officials, planners and other urban specialists, water pollution specialists, engineers, developers, soil scientists and conservationist planners. Not all the terms are necessarily used in the chapter, but they are in common use in urban conservation and environmental matters.

Glossary

Absorption	The act or process of taking in water by inflow of atmospheric vapor, hygroscopic absorption, wetting, infiltration, influent seepage and gravity flow of streams into sinkholes or other large openings.
Abstraction	That portion of rainfall which does not become runoff. It includes interception, infiltration, and storage in depression. It is affected by land use, land treatment and condition, and antecedent soil moisture.
Abutment	The support at either end of a bridge: usually classified as spill-through or vertical.
Accretion	1. A process of accumulation by flowing water whether of silt, sand, pebbles, etc. Accretion may be due to any cause and includes alleviation. 2. The gradual building up of a beach by wave action. 3. The gradual building of a channel bottom, bank, or bar due to silting or wave action.
Acre-Foot	The amount of water that will cover 1 acre to a depth of 1 foot. Equals 43,560 cubic feet (**1233.5 m^3**). Abbreviated AF.
Aggradation	General and progressive upbuilding of the longitudinal profile of a channel by deposition of sediment.
Allowable Headwater	The depth or elevation of impounded water at the entrance to a hydraulic structure beyond which flooding or some other unfavorable result could occur.
Alluvial Channel	A channel wholly in alluvium, no bedrock exposed in channel at low flow or likely to be exposed by erosion during major flow.
Alluvium	Unconsolidated clay, silt, sand, or gravel deposited by a stream in a channel, flood plain, fan or delta.
Anabranched Stream	A stream whose flow is divided at normal and lower stages by large islands or, more rarely, by large bars. The width of individual islands or bars is greater than three times water width.
Annual Flood	The highest peak discharge in a water year.
Annual Series	A frequency series in which only the largest value in each year is used, such as annual floods.
Annual Yield	The total amount of water obtained in a year from a stream, spring, artesian well, etc. Usually expressed in inches depth, acre-feet, millions of gallons, or cubic feet.
Antecedent Moisture Conidition (AMC	The degree of wetness of a watershed at the beginning of a storm.
Anti-seepage Collar	A device attached to the outside of a culvert to prevent failure by washout of the fill next to the culvert.
Area Rainfall	The average rainfall over an area, usually as derived from, or discussed in contrast with, point rainfall.

Armor	Artificial surfacing of channel beds, banks, or embankment slopes to resist scour and lateral erosion.
Armoring	Armoring is the concentration of a layer of stones on the bed of the stream which are of a size larger than the transport capability of the recently experienced flow.
Avulsion	A sudden change in the course of a channel, usually by breaching of the banks during a flood.
Aquifer	A porous, water-bearing geologic formation. Generally restricted to materials capable of yielding an appreciable supply of water.
Artesian	Pertains to groundwater that is under pressure and will rise to a higher elevation if given an opportunity to do so.
B	Barrel width, ft.
Backwater	The increase in water-surface profile, relative to the elevation occurring under natural channel and flood-plain conditions, induced upstream from a structure, bridge, or culvert, that obstructs or constricts a channel. It also applies to the water surface profile in a channel or conduit.
Baffle	A structure built on the bed of a stream to deflect or disturb the flow. Also a device used in a culvert to facilitate fish passage.
Bank	Lateral boundaries of a channel or stream, as indicated by a scarp, or on the inside of bends, by the streamward edge of permanent vegetal growth.
Bar	An elongated deposit of alluvium, not permanently vegetated, within or along the side of a channel.
Base Flood	The 100-Year flood.
Base Flow	Stream discharge derived from groundwater sources. Sometimes considered to include flows from regulated lakes or reservoirs. Fluctuates much less than storm runoff.
Basin, Drainage	The area of land drained by a watercourse.
Basin Lag	The amount of time from the centroid of the rainfall hyetograph to the hydrograph peak.
Bed (of a channel	The part of a channel not permanently vegetated, bounded by banks, or stream)over which water normally flows.
Bed Load	Sediment that is transported in a stream by rolling, sliding, or skipping along the bed or very close to it; considered to be within the bed layer.
Bed Material	Sediment consisting of particle sizes large enough to be found in appreciable quantities at the surface of a streambed.
Bed Shear	The force per unit area exerted by a fluid flowing past a stationary (tractive force)boundary.
Benching	Benching is a series of permanent, deep cuts that are constructed in steep backslopes.
Berm	A narrow shelf or ledge; also a form of dike.
Braided Stream	A stream whose surface is divided at normal stage by small mid-channel bars or small islands. The individual width of bars and islands is less than three times the water width. A braided stream has the aspect of a single large channel within which are subordinate channels.
Bridge	A structure including supports erected over a depression or an obstruction and having a tract or passageway for carrying traffic or moving loads, and having an opening measured along the center of the roadway of more than 20 feet **(6.0 m)** between undercopings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes; it may also include multiple pipes, where the clear distance between openings is less than

	half of the smaller contiguous opening. Also a structure designed hydraulically using the principles of open channel flow to operate with a free water surface, but may be inundated under flood conditions.
Breakers	The surface discontinuities of waves as they break-up. They may take different shapes (spilling, plunging, surging). Zone of break-up is called surf zone.
Bridge Opening	The cross-sectional area beneath a bridge that is available for conveyance of water.
Bridge Waterway	The area of a bridge opening available for flow, as measured below a specified stage and normal to the principal direction of flow.
Broken-Back Culvert	A culvert comprising two or more longitudinal structure profiles. Such culverts are sometimes effective in reducing outflow velocities by the energy dissipation of a hydraulic jump.
By-Pass	Flow which bypasses an inlet on grade and is carried in the street or channel to the next inlet downstream. Also called carryover.
Capacity	A measure of the ability of a channel or conduit to convey water.
Catch Basin	A structure with a sump for inletting drainage from a gutter or median and discharging the water through a conduit. In common usage it is a grated inlet with or without a sump.
Catchment	The watershed. (Implying all physical characteristics.)
Catchment Area	The area tributary to a lake, stream, or drainage system.
CFS	Abbreviation for cubic feet per second. A unit of water flow. Sometimes called "second feet."
Channel	(1) The bed and banks that confine the surface flow of a natural or artificial stream. Braided streams have multiple subordinate channels, which are within the main stream channel. Anabranched streams have more than one channel. (2) The course where a stream of water runs, or the closed course or conduit through which water runs, such as a pipe.
Channel Lining	The material applied to the bottom and/or sides of a natural or manmade channel. Material may be concrete, sod, grass, rock, or any of several other types.
Channel Routing	The process whereby a peak flow and/or its associated streamflow hydrograph is mathematically transposed to another site downstream.
Check Dam	A low structure, dam or weir, across a channel for the control of water stage, or velocity, or to control channel erosion.
Check Flow	A flow, larger or smaller than the design flow, which is used to assess the performance of the facility.
Chute	An open or closed channel used to convey water, usually situated on the ground surface.
Coast Line (shore line)	The line forming the boundary between the land and water.
Coastal Zone	The strip of land that extends inland to the first major change in terrain (lake shore)features.
Coefficient Of Discharge	The coefficient used for orifice flow processes.
Combination Inlet	Drainage inlet usually composed of two or more inlet types, e.g., curb-opening and a grate inlet.
Conduit	An artificial or natural channel; usually a closed structure such as a pipe.
Conjugate Depth	The alternate depth of flow involved with the hydraulic jump.
Continuity Equation	Discharge equals velocity times cross-sectional area. (Q = V x A)

Control Section	A cross section, such as a bridge crossing, reach of channel, or dam, with limited flow capacity, in which the discharge is related to the upstream water-surface elevation.
Contraction	The effects of a channel constriction on flow.
Contraction Scour	The response of a river to the change in its bed load requirement as a result of a contraction of flow. The flow contraction is due to an encroachment of either the main channel or the flood plain by a natural constriction or the highway embankment.
Controlled Spillways	A reservoir outlet works wherein the outflow is controlled by tainter gates or some similar device.
Conveyance	A measure, K, of the ability of a stream, channel, or conduit to convey water. In Manning's formula $K = (1.49/n)AR^{2/3}$.
Corrosion	The deterioration of pipe or structure by chemical action.
Cover	The extent of soil above the crown of a pipe or culvert. The vegetation, or vegetational debris such as mulch, that exists on the soil surface. In some classification schemes fallow or bare soil is taken as the minimum cover class.
Critical Depth	The depth at which water flows over a weir; this depth being attained automatically where no backwater forces are involved. It is the depth at which the energy content of flow is a minimum.
Cross Drainage	The runoff from contributing drainage areas both inside and outside the highway right-of-way and the transmission thereof from the upstream side of the highway facility to the downstream side.
Cross-Section	The shape of a channel, stream, or valley, viewed across its axis. In watershed investigations it is determined by a line approximately perpendicular to the main path of water flow, along which measurements of distance and elevation are taken to define the cross-sectional area.
Culvert	A structure which is usually designed hydraulically to take advantage of submergence to increase hydraulic capacity. A structure used to convey surface runoff through embankments. A structure, as distinguished from bridges, which is usually covered with embankment and is composed of structural material around the entire perimeter, although some are supported on spread footings with the streambed serving as the bottom of the culvert. Also, a structure which is 20 feet (**6.0 m**) or less in centerline length between extreme ends of openings for multiple boxes.
Culvert Inlet	Usually is the placing of a sediment filter or excavated impoundment Protectionarea at the inlet end of storm sewer culverts.
Curb-Opening Inlet	Drainage inlet consisting of an opening in the roadway curb.
Cumulative	A tabulation or graphical plot of the accumulated measures of Conveyance conveyance; proceeding from one stream bank to the other.
Cutoff Wall	A wall that extends from the end of a structure to below the expected scour depth, or scour-resistant material.
D	Culvert diameter or barrel depth.
D_{50}	Median size of rip rap. The particle diameter at the 50 percentile point on a size weight distribution curve.
D_{16}	The particle diameter at the 16 percentile point on a size weight distribution curve.
D_{85}	The particle diameter at the 85 percentile point on a size weight distribution curve.
d_c	Critical depth of flow, ft.
Debris	Material transported by the stream, either floating or submerged, such as logs or brush.

Degradation	General and progressive lowering of the longitudinal profile of a channel by erosion.
Deposition	The settling of material from the stream flow onto the bottom.
Depression Storage	Rainfall which is temporarily stored in depressions within a watershed.
Depth-Area Curve	A graph showing the change in average rainfall depth as size of area changes.
Design Discharge Or Flow	The rate of flow for which a facility is designed.
Design Flood	The recurrence interval that is expected to be accommodated without Frequencycontravention of the adopted design constraints. The return interval (recurrence interval or reciprocal of probability) used as a basis for the design discharge.
Design Highwater	The maximum water level that a bridge opening is designed to Elevationaccommodate without contravention of the adopted design constraints. The usual term used to describe the estimated water surface elevation in the stream at the project site for the design discharge.
Design Flood	A flood that does not overtop the roadway.
Design Storm	A given rainfall amount, areal distribution, and time distribution, used to estimate runoff. The rainfall amount is either a given frequency (25-year, 50-year, etc.) or a specific large value.
Detention Basin	A basin or reservoir incorporated into the watershed whereby runoff is temporarily stored, thus attenuating the peak of the runoff hydrograph.
Dike	An impermeable linear structure for the control or confinement of overbank flow. River training structure used for bank protection.
Direct Runoff	The water that enters the stream channels during a storm or soon after, forming a runoff hydrograph. May consist of rainfall on the stream surface, surface runoff, and seepage of infiltrated water (rapid subsurface flow).
Discharge	The rate of the volume of flow of a stream per unit of time, usually expressed in cfs.
Diversion Dike	A ridge of compacted soil constructed at the top or base of a sloping disturbed area and may be either temporary or permanent.
Drainage Area	The area draining into a stream at a given point. The area may be of different sizes for surface runoff, subsurface flow, and base flow, but generally the surface flow area is used as the drainage area.
Drop Inlet	Drainage inlet with a horizontal or nearly horizontal opening.
Dust Controls	Measures such as vegetative cover, mulch, irrigation or spray-on adhesives that are used to reduce surface and air movement of dust during land disturbing, demolition and construction activities.
Effective Duration	The time in a storm during which the water supply for direct runoff is produced. Also used to mean the duration of excess rainfall.
Effective Particle	The diameter of particles, spherical in shape, equal in size and arranged Sizein a given manner, of a hypothetical sample of granular material that would have the same transmission constant as the actual material under consideration.
Emergency Spillway	A rock or vegetated earth waterway around a dam, built with its crest above the normally used principal spillway. Used to supplement the principal spillway in conveying extreme amounts of runoff safely past the dam.
End Section	A concrete or metal structure attached to the end of a culvert for purposes of retaining the embankment from spilling into the waterway, appearance, anchorage, etc.
Energy Dissipation	The phenomenon whereby energy is dissipated or used up.

Energy Grade Line	A line joining the elevation of energy heads; a line drawn above the hydraulic grade line a distance equivalent to the velocity head of the flowing water at each section along a stream, channel or conduit.
Energy Gradient	Slope of the line joining the elevations of total energy along a conduit of flowing water.
Ephemeral Stream	A stream or reach of a stream that does not flow continuously for most of the year.
Equalizer	A culvert or opening placed where it is desirable to equalize the water head on both sides of the embankment.
Equivalent Cross-to Slope	An imaginary straight cross-slope having conveyance capacity equal that of the given compound cross-slope.
Erosion Mat	A general term for any protective covering mat or soil retention mat this is installed on a prepared planting area of a slope, channel, or shoreline. A protective covering mat, also referred to as an "Erosion Control Revegetative Mat" (ECRM), is a blanket-like covering laid on top of a prepared seed bed to protect the soil and seed from the erosive forces of nature. A soil retention mat, also referred to as a "Turf Reinforcement Mat" (TRM), helps to permanently stabilize the soil by acting as a reinforcement for the vegetation. This open weaved, synthetic mat is installed on top of a prepared seed bed and then filled with topsoil or granular material such as pea grave (ie., Course Aggregate No. 4 or 5). As the vegetation grows, the roots intertwine into the mat, 'reinforcing the turf". In vegetated channels, this reinforcement helps to raise the channel's maximum permissible shear stress.
Erosion Bale	Temporary sediment barriers consisting of a row or rows of entrenched and anchored straw or hay bales.
Erosion	The wearing away or scouring of material in a channel, opening, or outlet works caused by flowing water.
Evapotranspiration	Plant transpiration plus evaporation from the soil. Difficult to determine separately, therefore used as a unit for study.
Excess Rainfall	Direct runoff.
Exfiltration	The process by which stormwater leaks or flows to the surrounding soil through openings in a conduit.
Fetch	The distance the wind blows over water in generating waves.
Filter	A device or structure for removing solid or colloidal material from stormwater or preventing migration of fine-grained soil particles as water passes through soil. The water is passed through a filtering medium; usually a granular material or finely woven or non-woven cloth.
Filter Berms	See "Stone or Rock Ditch Checks".
Filtration	The process of passing water through a filtering medium consisting of either granular material of filter cloth for the removal of suspended or colloidal matter.
Flanking Inlets	Inlets placed upstream and on either side of an inlet at the low point in a sag vertical curve. The purposes of these inlets are to intercept debris as the slope decreases and to act as relief of the inlet at the low point.
Flared Inlet	A specially fabricated pipe appurtenance or a special feature of box culverts. This type of inlet is effective in reducing the calculated headwater.
Flared Wingwalls	The part of a culvert headwall which serves as a retaining wall for the highway embankment. The walls form an angle to the centerline of the culvert.
Flood	In common usage, an event that overflows the normal banks. In technical usage, it refers to a given discharge based, typically, on a statistical analysis of an annual series of events.

Flood Frequency	The average time interval, in years, in which a given storm or amount of water in a stream will be exceeded.
Flood Of Record	Reference to the maximum estimated or measured discharge that has occurred at a site.
Floodplain	The alluvial land bordering a stream, formed by stream processes, that is subject to inundation by floods.
Flood Pool	Floodwater storage elevation in a reservoir. In a floodwater retarding reservoir, the temporary storage between the crests of the principal and emergency spillways.
Flood Routing	Determining the changes in a flood hydrograph as it moves downstream through a channel or through a reservoir (called reservoir routing). Graphic or numerical methods are used.
Floodwater	A dam, usually with an earth fill, having a flood pool where incoming Retarding
Flow-Control	A structure, either within or outside a channel, that acts as a Structurecountermeasure by controlling the direction, depth, or velocity of flowing water.
Flow Concentration	A preponderance of the streamflow.
Flow Distribution	The estimated or measured spatial distribution of the total streamflow.
Flume	An open or closed channel used to convey water.
Ford	A location where a highway crosses a river or wash by allowing flow over the highway. Often with cut-off walls and markers.
Freeboard	The vertical distance between the level of the water surface, usually corresponding to design flow and a point of interest such as a low chord of a bridge beam or specific location on the roadway grade.
Free Outlet	Those outlets whose tailwater is equal to or lower than critical depth. For culverts having free outlets, lowering of the tailwater has no effect on the discharge or the backwater profile upstream of the tailwater.
Frequency	In analysis of hydrologic data, the recurrence interval is simply called frequency.
Froude Number	A dimensionless number that represents the ratio of inertial forces to gravitational forces. High froude numbers are indicative of high flow velocity and high potential for scour.
Frontal Flow	The portion of flow which passes over the upstream side of a grate.
Functional Values	Characteristics of surface water and wetlands. These include terrestrial and aquatic wildlife habitat, flood control, groundwater recharge, aesthetics, shore and bank line geometry, and water quality.
g	The acceleration of gravity. At sea level it is 32 ft/sec^2 or 9.8 m/sec^2.
Gabion	Large, multi-celled, rectangular wire mesh boxes filled with rock to form flexible monolithic building blocks. They are used as erosion control structures in channels, revetments, retaining walls, abutments and check dams.
General Scour	Scour involving the removal of material from the bed and banks across or most of the width of a channel and is not localized at an element such as a pier, abutment or other obstruction to flow. Also termed contraction scour.
Graded Filter	An aggregate filter which is proportioned by particle size to allow water to pass through at a specified rate while preventing migration of fine-grained soil particles without clogging.
Grate Inlet	Drainage inlet composed of a grate in the roadway section or at the roadside in a low point, swale, or ditch.

Groin	A structure in the form of a barrier placed oblique to the primary motion of water, designed to control movement of bed load. Groins are usually solid, although they may be constructed with openings to control elevations of sediments.
Groundwater	Subsurface water occupying the saturation zone, from which wells and springs are fed. A source of base flow in streams. In a strict sense the term applies only to water below the water table. Also called phreatic water.
Grouted Riprap	A rigid lining which consists of riprap with all or part of the voids filled with portland cement.
Guide Banks	Embankments built upstream from one or both abutments of a bridge to guide the approaching flow through the waterway opening.
H	Total energy head loss, ft.
H_E	Entrance head loss, ft.
Head	Potential energy expressed as the height of water above a datum.
Head Cutting	Channel degradation associated with abrupt changes in the bed elevation (headcut), that migrates in an upstream direction.
Headloss	A loss of energy in a hydraulic system.
Headwall	The structural appurtenance usually applied to the end of a culvert to control an adjacent highway embankment and protect the culvert end.
Headwater, H_w	That depth of water impounded upstream of a culvert due to the influence of the culvert constriction, friction, and configuration.
H_f	The friction headloss, ft.
Highwater	The water surface elevation that results from the passage of flow. It may Elevationbe "observed highwater elevation" as a result of an event, or "calculated highwater elevation" as part of a design process.
Historical Flood	A past flood event of known or estimated magnitude.
h_o	The height of the hydraulic grade line above the outlet invert, ft.
Hydraulic Grade	A profile of the piezometric level to which the water would rise in Linepiezometer tubes along a pipe run. In open channel flow, it is the water surface.
Hydraulic Gradient	The slope of the hydraulic grade line.
Hydraulic Head	The height of the free surface of a body of water above a given point.
Hydraulic Jump	A hydraulic phenomenon, in open channel flow, whereby supercritical flow is converted to subcritical flow. This can result in an abrupt rise in the water surface.
Hydraulic Radius	A measure of the boundary resistance to flow, computed as the quotient of cross-sectional area of flow divided by the wetted perimeter. For wide shallow flow, the hydraulic radius can be approximated by the average depth.
Hydraulic Roughness	Is a composite of the physical characteristics which influence the flow of water across the earth's surface, whether natural or channelized. It affects both the time response of a watershed and drainage channel as well as the channel storage characteristics.
Hydraulics	The characteristics of fluid mechanics involved with the flow of water in or through drainage facilities.
Hydrograph	A graph showing, for a given point on a stream or for a given point in any drainage system, the discharge, stage, velocity or other property of water with respect to time.
Hydrologic Soil-Cover Complex	A combination of a hydrologic soil group and a type of cover.

Hydrologic Soil	A group of soils having the same runoff potential under similar storm Groupand cover conditions.
Hydrology	The study of the occurrence, circulation, distribution, and properties of the waters of the earth and its atmosphere.
Hyetograph	A graphical representation of average rainfall, rainfall-excess rates or volumes over specified areas during successive units of time during a storm.
Impermeable Strata	A strata in which texture is such that water cannot move perceptibly through it under pressures ordinarily found in subsurface water.
Impervious	Impermeable to the movement of water.
Improved Inlet	Flared, depressed or tapered culvert inlets which decrease the amount of energy needed to pass the flow through the inlet and thus increase the capacity of culverts.
Infiltration	That part of rainfall that enters the soil. The passage of water through the soil surface into the ground. Used interchangeably herein with the word: percolation.
Infiltration Rate	The rate at which water enters the soil under a given condition. The rate is usually expressed in inches per hour, feet per day, or cubic feet per second.
Inflow	The rate of discharge arriving at a point (in a stream, structure, or reservoir).
Initial	When considering surface runoff, Ia is all the rainfall before runoff begins.
Interlocking Cells	Manufactured cellular devices which are usually filled with a granular material.
Abstraction (Ia)	When considering direct runoff, Ia consists of interception, evaporation, and the soil-water storage that must be exhausted before direct runoff may begin. Sometimes called "initial loss."
Inlet	A structure for capturing concentrated surface flow. May be located
Inlet Efficiency	The ratio of flow intercepted by an inlet to the total flow.
Inlet Time	The time required for stormwater to flow from the most distant point in a drainage area to the point at which it enters a storm drain.
Intensity	The rate of rainfall upon a watershed, usually expressed in inches per hour.
Interception	Precipitation retained on plant or plant residue surfaces and finally absorbed, evaporated, or sublimated. That which flows down the plant to the ground is called "stemflow" and not counted as true interception.
Intercepting	A type of permanent diversion dike, which is used along the top of Embankmentbackslopes in cut areas to prevent the adjacent lateral drainage from flowing over or down the backslopes.
Intermittent	Temporary or permanent waterways that are shaped, sized, and lined Channelswith appropriate vegetation or structural material to safely convey stormwater runoff.
Invert	The flow line in a channel cross-section, pipe, or culvert.
Inverted Syphon	A structure used to convey water under a road using pressure flow. The hydraulic grade line is above the crown of the structure.
Isohyet	A line on a map, connecting points of equal rainfall amounts.
Jetty	An elongated obstruction projecting into a stream to control shoaling and scour by deflection of currents and waves. They may be permeable or impermeable.
Lag Time, T_L	The difference in time between the centroid of the excess rainfall (that rainfall producing runoff) and the peak of the runoff hydrograph. Often estimated as 60 percent of the time of concentration ($T_L = 0.6T_c$)

Levee	A linear embankment outside a channel for containment of flow.
Littoral Transport	The movement of sediments in the near shore zone by waves and currents. The movement can be parallel to the shore (long shore transport) or perpendicular to the shore (onshore-offshore transport).
Local Scour	Scour in a channel or on a flood plain that is localized at a pier, abutment or other obstruction to flow. The scour is caused by the acceleration of the flow and the development of a vortex system induced by the obstruction to the flow.
Manhole	A structure by which one may access a drainage system.
Manning's "n"	A coefficient of roughness, used in a formula for estimating the capacity of a channel to convey water. Generally, "n" values are determined by inspection of the channel.
Mass Inflow Curve	A graph showing the total cumulative volume of stormwater runoff plotted against time for a given drainage area.
Maximum Probable	The greatest flood that may reasonably be expected, taking into Flood
Mean Daily	The average of mean discharge of a stream for one day. Usually given Dischargein cfs.
Meanders	The changes in direction and winding of flow which are sinuous in character.
Migration, Channel	Change in position of a channel by lateral erosion of one bank and simultaneous accretion of the opposite bank.
Mulch	A degradable, protective ground cover usually composed of woodships or wood fibers, and used in conjunction with seeding to prevent erosion by protecting the soil surface from raindrop impact. In addition, it helps to foster the growth of vegetation by increasing available moisture and providing insulation against extreme heat and cold.
Natural Scour	Scour which occurs along a channel reach due to an unstable stream, no exterior causes.
Normal Stage	The water stage prevailing during the greater part of the years.
One-Dimensional Water Surface Profile	An estimated water surface profile which accommodates flow only in the up-stream-downstream direction.
Ordinary High	The line on the shore established by the fluctuations of water and Waterindicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of liter and debris, or other appropriate means that consider the characteristics of the surrounding areas.
Outfall	The point location or structure where drainage discharges from a channel, conduit or drain.
Outlet Protection	The placing of an energy dissipating device at the outlets of pipes or channel sections.
Overland Flow	Runoff which makes its way to the watershed outlet without concentrating in gullies and streams (often in the form of sheet flow).
Partial-Duration	A list of all events, such as floods, occurring above a selected base, Serieswithout regard to the number, within a given period. In the case of floods, the selected base is usually equal to the smallest annual flood, in order to include at least one flood in each year.
Peak Discharge	Maximum discharge rate on a runoff hydrograph.
Percolation	The movement or flow of water through the interstices or the pores of a soil or other porous medium. Used interchangeably herein with the word "infiltration."
Permeability	The property of a material that permits appreciable movement of water through it when it is saturated and movement is actuated by hydrostatic pressure of the magnitude normally encountered in natural subsurface water.

Permanent Seeding	The establishment of perennial vegetative cover on disturbed areas by planting seed. This cover can include grasses, legumes and/or wildflowers.
Perennial Stream	A stream or reach of a stream that flows continuously for all or most of the year.
Pervious Soil	Soil containing voids through which water will move under hydrostatic pressure.
pH	The reciprocal of the logarithm of the Hydrogen ion concentration. The concentration is the weight of hydrogen ions, in grams, per liter of solution. Neutral water has a pH value of 7.
Pipe Down Drains	Also referred to as "slope drains", are used to help direct runoff down a slope at a specific location. They are usually used in conjunction with diversion dikes, intercepting embankments, or temporary fill diversions.
Point Rainfall	Rainfall at a single rain gage.
Precipitation	The process by which water in liquid or solid state falls from the atmosphere.
Principal Spillway	Conveys all ordinary discharges coming into a reservoir and all of an extreme discharge that does not pass through the emergency spillway.
Rainfall Excess	The water available to runoff after interception, depression storage, and infiltration have been satisfied.
Rainfall Intensity	Amount of rainfall occurring in a unit of time, converted to its equivalent in inches per hour at the same rate.
Rating Curve	A graphical plot relating stage to discharge.
Reach	A length of stream or valley, selected for purpose of study.
Recession Curve	The receding portion of a hydrograph, occurring after excess rainfall has stopped.
Recharge	Addition of water to the zone of saturation from precipitation or infiltration.
Recharge Basin	A basin excavated in the earth to receive the discharge from streams or storm drains for the purpose of replenishing groundwater supply.
Regional Analysis	A regional study of gaged watersheds which produces regression equations relating various watershed and climatological parameters to discharge. Use for design of ungaged watershed with similar characteristics.
Regulatory Flood	The 100-year flood, which was adopted by the Federal Emergency Management Agency (FEMA), as the base flood for flood plain management purposes.
Regulatory	The floodplain area that is reserved in an open manner by Federal, State, Floodwayor local requirements, i.e., unconfined or unobstructed either horizontally or vertically, to provide for the discharge of the base flood so that the cumulative increase in water surface elevation is no more than a designated amount.
Reservoir Routing	Flood routing of a hydrograph through a reservoir.
Retard	A structure designed to decrease velocity and induce silting or accretion. Retard type structures are permeable structures customarily constructed at and parallel to the toe of a slope.
Retention Basin	A basin or reservoir wherein water is stored for regulating a flood. It does not have an uncontrolled outlet. The stored water is disposed by a means such as infiltration, injection (or dry) wells, or by release to the downstream drainage system after the storm event. The release may be through a gate-controlled gravity system or by pumping.
Revetment	A rigid or flexible armor placed on a bank or embankment as protection against scour and lateral erosion.

Riprap	A flexible lining having a loose assemblage of relatively large rocks or stones that vary in size.
Roughness	The estimated measure of texture at the perimeters of channels and conduits. Usually represented by the "n-value" coefficient used in Manning's channel flow equation.
Runoff	That part of the precipitation which runs off the surface of a drainage area after all abstractions are accounted for.
Runoff Coefficient	A factor representing the portion of runoff resulting from a unit rainfall. Dependent on terrain and topography.
Safety Fence	A protective barrier installed to prevent access to an erosion control measure. Typically used around detention basins.
Saturated Soil	Soil that has its interstices or void spaces filled with water to the point at which runoff occurs.
Scour	The result of the erosive action of running water, excavating and carrying away material from the bed and banks of streams.
Scupper	A vertical hole through a bridge deck for the purpose of deck drainage. Sometimes a horizontal opening in the curb or barrier is called a scupper.
Sediment Pool	Reservoir storage provided for sediment, thus prolonging the usefulness of floodwater or irrigation pools.
Sedimentation	The deposition of soil particles which have been carried by flood waters.
Sedimentation Basin	A basin or tank in which stormwater containing settleable solids is retained to remove by gravity or filtration a part of the suspended matter.
Sediment Traps or Basins	Storage areas provided by either excavation or the provision of a damor a barrier for the purpose of trapping and storing sediment.
Sheeting	A lining of wood or steel driven into the subsoil and used to support an embankment or the walls or an excavation. It may be used as a permanent or temporary installation.
Silt Fence	A temporary sediment control barrier consisting of a synthetic filter fabric that is stretched across supporting posts and entrenched at the bottom. It is limited to conditions in which only sheet or overland flows are expected and is not recommended for use in channels.
Silt Screen	A floating geotextile material used to minimize sediment transport within a body of water. Silt screens float from the surface of the water to approximately 2 feet **(600 mm)** above the water bed.
Skew	A measure of the angle of intersection between a line normal to the roadway centerline and the direction of the streamflow at flood stage on the lineal direction of the main channel.
Skewness	The curvature observed in a plot of data on log-normal paper.
Slotted Drain Inlets	Drainage inlets composed of a continuous slot built into the top of a pipe which serves to intercept, collect and transport the flow.
Sod	A grass-covered surface soil that is held together by matted roots and used to stabilize fine graded disturbed areas.
Soffit	The inside top of the culvert or storm drain pipe.
Soil Porosity	The percentage of the soil (or rock) volume that is not occupied by solid particles, including all pore space filled with air and water.
Soil-Water-Storage	The amount of water the soils (including geologic formations) of a watershed will store at a given time. Amounts vary from watershed to watershed. The amount for a given watershed is continually varying as rainfall or evapotranspiration takes place.

Splash-Over	That portion of frontal flow at a grate which splashes over the grate and is not intercepted.
Spread	The accumulated flow in and next to the roadway gutter. This water often represents an interruption to traffic flow during rainstorms. The lateral distance, in feet, of roadway ponding from the curb.
Spur	A structure, permeable or impermeable, projecting into a channel from the bank for the purpose of altering flow direction, inducing deposition, or reducing flow velocity along the bank.
Spur Dike	A dike placed at an angle to the roadway for the purpose of shifting the erosion characteristics of stream flow away from a drainage structure. Often used at bridge abutments.
Stage	Height of water surface above a specified datum.
Stage-Discharge	Sometimes referred to as the Rating Curve of a stream cross-section. A - Relationshipcorrelation between stream flow rates and corresponding water surface elevations.
Stilling Basin	An energy dissipator placed at the outlet of a structure.
Stone or Rock Ditch Checks	Temporary or permanent dams constructed across a swale or drainage ditch. They may be constructed from course aggregate, riprap, breaker run, or railroad ballast and are commonly referred to as "filter berms".
Storage-Indication Method	A flood-routing method, also often called the modified Puls method.
Storm Drain	The water conveyance elements (laterals, trunks, pipes) of a storm drainage system. Extend from inlets to an outlet.
Storm Duration	The period or length of storm.
Stream Contraction	A narrowing of the natural stream waterway. Usually in reference to Constrictiona drainage facility installed in the roadway embankment.
Stream Reach	A length of stream channel selected for use in hydraulic or other computations.
Submerged Inlets	Inlets of culverts having a headwater greater than about 1.2 D.
Submerged Outlets	Submerged outlets are those culvert outlets having a tailwater elevation greater than the soffit of the culvert.
Subsurface Drains	Perforated conduits such as pipe, tubing or tile installed beneath the ground to intercept and convey ground water.
Superflood	Flood used to evaluate the effects of a rare flow event; a flow exceeding the 100-year flood. It is recommended that the superflood be on the order of the 500-year event or a flood 1.7 times the magnitude of the 100-year flood if the magnitude of the 500-year flood is not known.
Surface Runoff	Total rainfall minus interception, evaporation, infiltration, and surface storage, and which moves across the ground surface to a stream or depression.
Surface Storage	Stormwater that is contained in surface depressions or basins.
Surface Water	Water appearing on the surface in a diffused state, with no permanent source of supply or regular course for a considerable time; as distinguished from water appearing in water courses, lakes, or ponds.
Synthetic Hydrograph	A hydrograph determined from empirical rules. Usually based on the physical characteristics of the basin.
Swale	A slight depression in the ground surface where water collects.
Tailwater, TW	The depth of flow in the stream directly downstream of a drainage facility. Often calculated for the discharge flowing in the natural stream without the highway constriction.

	Term is usually used in culvert design and is the depth measured from the downstream flow line of the culvert to the water surface.
Temporary Fill Diversions	Channels with a supporting ridge of soil on the lower side, constructed along the top of an active earth fill in order to divert storm water runoff away from an unprotected fill slope to a stabilized outlet or sediment-trapping facility.
Temporary Seeding	The establishment of a temporary vegetative cover on disturbed areas by seeding with an annual herbaceous plant, usually grass, that is quick to germinate.
Thalweg	The line connecting the lowest flow points along the bed of a channel. The line does not include local depressions.
Time Of Concentration, T_c	The time it takes water from the most distant point (hydraulically) to reach a watershed outlet. T_c varies, but often used as constant.
Topsoiling	A method of preserving and using the surface layer of undisturbed soil, often rich in organic matter, in order to obtain a more desirable planting and growth medium.
Trash Rack	A device used to capture debris, either floating, suspended, or rolling along the bed, before it enters a drainage facility.
Travel Time	The average time for water to flow through a reach or other stream or valley length.
Turbidity Barriers	Fence-like structures that are placed within a body of water to "barricade" sediment from being transported. A geotextile material is stretched on posts from the bottom of the waterbed to an elevation 2 feet **(600 mm)** above the anticipated high water mark for the time of year the barrier is to be placed.
Tributaries	Branches of the watershed stream system.
Uncontrolled Spillway	A facility at a reservoir at which flood water discharge is governed only by the inflow and resulting head in the reservoir. Usually the emergency spillway is uncontrolled.
Ungaged Stream Sites	Locations at which no systematic records are available regarding actual stream-flows.
Uniform Flow	Flow of constant cross-section and average velocity through a reach of channel during an interval of time.
Unit Hydrograph	A hydrograph of a direct runoff resulting from 1 inch of effective rainfall generated uniformly over the watershed area during a specified period of time or duration.
Unsteady Flow	Flow of variable cross-section and average velocity through a reach of channel during an interval of time.
Watercourse	A channel in which a flow of water occurs, either continuously or intermittently, with some degree of regularity.
Watershed	The catchment area for rainfall which is delineated as the drainage area producing runoff. Usually it is assumed that base flow in a stream also comes from the same area.
Water Table	The upper surface of the zone of saturation, except where that surface is formed by an impermeable body (perched water table).
Water Year	The 12-month period, October 1 through September 30. It is designated by the calendar year in which it ends.
Weir Flow	Free surface flow over a control surface which has a defined discharge vs. depth relationship.
Wells	Shallow to deep vertical excavations, generally with perforated or slotted pipe backfilled with selected aggregate. The bottom of the excavation terminates in pervious strata above the water table.
Wet Well Sump	The feature in a pump station in which runoff waters are temporarily stored.

Wetted Perimeter	The boundary over which water flows in a channel, or culvert, taken normal to flow.

FDM 10-15-5 Erosion Control CADD Cells

February 27, 2004

This procedure contains illustrations of many of the erosion control features described previously in this chapter. They are grouped here in order to create a library of graphics which are available to designers for use in their project plans. All the attachments have a CADD cell name and most have a reference to other procedures in this chapter where design guidance can be found.

Cells can be viewed at the following address:

https://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/cad/default.aspx

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FDM 10-15-10 References

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The following references were used in the development of this chapter.

1. American Association of State Highway and Transportation Officials, INC; "Highway Drainage Guidelines, Volume III, AASHTO Guidelines for Erosion and Sediment Control in Highway Construction. "1992; Model Drainage Construction." 1992; "Model Drainage Manual" 1991".
2. "Virginia Erosion and Sediment Control Handbook, third edition" 1992.
3. Storm Water Pollution Prevention Plan Handbook, State of California, Department of Transportation", October 1992.
4. "Road Design Manual, Design Policy and Criteria, Chapter Eight, Drainage Design and Erosion Control" Minnesota Department of Transportation, January 31, 1992.
5. "Statewide General Special Specification 1225, Soil Retention Blankets" Texas Department of Transportation, February 1993.
6. "Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas" United States Department of Agriculture, Soil Conservation Service.
7. "Soil Erosion and Sedimentation Control Measures" Michigan Department of Transportation, 1991.
8. "Wisconsin Construction Site Best Management Practice Handbook", Wisconsin Department of Natural Resources, April 1989.
9. "Design of Roadside Channels with Flexible Linings" United States Department of Transportation, Federal Highway Administration.
10. National Cooperative Highway Research Program Reports; 18 "Erosion Control on Highway Construction"; 221 "Erosion Control During Highway Construction, Manual on Principles and Practices."
11. "Silt Curtains to Control Sediment Movement on Construction Sites" Research and Development Branch, Ontario Ministry of Transportation.
12. "Erosion Control Manual" Colorado Department of Transportation. 1978.
13. Department of the Army, Waterways

    Experiment Station, Corps of Engineers, Transmittal of Technical Report D-78-39. Subject Silt Curtains and Turbidity Barriers.