

# R

**R<sup>2</sup> (Coefficient of Determination)** — (Statistics) A measure of the fraction of the variance of the *Dependent*, or *Endogenous Variable* explained by the *Independent*, or *Exogenous Variable(s)*. Where only two variables are involved, i.e., the dependent variable and a single independent variable, the coefficient of determination (R<sup>2</sup>) is also equal to the square of the *Correlation Coefficient*.

**Race** — (1) A strong or swift current of water. (2) The channel of such a current. Also, an artificial channel built to transport water and use its energy; a *Raceway*.

**Raceway** — A rectangular fish rearing unit that has a continuous flow of freshwater to maintain suitable oxygen, temperature, and cleanliness for intensive production.

**Radial Drainage** — An arrangement of stream courses in which the streams radiate outward in all directions from a central zone or inward from all directions to a central area.

**Radial Flow** — The flow of water in an aquifer toward a vertically oriented well.

**Radioisotope** — Isotopic forms of an element that exhibit radioactivity. Isotopes are varieties of a chemical element that differ in atomic weight, but are very nearly alike in chemical properties. The difference arises because the atoms of the isotopic forms of an element differ in the number of neutrons in the nucleus. For example, ordinary chlorine is a mixture of isotopes having atomic weights of 35 and 37, and the natural mixture has an atomic weight of about 35.543. Many of the elements similarly exist as mixtures of isotopes, and a great many new isotopes have been produced in the operation of nuclear devices such as the cyclotron. There are 275 isotopes of the 81 stable elements, in addition to more than 800 radioactive isotopes.

**Radionuclides** — Radioactive chemicals that are usually naturally occurring and found in drinking water. Typical radionuclides for which the *U.S. Environmental Protection Agency (EPA)* has established *Maximum Contaminant Levels (MCLs)* as part of its enforcement of the *Safe Drinking Water Act (SDWA)* include radium 226 and 228, gross alpha particle activity, and beta particle activity.

**Radius of Influence** — The radial distance from the center of a well bore to the point where there is no lowering of the water table or *Potentiometric Surface* (the edge of its *Cone of Depression*).

**Radon** — A radioactive element, chemical symbol Rn, atomic number 86, and atomic weight 222 (Radon-222). Radon is a colorless, tasteless, odorless, naturally-occurring inert gas derived from the natural breakdown (i.e., radioactive decay) of three radioactive isotopes: uranium-238, uranium-235, and thorium-232. These isotopes are typically found in igneous and metamorphic rocks, such as granite and gneiss, and in sedimentary rocks such as organic-rich black shale, phosphatic rock, and coal. Uranium-238 is the most common parent of radon gas because it comprises more than 99 percent of uranium and thorium isotopes found on earth. Radon-222, one of the most common radioactive daughter elements of uranium-238 decay has a relatively short half-life of only 3.8 days. Consequently, radon-222 is relatively unstable and more likely to decay and emit radiation at any particular moment. Daughter isotopes of radon-222 have an even shorter half-life, resulting in a cascade or “burst” of radiation from radon and its daughter products. Radon occurs in groundwater, but not in surface water due to its high volatility. In groundwater, radon will stay in solution until the pressure on the groundwater is decreased. Due to its short half-life and the slow rate of natural groundwater flow, radon in groundwater typically cannot migrate far from its source. Radon is relatively easy to remove from water; several effective options for the treatment of radon in water include storage, adsorption on *Granular Activated Carbon (GAC)*, and aeration. It has been proposed that radon provides about one-half of the radiation to which the average American is exposed. The chemically inert gas enters homes through soil, water, and building materials. The threat is not uniformly distributed across the United States. An important source of personal exposure to radon appears to be drinking water obtained from wells. The threat comes from the inhalation of the gas released from water during showering, bathing, cooking, and other water uses. Ingestion of water does not appear to present a threat.

**Rain** — (1) The liquid form of precipitation. (2) Water falling to earth in drops that have been condensed from moisture in the atmosphere. Generally larger than 0.02 inches (0.05 cm) in diameter and which fall in still air at velocities usually greater than 10 feet (3.0 meters) per second.

**Rain Area** — (1) The area indicated on a weather map over which rain fell within a certain period of time. (2) The

area over which rain is falling. (3) The most rainy portion of a cyclonic storm.

**Rainband** — (Physics and Meteorology) A dark band in the yellow portion of the solar spectrum near the sodium lines, caused by watery vapor in the atmosphere, and hence sometimes used in weather predictions.

**Rain Barrel** — A barrel of, or for rain water, particularly a barrel placed so as to catch water dripping from eaves of a house or other buildings.

**Rainbow** — (Meteorology) A circular bow or arc exhibiting, in concentric bands of light, the several colors of the spectrum, and formed opposite the sun by the refraction and reflection of the sun's rays in drops of rain. Also, a similar arc may be formed by the moon, or some other source of light, or one formed in spray mist, fog, clouds, etc. Rainbows are circular because the drops, being spherical, are alike in every position. In the case of the ordinary rainbow, or *Primary Rainbow*, the effective rays are refracted on entering each drop, reflected from its interior surface and refracted again on emerging, then passing to the observer's eye. The red is seen on the outside edge of the bow. Also, there is often seen another larger bow, the *Secondary Rainbow*, concentric with and near the first. Its formation differs from that of the primary rainbow in that there are two internal reflections, it is much fainter, and it has the red on the inside edge. Faint-colored arcs sometimes seen next to the primary or secondary bow, due to interference, are *Supernumerary*, or *Spurious*, *Rainbows*. *White Rainbows* are sometimes formed by fog or clouds, but are too minute to give distinctly the concentric bands of color of the ordinary rainbow.

**Raindrop** — A drop of rain.

**Rainfall** — (1) A shower or fall of rain. (2) The quantity of water that falls as rain only in a specified area and time interval. Not strictly synonymous with *Precipitation*.

**Rainfall Component** — That part of the flow of a channel attributed to rain falling directly on the surface of the channel.

**Rainfall Duration** — The period of time during which rainfall occurs, exceeds a given intensity, or maintains a given intensity.

**Rainfall, Excess** — That part of the rain in a given storm which falls at intensities exceeding the *Infiltration Capacity* of the land. The volume of rainfall available for direct runoff. It is equal to the total rainfall minus *Interception*, *Depression Storage*, and *Absorption*.

**Rainfall, Excessive** — Rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area. Within the United States, according to the *National Weather Service (NWS)*, it is defined, for states along the southern Atlantic coast and the Gulf coast, as rainfall in which the depth of precipitation is 0.90 inch at the end of 30 minutes and 1.50 inches at the end of one hour, and for the rest of the country as rainfall in which the depth of precipitation at the end of each of the same periods is 0.50 and 0.80 inch, respectively.

**Rainfall Frequency** — The frequency, usually expressed in years, at which a given rainfall intensity and duration can be expected to be equaled or exceeded.

**Rainfall (Precipitation) Intensity Area Curve** — A curve which expresses the relation between average rainfall or precipitation depth (or the rate) and the area over which it occurs for a given storm duration. Each curve generally covers a period of years during which the intensities shown will not, on the average, be exceeded more than once.

**Rainfall (Precipitation) Intensity-Duration Curve** — A curve showing the relationship between average rainfall or precipitation depth (or the rate) and storm duration in a given area.

**Rainfall (Precipitation) Intensity-Duration-frequency Curve** — Curves showing the relationship between rainfall or precipitation intensity and duration for different levels of frequency; each curve represents the rainfall intensity-duration which will be equaled or exceeded once in a certain number of years, indicated as the frequency of that curve.

**Rainfall (Precipitation) Intensity Frequency** — The average time interval between the occurrence of the rainfall or precipitation of a given or greater intensity.

**Rainfall, Maximization** — (1) *Moisture Maximization* — The process of adjusting precipitation upward to a theoretical value that would have pertained if the moisture content of the air had been at the maximum with other storm conditions remaining unchanged. (2) *Sequential Maximization* — Reducing the observed elapsed time between storms to develop a hypothetical severe precipitation sequence. (3) *Spatial Maximization* — Reducing the distance between precipitation storms for a hypothetical severe sequence.

**Rainfall Rate** — The amount of precipitation occurring in a unit of time; generally expressed in inches per hour.

**Rainfall (Precipitation), Residual** — Rain (or precipitation) that falls at the end of a storm at a rate less than the infiltration capacity.

**Rain Forest** — A tropical woodland that has an annual rainfall of at least 100 inches (254 centimeters) and often much more, typically restricted to certain lowland areas.

**Rain Gauge, also Rain Gage** — An instrument for catching and measuring the depth of rainfall. There are various kinds and sizes of rain gages, most of which catch the rainfall in a collector or cross-sectional area larger than that of the measuring compartment, so that a given depth of water in the latter represents a considerably smaller depth of rainfall catch.

**Rain, Heavy** — Rain which, at the time of observation, is falling with an intensity in excess of 0.30 inches (0.76 cm) per hour (over 0.03 inches [0.08 cm] in 6 minutes). Also see *Precipitation*.

**Rain, Light** — Rain which, at the time of observation, is falling with an intensity of between a trace and 0.10 inches (0.25 cm) per hour (0.01 inches [0.03 cm] in 6 minutes). Also see *Precipitation*.

**Rainmaker** — One who is supposedly capable of producing rain.

**Rain, Moderate** — Rain which, at the time of observation, is falling with an intensity of between 0.10 inches (0.25 cm) per hour (0.01 inches [0.03 cm] in 6 minutes) and 0.30 inches (0.76 cm) per hour (0.03 inches [0.08 cm] in 6 minutes). Also see *Precipitation*.

**Rain, Net** — The portion of rainfall which reaches a stream channel or concentration point as direct surface flow.

**Rain Sensor** — A simple, relatively inexpensive device that measures rainfall and prevents unnecessary irrigation with an automatic controller.

**Rain Shadow** — A dry region on the lee side of a topographic barrier, usually a mountain range, where the rainfall is noticeably less than on the windward side.

**Rainstick** — A common term for a type of tubular rattle that mimics the sound of rainfall; a primitive musical instrument in which sound is produced by the movement of particles (sand, stones, etc.) through a hollow tube with an internal matrix that is closed on each end.

**Rainwater** — Water that has fallen as rain and contains little dissolved mineral matter.

**Raised Bogs** — See *Peatland*.

**Random Sample** — (Statistics) A sample selected in such a manner that all possible samples of the same size have an equal and independent chance of being included.

**Random Variable** — (Statistics) A variable characterized by random behavior in assuming its different possible values. Mathematically, it is described by its probability distribution, which specifies the possible values of a random variable together with the probability associated with each value.

**Range** — (1) Geographic region in which a given plant or animal lives and grows. (2) Lands that support an understory of periodic cover of herbaceous or shrubby plants suitable for grazing. The following represent some common range classifications:

- [1] **Range, Primary** — Includes areas which are readily accessible, have available water and will be overused before livestock significantly graze other areas;
- [2] **Range, Secondary** — Areas less preferred by livestock which will ordinarily not be grazed significantly until the primary range has been overused;
- [3] **Range, Suitable** — Lands that are or can be made accessible to livestock, that produce forage or have inherent forage producing capabilities, and that can be grazed on a sustained yield basis under given management goals;
- [4] **Range, Transitory** — Lands temporarily suitable for grazing, but transient over time and/or location, for example, grass may cover an area for a period before being replaced by growth not suitable for forage;
- [5] **Range, Unsuitable** — Areas that should not be grazed by livestock because of unstable soils, steep topography, or inherent low potential for forage production.

**Range Carrying Capacity** — Permitted *Animal Unit Month (AUM)* production.

**Range Condition** — The state of the plant community on a range site in relation to the potential natural plant community for that site. Ratings generally follow categories of poor, fair, good, or excellent.

**Range Line** — In the generally recognized *U.S. Public Land Survey*, every 24 miles a station is indicated measuring both east and west from a predetermined principal meridian. Similar measurements are also taken north and south from a predetermined base line. In this manner a succession of quadrilaterals are formed, each roughly 24 miles square. Each of these is subdivided into 16 smaller quadrilaterals roughly six miles square. In this system of grid lines, north-south lines become *Range Lines* and east-west lines become *Township Lines*.

**Rankine Scale** — A scale of absolute temperature using *Fahrenheit* degrees, in which the freezing point of water is 491.69° and the boiling point of water is 671.69°. [Named after William John Macquorn Rankine (1820–1872), Scottish engineer and physicist.]

**Rapid Drawdown** — Lowering the elevation of water against a bank faster than the bank can drain, leaving a pressure imbalance that may cause the bank to fail.

**Rapids** — A part of a stream where the current is moving with a greater swiftness than usual and where the water surface is broken by obstructions, but without a sufficient break in slope to form a water fall, as where the water descends over a series of small steps. It commonly results from a sudden steepening of the stream gradient, from the presence of a restricted channel, or from the unequal resistance of the successive rocks traversed by the stream.

**Rapid Sand Filter** — Generally a concrete basin filled with graded gravel and coarse sand. Filtration rates are about 40 times higher than in a slow sand filter, and cleaning is via a backwash operation.

**Rapture of the Deep** — A state of euphoria and exhilaration that occurs when nitrogen in normal air enters the bloodstream at approximately seven times atmospheric pressure (as in deep-water diving). Also called *Nitrogen Narcosis*.

**Rare Species** — A species of plant or animal which, although not presently threatened with extinction, is in such small numbers throughout its range that it may be endangered if its environment worsens.

**Rate Structures (Water and Wastewater Treatment)** — Rate structures for water and wastewater treatment are generally classified into three primary categories: declining block, uniform, and inverted. Details of these primary rate structures are as follows:

- [1] **Declining Block Rate** — Provides a means of recovering costs from the customer classes under a single rate schedule, recognizing the different water and wastewater demands and costs associated with each customer class. Under this rate schedule economies of scale are recognized since the price per unit declines as the water customer consumes more water;
- [2] **Uniform Rate** — Provides separate rates for each customer class based on the demand, use, and other characteristics of the customer class;
- [3] **Inverted-Block Rate** — Incorporates a unit charge that increases with increasing water consumption or demands for wastewater treatment; requires a multiple blocking structure with the rate per unit of consumption increasing with each successive level.

Variations and applications of these primary rate structures typically include:

- [1] **Unmeasured Usage** — Flat rate, irrespective of usage, generally based on (pipe) size of service;
- [2] **Constant Block with Service Charge** — Constant rate per unit, times the number of units consumed, plus flat rate service charge;
- [3] **Increasing Block with Service Charge** — Cost per unit increases with increasing (block) rate of water usage, plus flat rate service charge;
- [4] **Decreasing Block with Service Charge** — Cost per unit decreases with increasing (block) rate of water usage, plus flat rate service charge;
- [5] **Increasing Block with Minimum Allowance** — Cost per unit increases with increasing (block) rate of water usage over a minimum charge for minimum amount of use (*Lifeline Rate*).

**Rating Curve** — (1) A graphic representation of a *Rating Table* (see below). (2) A curve showing the relation between *Gage Height* and discharge of a stream or conduit at a given *Gaging Station*. (3) A curve showing the relation between the discharge of a gage, meter, or other hydraulic structure or instrument and the pertinent hydraulic conditions affecting the discharge, such as pressure, hydrostatic head, and velocity of approach. If more than one condition affects discharge, a family of curves is needed to represent the rating.

**Rating Table** — (1) A table showing the relation between two mutually dependent quantities or variables over a given range of magnitude. (2) A table showing the relation between the *Gage Height* and the discharge of a stream or conduit at a given *Gaging Station*. (3) A table showing the relationship between the stage in a reservoir and its volume. Also referred to as *Discharge Table*.

**Rational Method (or Formula)** — (1) A simple procedure for calculating the direct precipitation peak runoff from a watershed, using the rainfall intensity, the area of the watershed, and the runoff coefficient appropriate for the type of watershed runoff surface. (2) A technique for estimating peak discharge rates based on average rainfall intensity (*i*), the drainage area (*A*), and a coefficient based on watershed characteristics (*C*). The discharge in cubic feet per second is derived from the following formula:  $Q = CiA$ . The rational method is commonly applied to areas as large as 5 square miles, but is preferably used for drainage areas under a half square mile. The 2-, 5-, 10-, 25-, and 50-year flood recurrence discharges can be estimated with this formula.

**Rates of Rise and Fall** — How rapidly the elevation of the water rises and falls during a flood.

**Ravine** — (1) A deep, narrow valley or gorge in the earth's surface worn by running water. (2) A small narrow steep-sided valley that is larger than a gully and smaller than a canyon and that is usually worn by running water.

**Raw Sewage** — Untreated domestic or commercial wastewater.

**Raw Sludge** — The material settled out during the primary clarification of sewage.

**Raw Water** — (1) Water that is direct from the source — ground or surface water — without any treatment. (2)

Untreated water, usually that entering the first unit of a water treatment plant.

**RCRA** — See *Resource Conservation and Recovery Act*.

**Reach (of River)** — (1) Most generally, any specified length of a stream, channel, or conveyance. (2) A length of channel which is uniform in its discharge depth, area, and slope; a relatively homogeneous length of stream having a similar sequence of characteristics. (3) A length of channel for which a single gage affords a satisfactory measure of the stage and discharge. (4) The length of a river between two gaging stations.

**Readily Water-Soluble Substances** — In water pollution, chemicals that are soluble in water at a concentration equal to or greater than one milligram per liter (mg/l).

**Reaeration** — (1) Absorption of oxygen into water from the atmosphere. The rate of reaeration is proportional to the oxygen deficit. (2) Introduction of air into the lower layers of a reservoir. As the air bubbles form and rise through the water, the oxygen dissolves into the water and replenishes the dissolved oxygen. The rising bubbles also cause the lower waters to rise to the surface where they take on more oxygen from the atmosphere.

**Reaeration (of Streams)** — The natural process by which flowing stream water is mixed with the atmosphere, resulting in the addition of *Dissolved Oxygen* to the water.

**Reasonable and Beneficial Use [California]** — A requirement in the California State Constitution (Article X, Section 2) that all water resources must be put to beneficial use, preventing waste or unreasonable use or unreasonable methods of use.

**Reasonable Pump Lift** — A determination of the rate and volume of water to be pumped from an aquifer. The reasonable pump lift (rate of withdrawal) would include consideration of:

- [1] water quality in the aquifer or the basin, including sea water intrusion, base of fresh water, and lateral or vertical migration of contaminants;
- [2] the ground water management program;
- [3] the thickness of the aquifer;
- [4] the depth of existing wells;
- [5] the capital cost of new wells;
- [6] the net cash flow; and
- [7] the total amount of ground water that can be extracted during one water year by the total number of existing wells.

**Reasonable Use** — A rule with regard to percolating or riparian water restricting the landowner to a reasonable use of his own rights and property in view of and qualified by the similar rights of others, and the condition that such use not injure others in the enjoyment of their rights.

**Reasonable Use Theory** — A *Riparian Owner* may make reasonable use of his water for either natural or artificial wants. However, he may not so use his rights so as to affect the quantity or quality of water available to a lower riparian owner.

**Réaumur, or Reaumur (R)** — Relating to, being, or indicated on a thermometer scale that registers the freezing point of water as 0° and the boiling point a 80°. Named after René Antoine Ferchault de Réaumur.

**Recalcitrant** — Of a substance that is degraded at an extremely slow rate if at all when released into the environment. Consequently, this type of material tends to accumulate in water, soil, and biota.

**Recarbonation (Recarbonization)** — (Water Quality) The process of introducing carbon dioxide as a final stage in the lime-soda ash softening process. This lowers the pH and converts carbonates to bicarbonates, thereby stabilizing the solution against precipitates of carbonates.

**Receiving Waters** — (1) Rivers, lakes, oceans, or other water courses or bodies of water that receive waters from another source. (2) (Water Quality) Bodies of water that receive treated or untreated effluent discharges.

**Recessional Moraine** — *Glacial Till* occurring as ridges where the front of a retreating glacier temporarily held a fixed position. Also see *Moraines*, *Lateral Moraines*, and *Terminal Moraines*.

**Recession Hydrograph (Curve)** — A *Hydrograph* which shows the decreasing rate of runoff following a period of rain or snowmelt. Since *Direct Runoff* and *Base Runoff* recede at different rates, separate curves, called direct runoff recession curves, are generally drawn. Use of the term *Depletion Curve* in the sense of base runoff recession is not recommended.

**Recharge (Hydrologic)** — (1) The downward movement of water through soil to groundwater. (2) The process by which water is added to the *Zone of Saturation*. (3) The introduction of surface or ground water to groundwater storage such as an aquifer. Recharge or replenishment of groundwater supplies consists of three (3) types:

- [1] **Natural Recharge** which consists of precipitation or other natural surface flows making their way into groundwater supplies;
- [2] **Artificial or Induced Recharge** which includes actions by man specifically designed to increase supplies

in a groundwater reservoirs through various methods such as water spreading (flooding), ditches, and pumping techniques; and

- [3] **Incidental Recharge** which consists of actions, such as irrigation and water diversion, which add to groundwater supplies but are intended for other purposes.

Recharge may also refer to the amount of water so added.

**Recharge Area (Groundwater)** — (1) The land area over which precipitation infiltrates into soil and percolates downward to replenish an aquifer. (2) The area in which water reaches the *Zone of Saturation* by surface infiltration. Infiltration moves downward into the deeper parts of an aquifer in a recharge area. Also referred to as a *Recharge Zone*.

**Recharge, Artificial** — The designed (as opposed to the natural or incidental) replenishment of ground water storage from surface water supplies. There exist five (5) common techniques to effect artificial recharge of a groundwater basin:

- [1] **Water Spreading** consisting of the basin method, stream-channel method, ditch method, and flooding method, all of which tend to divert surface water supplies to effect underground infiltration;
- [2] **Recharge Pits** designed to take advantage of permeable soil or rock formations;
- [3] **Recharge Wells** which work directly opposite of pumping wells although have limited scope and are better used for deep, confined aquifers;
- [4] **Induced Recharge** which results from pumping wells near surface supplies thereby inducing higher discharge towards the well; and
- [5] **Wastewater Disposal** which includes the use of secondary treatment wastewater in combination with spreading techniques, recharge pits, and recharge wells to reintroduce the water to deep aquifers thereby both increasing the available groundwater supply and also further improving the quality of the wastewater.

Also referred to as *Induced Recharge*. Also see *Natural Recharge*, *Incidental Recharge*, *Injection*, and *Perennial Yield*.

**Recharge Basin** — A surface facility, often a large pond, used to increase the infiltration of surface water into a ground water basin.

**Recharge Boundary** — An aquifer system boundary that adds water to the aquifer. Streams and lakes are typical recharge boundaries.

**Recharge, Incidental** — Ground water recharge (infiltration) that occurs as a result of human activities unrelated to a recharge project, for example, irrigation and water diversion (unlined canals). Also see *Artificial (or Induced) Recharge*, *Natural Recharge*, and *Perennial Yield*.

**Recharge, Induced** — See *Artificial Recharge*, above. Also see *Injection*.

**Recharge, Natural** — The replenishment of groundwater storage from naturally-occurring surface water supplies such as precipitation and stream flows. Also see *Artificial (or Induced) Recharge*, *Incidental Recharge*, and *Perennial Yield*.

**Recharge Rate** — The quantity of water per unit of time that replenishes or refills an aquifer.

**Recharge Well** — Used in conjunction with artificial or induced ground water recharge techniques, the recharge well works directly opposite of pumping wells to induce surface water into the ground water system. Based on the nature of the soil and rock being recharged, the use of recharge wells typically have limited scope and are better employed for recharging deep, confined aquifers. Also see *Injection*.

**Recharge Zone** — A land area into which water can infiltrate into an *Aquifer* relatively easily. The infiltration replenishes the aquifer. The location is also referred to as a *Recharge Area*.

**Recirculated Water** — Water that is used more than one time before it passes back into the natural hydrological system or discharged into a wastewater system. Also referred to as *Recycled Water*.

**Recirculation** — Water reused within a plant unit. Sometimes, it also means water discharged by one unit and reused by other units in the same plant.

**Reclamation** — The act or process of reclaiming or converting a resource to another use, as swamp or desert lands to irrigable lands or urban lands.

**(United States) Reclamation Act of 1902** — An act passed by Congress on June 17, 1902 which created the U.S. Reclamation Service (USRS, renamed the U.S. Bureau of Reclamation, USBR, in 1923) as a separate entity within the U.S. Department of the Interior (USDI), apart from the U.S. Geological Survey (USGS). This act committed the federal government to construct irrigation projects in the West and reclaim arid lands for cultivation and settlement. The Truckee–Carson Irrigation Project, located in the lower Carson River Basin in Churchill County, Nevada, became the first reclamation irrigation project completed under this act. In 1919 this project would be

renamed the Newlands Project in honor of one of the bill's sponsors, Nevada's U.S. Senator Francis G. Newlands. (Note: There had been some question as to whether the Salt River Project in Arizona or the Truckee-Carson Irrigation Project in Nevada was the first federally-approved and federally-funded reclamation project. Actually, the Truckee-Carson Project was one of five projects to be recommended by the Director of the U.S. Reclamation Service. The Truckee-Carson Irrigation Project was authorized on March 14, 1903 and the first water became available on April 1, 1905. The Salt River Project was also authorized on March 14, 1903, construction began August 24, 1903 and the first water became available May 15, 1907, two years after the Truckee-Carson Project began operations.)

**Reclamation District** — (Legal) A district created by legislation for the purpose of reclaiming swamp, marshy, or desert lands and making them suitable for cultivation or habitation. Usually such districts have power to levy assessments, issue bonds and the like.

**Reclamation Drought Index (RDI)** — The RDI was developed as a tool for defining drought severity and duration, and for predicting the onset and end of periods of drought. The impetus for the development of the RDI came from the *Reclamation States Drought Assistance Act of 1988*, which allowed states to seek federal drought relief assistance. The RDI is calculated at a river basin level and incorporates the supply components of precipitation, snowpack, streamflow and reservoir storage levels. The RDI differs from the *Surface Water Supply Index (SWSI)* in the incorporation of a temperature component. The RDI is adaptable to a particular region and readily accounts for both climate and water supply factors. RDI classifications include:

- 4.0 or more – extremely wet
- 1.5 to 4.0 – moderately wet
- 0 to 1.5 – normal to mild wetness
- 0 to -1.5 – normal to mild drought
- 1.5 to -4.0 – moderate drought
- 4.0 or less – extreme drought

Also see *Drought Indexes (Indices)*.

**(United States) Reclamation Service** — A bureau of the U.S. Department of the Interior, created under the *Reclamation Act of 1902* and organized to reclaim desert lands (chiefly in the West) by irrigation projects for public sale and to develop electric power. The U.S. Reclamation Service changed its name to the Bureau of Reclamation (BOR) in 1923.

**Reclaimed Sewage** — Wastewater treatment-plant effluent that has been diverted or intercepted for use before it reaches a natural waterway or aquifer.

**Reclaimed Waste Water** — Waste water that becomes suitable for a specific beneficial use as a result of treatment or brackish water demineralized for use. General types of reclaimed waste water include:

[1]**Primary Effluent** — reclaimed water that only has had sewage solids removed and is typically used only for surface irrigation of tree, fodder, and fiber crops;

[2]**Secondary Effluent** — reclaimed water that has had sewage solids removed and has been oxidized and disinfected and is used to irrigate golf courses and cemeteries and provide water for pasture and food crops; and

[3]**Tertiary Recycled Water** — water produced by conventional sewage treatment followed by more advanced procedures including filtration and disinfection, providing it with the broadest range of uses.

Also see *Waste Water Reclamation* and "*Repurified Water*."

**Reclaimed Water** — Refers to water that has received at least *Secondary Wastewater Treatment* and is reused after flowing out of a wastewater treatment facility.

**Reclamation** — (1) The process of land treatment that minimizes water degradation, air pollution, damage to aquatic or wildlife habitat, flooding, erosion, and other adverse effects from surface mining operations including adverse surface effects incidental to underground mines, so that mine lands are reclaimed to a usable condition which is readily adaptable for alternate land uses and creates no danger to public health or safety. The process may extend to affected land surrounding mining lands, and may require backfilling, grading, resoiling, revegetation, soil compaction, stabilization, and other measures. (2) May also apply to other land uses and land types, for example, the reclaiming of waste, desert, marshy or submerged land for cultivation, preservation, reuse, etc.

**Reclamation Act** — Refers to the Reclamation Act which was passed by Congress on June 17, 1902 and authorized the U.S. Secretary of the Interior to locate, construct, operate, and maintain facilities for the storage, diversion, and development of waters for the reclamation of arid and semiarid lands in the Western States. To facilitate these functions, in July 1902 the Secretary of the Interior established the U.S. Reclamation Service (USRS) within the U.S. Geological Survey (USGS). In March 1907 the USRS was established as a separate entity apart from the USGS and in June 1923 the name was changed to the U.S. Bureau of Reclamation (USBR). The basic purpose of

the Reclamation Act was to assist states and local governments to stabilize and stimulate local and regional economies, enhance and protect the environment, and improve the quality of life through the development of water and related land resources throughout the 17 contiguous western states and Hawaii.

**Reclamation District** — A subdivision of a state created by legislative authority for the purpose of reclaiming swamp, marshy, or desert lands within its boundaries and rendering them fit for habitation or cultivation, generally with funds raised by local taxation or the issue of bonds, and sometimes with authority to make rules or ordinances for the regulation of the project.

**Reclamation Project** — A water development project based on the Reclamation Act of 1902 for the irrigation of arid lands, particularly in the western United States, and for other purposes administered by the U.S. Department of the Interior, *Bureau of Reclamation (USBR)*. Also see *Newlands (Irrigation) Project [Nevada]*.

**Reclamation of Wastewater** — The process of treating salvaged water from municipal, industrial, or agricultural waste water sources for beneficial uses, whether by means of special facilities or through natural processes.

**Reclamation Withdrawal** — A withdrawal of public lands in connection with a reclamation project.

**Recommended Maximum Contaminant Level (RMCL)** — The maximum level of a contaminant in drinking water at which no known or anticipated adverse affect on human health would occur, and that includes an adequate margin of safety. Recommended levels are nonenforceable health goals. Also see *Maximum Contaminant Level (MCL)*.

**Reconditioning (Water Well)** — The deepening, reaming, casing, recasing, perforating, reperforating, jetting, swabbing, installing of liner pipe, packers and seals or any other significant change in the design or construction of a water well.

**Reconnaissance** — A preliminary inspection or survey of an area, such as a forest, range, watershed, or wildlife area, to gain general information useful for future management.

**Reconnaissance Report** — An initial planning document to determine whether further investigation is warranted.

**Reconstitute** — To bring (a liquid in concentrate or powder form) to normal strength by adding water.

**Recorder, Steam Flow** — A mechanical apparatus which records a continuous record of a water level or other hydrologic factors such as water temperature, flow rates, etc.

**Recording Gage** — A *Gage* which provides a continuous recording of the parameter being monitored. For example, see *Stream Gaging*.

**Recoverable from Bottom Material** — The amount of a given constituent that is in solution after a representative sample of bottom material has been digested by a method (usually using an acid or mixture of acids) that results in dissolution of readily soluble substances. Complete dissolution of all bottom material is not achieved by the digestion treatment and thus the determination represents less than the total amount (that is, less than 95 percent) of the constituent in the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

**Recoverable Ground Water** — The amount of water which may be physically and economically withdrawn from the ground water reservoir.

**Recovery** — The process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured.

**Recovery Plan** — A document which delineates, justifies, and schedules the research and management actions necessary to support recovery of a species, including those that, if successfully undertaken, are likely to permit reclassification or delisting of the species.

**Recreation Resource** — Land and water areas and their natural attributes, with or without man-made facilities, that provide opportunities for outdoor recreation.

**Recreation Visitor Day (RVD)** — A recreation visitor day is use of a site or area for 12 visitor-hours, aggregated as 1 person for 12 hours, 12 persons for 1 hour, or any equivalent combination of continuous or intermittent use.

**Recreational Benefit** — The value of a recreational activity to the recreationist, usually measured in dollars above the cost of participating in the recreational activity (travel, lodging, entrance fees, etc.). Used for valuing recreational resources produced through various water-development projects. A term used synonymously with the consumer surplus associated with the recreational activity.

**Recreational Rivers** — A classification under the national *Wild and Scenic Rivers Act* to include those rivers or sections of rivers that are readily accessible by road or railroad that may have some development along their shorelines, and that may have undergone some impoundments or diversions in the past:

- (1) **Timber Production** — Timber harvesting would be allowed under standard restrictions to protect the immediate river environment, water quality, scenic, fish and wildlife, or other values.



- (2) **Water Supply** – Existing low dams, diversion works, riprap and other minor structures are allowed providing the waterway remains generally natural in appearances. New structures are prohibited.
- (3) **Hydroelectric Power** – No development of hydroelectric power facilities is provided.
- (4) **Flood Control** – Existing flood control works may be maintained. New structures are prohibited.
- (5) **Mining** – Subject to regulations (i.e., 36 CFR 228) that the Secretaries of Agricultural and Interior may prescribe to protect the values of rivers included in the national system, new mining claims and mineral leases could be allowed and existing operations allowed to continue. However, mineral activity must be conducted in a way that minimizes surface disturbances, sedimentation and pollution, and visual impairment.
- (6) **Road Construction** – Paralleling roads or railroads could be constructed on one or both riverbanks. There can be several bridge crossings and numerous river access points.
- (7) **Agriculture** – Lands may be managed for a full range of agricultural uses, to the extent currently practiced.
- (8) **Recreational Development** – Campgrounds and picnic areas may be established close to the river. However, the recreational classification does not require extensive recreational development.
- (9) **Structures** – Small communities and dispersed or cluster residential development are allowed. New structures are allowed for both habitation and for intensive recreation use.
- (10) **Utilities** – New transmission lines, gas lines, water lines, etc., are discouraged. Where no reasonable alternative exists, additional or new facilities should be restricted to existing right-of-way. Where new rights-of-ways are indicated, the scenic, recreation, and fish and wildlife values must be evaluated in the selection of the site.
- (11) **Motorized Travel** – Motorized travel on land or water may be permitted, prohibited or restricted. Controls will usually be similar to surrounding lands and waters.

Also see *Wild and Scenic Rivers Act*, *Wild Rivers*, and *Scenic Rivers*.

**Rectangular Pattern** — An arrangement of stream courses in which tributaries flow into larger streams at angles approaching 90°.

**Rectify** — (Chemistry) (1) To refine or purify, especially by distillation. (2) To adjust (the proof of alcoholic beverages) by adding water or other liquids.

**Recurrence Interval (Return Period)** — (1) A statistical expression of the average time between floods equaling or exceeding a given magnitude. (2) The average time interval, usually in years, between the occurrence of a flood or other hydrologic event of a given magnitude or larger. The reciprocal, or inverse, of the recurrence interval is the probability (chance) of occurrence, in any year, of a flood equaling or exceeding a specified magnitude. For example, a flood that would be equaled or exceeded on the average of once in 100 years would have a recurrence interval of 100 years and a 0.01 probability, or 1 percent chance of occurring or being exceeded in any year. (3) (USGS) The average time, usually expressed in years, between occurrences of hydrologic events of a specified type (such as exceedances of a specified high flow or non-exceedance of a specified low flow). The terms “return period” and “recurrence interval” do not imply regular cyclic occurrence. The actual times between occurrences vary randomly, with most of the times being less than the average and a few being substantially greater than the average. For example, the 100-year flood is the flow rate that is exceeded by the annual maximum peak flow at intervals whose average length is 100 years (that is, once in 100 years, on average); almost two-thirds of all exceedances of the 100-year flood occur less than 100 years after the previous exceedance, half occur less than 70 years after the previous exceedance, and about one-eighth occur more than 200 years after the previous exceedance. Similarly, the 7-day 10-year low flow ( $7Q_{10}$ ) is the flow rate below which the annual minimum 7-day-mean flow dips at intervals whose average length is 10 years (that is, once in 10 years, on average); almost two-thirds of the non-exceedances of the  $7Q_{10}$  occur less than 10 years after the previous non-exceedance, half occur less than 7 years after, and about one-eighth occur more than 20 years after the previous non-exceedance. The recurrence interval for annual events is the reciprocal of the annual probability of occurrence. Thus, the 100-year flood has a 1-percent chance of being exceeded by the maximum peak flow in any year, and there is a 10-percent chance in any year that the annual minimum 7-day-mean flow will be less than the  $7Q_{10}$ .

**Recycled Water** — (1) Water that is used more than one time before it passes back into the natural hydrologic system. (2) Water that is used more than one time by the same users. Also referred to as *Recirculated Water*.

**Recycling** — The process by which salvaged materials become usable products.

**Red Book** — (Water Quality) The 1976 publication issued by the *U.S. Environmental Protection Agency (EPA)*, *Quality Criteria for Water*, that is used as a basis for ambient water quality standards.

**Redd** — A type of fish spawning area associated with flowing water and clean gravel. Fishes that utilize this type of spawning area include trout, salmon, some minnows, etc.

**Red Data Book** — A collection of the available information relative to *Endangered and Threatened Species*. Each volume contains colored loose-leaf information sheets arranged by species. The sheets are updated as the status of a species changes. Red sheets are used for those species that are endangered; amber for vulnerable; white for rare; green for out of danger; and gray for species that are indicated to be endangered, vulnerable, or rare, but with insufficient information to be properly classified. The book is maintained by the *International Union for Conservation of Nature and Natural Resources*.

**Red Snow** — Snow on which red-pigmented algae has grown, commonly found in Arctic and alpine regions.

**Red Tide** — A visible red-to-orange coloration of the sea caused by the presence of a bloom or excessive growth of dinoflagellates in marine waters, resulting in a red, brown, green or yellow tint in the water. The event causes the death of marine biota and the accumulation of toxins in mussels or clams. Consumption of the toxin-containing shellfish can cause *Paralytic Shellfish Poisoning* or severe gastric distress in humans.

**Reef** — A strip or ridge of rocks, sand, or coral that rises to, or near the surface of a body of water.

**Reference Wetland** — A wetland within a relatively homogeneous biogeographic region that is representative of a specific hydrogeomorphic wetland type.

**Reflectance** — The ratio of the upwelling light to incident (downwelling) light. Reflectance is a strong function of wavelength, and a weak function of incident sunlight and the depth in the water. The color of natural waters can be objectively specified using their spectral reflectance. Also see *Water Color*.

**Reforestation** — The planting of trees on land from which the forest has been removed.

**Regelation** — (1) The fusion of two blocks of ice by pressure. (2) Successive melting under pressure and freezing when pressure is relaxed at the interface of two blocks of ice.

**Regime** — “Regime theory” is a theory of the formation of channels in material carried by the stream. Used in this sense, the word “regime” applies only to streams that take at least part of their boundaries from their transported load and part of their transported load from their boundaries, carrying out the process at different places and times in any one stream in a balanced or alternating manner that prevents unlimited growth or removal of boundaries. A stream, river, or canal of this type is called a “regime stream, river, or canal.” A regime channel is said to be “in regime” when it has achieved average equilibrium; that is, the average values of the quantities that constitute regime do not show a definite trend over a considerable period, generally, approximately a decade. In unspecialized use, “regime” and “regimen” are synonymous.

**Regimen of a Stream** — The system or order characteristic of a stream, i.e., its habits with respect to velocity and volume, form and changes in channel, capacity to transport sediment, and amount of material supplied for transportation. The term is also applied to a stream which has reached an equilibrium between corrosion and deposition or, in other words, to a graded stream.

**Regional Response Team (RRT)** — An organization under the joint leadership of the *U.S. Environmental Protection Agency (EPA)* and the U.S. Coast Guard that serves as the organizational unit to provide for planning and preparedness activities related to spills or discharges of oil and hazardous substances and for coordination and technical advice during such spills or discharges in each of the 10 federal regions outlined by the EPA.

**Regression** — (Statistics) A statistical method for studying and expressing the change in one *Variable* associated with and dependent upon changes in another related variable or set of variables.

**Regression Analysis** — (Statistics) Mathematical procedures for attributing the variability of one quantity to changes in one or more other quantities. Often called “line fitting” or “curve fitting” since it produces an equation that can be used to predict the quantity of interest under many conditions. The concept is to attempt to fit a mathematical function to a series of data whereby the square of the error terms measuring the differences between the model estimates and actual observations is minimized, hence the term *Ordinary Least Squares (OLS)* is also used to describe this process. The standard of regression model is generally termed the *Classical Linear Regression (CLR) Model*. The CLR Model has five basic assumptions:

- [1] **Linearity** — The dependent variable, or the variable to be explained or forecasted, can be calculated as a linear function of a specific set of independent, or explanatory variables;
- [2] **Randomness of Disturbance Terms** — The expected value of the disturbance term, that is the term showing the differences between the model’s estimated values and the actual observed values, is zero;
- [3] **Uncorrelated Disturbance Terms** — The disturbance terms all have the same variance and are not correlated with each other (see *Serial Correlation*);
- [4] **Data Conformity** — The observations on the independent variable can be considered fixed in repeated samples, i.e., it is possible to repeat the sample with the same independent variables;
- [5] **Sample Size and Selection** — The number of observations is greater than the number of independent variables and that there are no linear relationships, i.e., no significant correlations, between the

independent variables (see *Multicollinearity*).

**Regular Program** — (FEMA) The phase of the *National Flood Insurance Program (NFIP)* that makes available increased amounts of flood insurance, with new and substantially improved structures being rated on an actuarial or actual risk basis.

**Regulation (of a Stream)** — (Hydrology) The artificial manipulation of the flow of a stream.

**Regulation Reservoir** — A reservoir used in canal and irrigation systems to reduce the mismatch between downstream demands and upstream water supplies in order to maintain a balanced operation.

**Regulatory Flood Datum (RFD)** — Established plane of reference from which elevation and depth of flooding may be determined for specific locations of the floodplain. It is the *Base Flood* plus a *Freeboard* factor of safety established for each particular area which tends to compensate for the many unknown and incalculable factors that could contribute to greater flood heights than that computed for a base flood.

**Regulatory Floodplain** — (1) That portion of the floodplain subject to floodplain regulations (usually the floodplain inundated by the one-percent chance flood). (2) Flood hazard area within which a community regulates development, including new construction, the repair of substantially damaged buildings, and substantial improvements to existing buildings. In communities participating in the *National Flood Insurance Program (NFIP)*, the regulatory floodplain must include at least the area inundated by the *Base Flood*, also referred to as the *Special Flood Hazard Area (SFHA)*. Also see *Floodplain*.

**Regulatory Floodway** — (1) The channel and that portion of the adjacent land area that is required through regulations to pass flood flows without increasing the water surface elevation more than a designated height. (2) As adopted into a community's floodplain management ordinance, is defined by the *Federal Emergency Management Agency (FEMA)* as the stream channel plus that portion of the overbanks that must be kept free from encroachment in order to discharge the 1-percent annual chance flood without increasing flood levels by more than 1 foot (some states specify a smaller allowable increase). The intention of the floodway is not to preclude development. Rather, it is intended to assist communities in prudently and soundly managing floodplain development and prevent additional damages to other property owners. The community is responsible for prohibiting encroachments, including fill, new construction, and substantial improvements, within the floodway unless it has been demonstrated through hydrologic and hydraulic analyses that the proposed encroachment will not increase flood levels within the community. In areas that fall within the 1-percent annual chance floodplain, but are outside the floodway (termed the floodway fringe), development will, by definition, cause no more than a 1-foot increase in the 1-percent annual chance water-surface elevation. Floodplain management through the use of the floodway concept is effective because it allows communities to develop in flood-prone areas if they so choose, but limits the future increases of flood hazards to no more than 1 foot.

**Rehydrate** — To cause (something *Dehydrated*) to take up fluid.

**Reimbursable Costs** — Those costs associated with a water project that are expected to be recovered, usually from direct beneficiaries, and repaid to the funding entity. Also see *Nonreimbursable Costs*.

**Rejuvenation** — A change in condition of erosion that causes a stream to begin more active erosion and a new cycle.

**Relation, Doctrine of** — See *Doctrine of Relation [Nevada]*.

**Relative Humidity** — The ratio of the amount of water vapor in the atmosphere to the amount necessary for saturation at the same temperature. Relative humidity is expressed in terms of percent and measures the percentage of saturation.

**Release** — Any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment of a hazardous or toxic chemical or extremely hazardous substance.

**Relicensing** — The process of renewing a license previously issued by the federal government (commonly involving the Federal Energy Regulatory Commission, FERC) to operate a hydroelectric power plant.

**Relict** — A landform that has survived decay or disintegration (such as an erosion remnant) or that has been left behind after the disappearance of the greater part of its substance (such as a remnant island).

**Reliction** — An increase of the land by the permanent withdrawal or retrocession of the sea or a river. The process of gradual exposure of land by permanent recession of a body of water. The alteration of a boundary line due to the gradual removal of land by a stream serving as the boundary. Also, the land so left uncovered. Also see *Dereliction*.

**Reliction, Doctrine of [Nevada]** — In a Nevada Supreme Court ruling (*State Engineer v. Cowles Bros.*, 86 Nev. 872, 1964) it was held that the lands so exposed by *Reliction* should belong to the adjoining land owners. This held true even for those lands exposed by the recession of a navigable body of water, whose bed is owned by the State of Nevada (e.g., Winnemucca Lake).

**Relief Ratio** — The average slope of a drainage basin; the ratio of maximum relief to basin length.

- Relief Wells (of a Dam)** — A vertical well or borehole, usually downstream of impervious cores, grout curtains, or cutoffs, designed to collect and direct seepage through or under a dam to reduce uplift pressure under or within the dam. A line of such wells forms a relief well curtain. Also referred to as *Drainage Wells*.
- Remedial Investigation (RI)** — (Environmental) An in-depth study designed to gather data needed to determine the nature and extent of contamination at a Superfund site, establish site cleanup criteria, identify preliminary alternatives for remedial action, and support technical and cost analyses of alternatives. The remedial investigation is usually done with the Feasibility Study (FS). Together they are usually referred to as the “RI/FS”.
- Remedial Response** — (Environmental) Long-term action that stops or substantially reduces a release or threat of a release of hazardous substances that is serious but not an immediate threat to public health.
- Remediation** — (Environmental) Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site.
- Remnant** — A remaining part of some larger landform or of a land surface that has been dissected or partially buried.
- Remote Sensing** — The measurement or acquisition of information of some property of an object or phenomenon by a recording device that is not in physical or intimate contact with the object or phenomenon under study. Also, the utilization at a distance (as from aircraft, spacecraft, satellites, or ships) of any device and its attendant display for gathering information pertinent to the environment, such as measurements of force fields, electromagnetic radiation, infrared sensing, land use, water bodies, etc. Such systems typically employ devices such as cameras, lasers, radio frequency receivers, radar systems, infrared detectors, sonar seismographs, gravimeters, magnetometers, and scintillation counters.
- Renewable Energy** — A source of energy that is replaced by natural phenomena, such as firewood or the water held by a dam and used for hydroelectric purposes. Conversely, fossil fuels are a nonrenewable source of energy.
- Renewable (Natural) Resource** — Natural resources that continuously can be replenished in the course of natural events within the limits of human time. Also see *Natural Resource* and *Nonrenewable Natural Resource*.
- Renewable Water Supply** — The rate of supply of water (volume per unit of time) potentially or theoretically available for use in a region on an essentially permanent basis.
- Replenishment** — The act of replenishing an aquifer, usually through artificial recharge, to offset excess groundwater pumping.
- Replenishment District** — An authority, serving a specific area of water users, which has the ability to combine resources to replenish over drafted aquifers with renewable water supplies.
- Replicate Samples** — A group of samples collected in a manner such that the samples are thought to be essentially identical in composition.
- Representativeness** — (Statistics) How well a given sample represents the total population from which it was taken.
- Representative Sample** — A portion of material or water that is as nearly identical in content and consistency as possible to that in the larger body of material or water being sampled.
- “Repurified Water”** — Denotes reclaimed or recycled wastewater that is treated far beyond the most stringent standards current in force and then remixed with fresh water to augment existing water supplies. Typically, such waters would undergo extensive *Tertiary Wastewater Treatment* and then be stored in a reservoir (say, for up to one year), subsequently blended with fresh water supplies and then undergo further disinfection through conventional drinking water treatment before being distributed to municipal water users.
- Re-Regulating Reservoir** — A reservoir for reducing diurnal (daily) fluctuations resulting from the operation of an upstream reservoir for power production.
- Reservation** — A withdrawal usually of a more or less permanent nature; also, any federal lands of the U.S. government which have been dedicated to a specified public purpose such as a national forest, wildlife refuge, or wilderness area.
- Reservation Doctrine, Reserved Rights Doctrine, and Winters Doctrine (or Winters Rights)** — The legal rule which states that when the United States reserves public lands for a particular purpose it also reserves sufficient water to accomplish that purpose. Those who initiate water rights after the date of the reservation are subject to the reserved right. The doctrine was first announced by the United States Supreme Court in the case of *Winters v. United States*, 207 U.S. 564 (1908), involving a dispute between an Indian reservation and a rancher. For many years it was thought that the doctrine only applied to Indian reservations, but in recent years it has been extended to other types of federal reservations, such as national parks and forests. Also see *Winters Rights (Decision)* and *Practically Irrigable Acreage (PIA)*.
- Reservation or Withdrawal of Water** — The withholding of water from appropriation. A reservation or withdrawal of water in order to preserve instream values would have the same affect as a *Minimum Flow Appropriation* for that purpose: The only essential difference is the procedure used.

**Reserve Capacity** — Extra treatment capacity built into solid waste and wastewater treatment plants and interceptor sewers to accommodate flow increases due to future population growth.

**Reserved Water Rights (Federal)** — (1) A category of federal water rights, created by federal law and recognized by judicial decision. These rights are created when the federal government withdraws land from the public domain to establish a federal reservation such as a national park, forest, or Indian reservation. By this action, the government is held to have reserved water rights sufficient for the primary purpose for which the land was withdrawn. (2) This class of water rights is a judicial creation derived from *Winters v. United States* (207 U.S. 564, 1907) and subsequent federal case law, which collectively hold that when the federal government withdraws land from general use and reserves it for a specific purpose, the federal government by implication reserves the minimum amount of water unappropriated at the time the land was withdrawn or reserved to accomplish the primary purpose of the reservation. Federal reserved water rights may be claimed when Congress has by statute withdrawn lands from the public domain for a particular federal purpose or where the President has withdrawn lands from the public domain for a particular federal purpose pursuant to congressional authorization. The right to such water is not lost by nonuse, and its priority date is the date the land was set aside. Also see *Winters Rights (Decision)*, *Reservation Doctrine*, *Reserved Rights Doctrine*, and *Winters Doctrine (or Winters Rights)*, and *Water Law [Federal]*.

**Reserves** — Natural resources that can be exploited in an economically feasible manner employing current technology. Compare to *Resources*.

**Reserve Supply** — Developed but presently unused surface water supply available to certain portions of a hydrologic study or planning area (as defined) to meet planned future water needs; the supply is not usually available to other areas needing additional water because of a lack of physical facilities and/or institutional arrangements.

**Reservoir (Water)** — (1) A pond, lake, or basin, either natural or artificial, for the storage, regulation, and control of water. (2) An artificially created lake in which water is collected and stored for future use.

**Reservoir Area** — The surface area of a reservoir when filled to controlled retention water level.

**Reservoir, Multipurpose** — A reservoir constructed and equipped to provide storage and release of water for two or more purposes such as flood control, power development, navigation, irrigation, pollution abatement, domestic water supply, etc.

**Reservoir, Re-Regulating** — A reservoir used to regulate the outflow from an upstream reservoir.

**Reservoir, Retarding** — An ungated reservoir for temporary storage of floodwater. Sometimes called a *Detention Reservoir*.

**Reservoir, Single-Purpose** — A reservoir planned to serve only one purpose.

**Reservoir Surface** — The surface of a reservoir at any level.

**Residential Water Use** — Water used normally for residential purposes, including household use, personal hygiene, and drinking, watering of domestic animals, and outside uses such as car washing, swimming pools, and for lawns, gardens, trees and shrubs. The water may be obtained from a public supply or may be self supplied. Also referred to as *Domestic Water Use*. Also see *Public Water Supply System* and *Self-Supplied Water*.

**Resident Population** — The number of persons who live within a state or other political subdivision (county, city, etc.) who consider it their permanent place of residence. College students, military personnel, and inmates of penal institutions are counted as permanent residents. According to this definition, tourist and seasonal or part-time residents are considered nonresident population.

**Residual Average Annual Flood Damages** — Those flood damages which are not prevented by a flood control project or by other structural or nonstructural flood damage prevention measures.

**Residual Chlorine** — The level of chlorine existing in the distribution system after chlorination at a drinking water treatment plant.

**Residual Depression Storage** — Depression storage existing at the end of a period of excess rain.

**Residual Detention Storage** — Detention storage existing at the end of a period of excess rain.

**Residual Discharge** — Direct surface discharge at the end of a period of excess rain.

**Residual Flood Damages** — Those flood damages which are not prevented by a flood plain management program. They may or may not be preventable by other flood control measures (including both structural and nonstructural means).

**Residual Mass Diagram** — A diagram or graph plotted with rectangular coordinates, with each ordinate equal to (a) the sum of all preceding quantities in the series up to a given point, minus (b) the arithmetic mean of the series times the number of quantities in the series up to a given point, and the corresponding abscissa representing time, number of the item in the series, etc. A general upward slope of a section of such a graph indicates that the terms in the series within the section are, in general, in excess of the average for the series, and vice versa. The diagram is used in determining cyclic variation of quantities such as precipitation.

**Residual Sodium Carbonate (RSC)** — The excess milliequivalents of carbonate and bicarbonate over the milliequivalents of calcium and magnesium in a sample of water, where:

$$\text{RSC} = (\text{CO}_3^{-2} + \text{HCO}_3^{-2}) - (\text{Ca}^{+2} + \text{Mg}^{+2})$$

where all concentrations are expressed in milliequivalents per liter (meq/l). Waters with RSC values over 2.5 are generally not suitable for irrigation uses.

**Residue on Evaporation (ROE)** — A procedure for establishing the mineral content of a water.

**Residium** — (Geology) Soil material formed from rock weathering in place.

**Resilience** — The ability of an ecosystem to maintain or restore biodiversity, biotic integrity, and ecological structure and processes following disturbance.

**Resolution** — The minimum distance between two adjacent features or objects, or the minimum size of a feature or object, that can be detected by a *Remote Sensing* system.

**Resources** — That which is, or may be, readily available as a source of supply or support. Also, the total amount of any rock, mineral, or fuel in the crust of the earth. Compare to *Reserves*. Also see *Natural Resources*.

**(The) Resources Agency [California]** — The mission of the California Resources Agency is to oversee the state's activities relating to the conservation, management, and enhancement of California's natural and cultural resources; including land, wildlife, water, and minerals. The administrative head of The Resources Agency, the Secretary for Resources, is a member of the Governor's Cabinet, serves as the Governor's representative on the Agency's boards and commissions, and oversees administration of the *California Environmental Quality Act (CEQA)*. The California Resources Agency is comprised of the following entities:

- California Coastal Commission
- Department of Boating and Waterways
- Department of Conservation
- California Conservation Corps
- Department of Fish and Game
- Department of Forestry and Fire Protection
- Department of Parks and Recreation
- Department of Water Resources
- California Energy Commission
- California State Lands Commission
- San Francisco Bay Conservation and Development Commission
- California Tahoe Conservancy
- Colorado River Board of California
- Coachella Valley Conservancy
- Santa Monica Mountains Conservancy
- State Coastal Conservancy
- State Reclamation Board

Other special programs administered by The Resources Agency include:

- CERES, the California Environmental Resources Evaluation System
- California Biodiversity Council
- California Rivers Assessment
- CAL-FED Bay-Delta Program
- Natural Community Conservation Program
- California Ocean Resources Management Program

**Resource Conservation and Recovery Act (RCRA)** — Federal legislation requiring that hazardous wastes be tracked from "cradle" (generation) to "grave" (disposal).

**Resource Management Plan (RMP)** — The basic document used by the U.S. Department of the Interior, *Bureau of Land Management (BLM)* to plan the course of management for the use and protection of all public land values, renewable resources, and supporting services.

**Resource Management System** — A combination of conservation practices identified by the primary use of land or water that, if effected, will at a minimum protect the resource base by meeting tolerable soil losses, maintaining acceptable water quality, and maintaining acceptable ecological and management levels for the selected resource use. Such systems may include conservation practices that provide for quality in the environment and quality in the standard of living.

**Resource Monitoring** — The act of continually or periodically observing resources to determine changes and trends

in their status and condition.

**Respiration** — (Biology) The oxidative process occurring within living cells by which the chemical energy of organic molecules (i.e., substances containing carbon, hydrogen, and oxygen) is released in a series of metabolic steps involving the consumption of oxygen (O<sub>2</sub>) and the liberation of carbon dioxide (CO<sub>2</sub>) and water (H<sub>2</sub>O).

**Response Action** — (Environmental) A generic term used to describe actions taken in response to actual or potential health-threatening environmental events such as spills, sudden releases, and similar such events.

**Restoration** — The act or process of bringing something back to a previous condition or position. For example, the establishment of natural land contours and vegetative cover following extensive degradation of the environment caused by activities such as *Surface Mining*. Under this condition, the term is used interchangeably with *Reclamation*.

**Resuspended** — Describes particles that have been remixed with the air or water from which they have settled. For example, sediment particles will settle from river water if the water is allowed to stand. Those particles may be remixed with the water if turbulent conditions reoccur.

**Retaining Wall** — A wall built to support or prevent the advance of a mass of earth or water.

**Retarding Reservoir** — Ungated reservoir for temporary storage of flood water. Also referred to as a *Detention Reservoir*.

**Retention** — That part of the precipitation falling on a drainage area that does not escape as a surface streamflow, during a given period.

**Retention Basin** — A permanent lake or pond used to slow stormwater runoff. Also see *Detention Basin*.

**Retention Facility** — A stormwater storage facility that normally holds water at a controlled level to serve functions such as recreation, aesthetic, and water supply. Stormwater runoff is temporarily stored above the controlled stage. Examples of types of retention storage reservoirs are permanent ponds in residential and commercial areas and in open spaces. Also see *Detention Facility*.

**Retention Storage** — Water retained in the capillary pores of the soil, not free to move by gravity, and in large part available to plants.

**Retention Time** — The interval of time that some waste, fluid or other material is in a treatment facility or process unit.

**Return Flow** — (1) The amount of water that reaches a ground or surface water source after release from the point of use and thus becomes available for further use. (2) That part of a diverted flow which is not consumptively used and returns to its original source or another body of water. (3) (Irrigation) Drainage water from irrigated farmlands that re-enters the water system to be used further downstream. Such waters may contain dissolved salts or other materials that have been leached out of the upper layers of the soil. Also see *Consumptive Use* and *Return Flow (Irrigation)*.

**Return Flow (Irrigation)** — (1) Irrigation water applied to an area which is not consumed in evaporation or transpiration and returns to a surface stream or ground water aquifer. (2) Water that is applied to a crop but not consumptively used, which makes its way back to a waterway and is available for use by downstream users. (3) Water which reaches surface drainage by overland flow or through groundwater discharge as a result of applied or natural irrigation.

**Return Flow Credit** — The concept of water use allocations based only on actual *Consumptive Use*; waters returned to the system are credited, in whole or part, against the original allowable allocations.

**Return Flow Credit [Nevada]** — Nevada's apportionment of Colorado River water is a consumptive use apportionment. Nevada can divert more than its apportionment, however, so long as it returns sufficient Colorado River water to the river such that its net depletion is no greater than the 300,000 acre-feet per year currently allowed. The calculated Colorado River water returned each year is known as "return flow credits". Also see *Colorado River Compact*.

**Return Period (or Recurrence Interval)** — In statistical analysis of hydrologic data, based on the assumption that observations are equally spaced in time with the interval between two successive observations as a unit of time, the return period is the reciprocal of 1 minus the probability of a value equal to or less than a certain value; it is the mean number of such time units necessary to obtain a value equal to or greater than a certain value one time. For example, with a one-year interval between observations, a return period of 100 years means that, on the average, an event of this magnitude, or greater, is not expected to occur more often than once in 100 years. Also see *Exceedence Interval*, *Recurrence Interval*, *Flood Frequency*, *Frequency Curve*.

**Return Seepage** — Water which percolates from canals and irrigated areas to underlying strata, raising the ground-water level, and eventually returning to natural channels.

**Reuse (of Water)** — (1) Water that is discharged by one user and is used by other users. (2) Repeated use of the same

water by subsequent users in sequential systems. Sometimes, it also means water discharged by one unit and used by other units in the same plant. Also referred to as *Recycled Water*.

**Reuse Systems** — Refers to the deliberate application of reclaimed water for a beneficial purpose. Reuse may encompass landscape irrigation (such as golf courses, cemeteries, highway medians, parks, playgrounds, school yards, nurseries, and residential properties), agricultural irrigation (such as food and fruit crops, wholesale nurseries, sod farms and pasture grass), aesthetic uses, ground-water recharge, environmental enhancement of surface water and wetland restoration, fire protection, and other useful purposes.

**Reuse Water** — Water used repeatedly.

**Reverse Osmosis** — (1) (Desalination) Refers to the process of removing salts from water using a membrane. With reverse osmosis, the product water passes through a fine membrane that the salts are unable to pass through, while the salt waste (brine) is removed and disposed. This process differs from electro dialysis, where the salts are extracted from the feedwater by using a membrane with an electrical current to separate the ions. The positive ions go through one membrane, while the negative ions flow through a different membrane, leaving the end product of freshwater. (2) (Water Quality) An advanced method of water or wastewater treatment that relies on a *Semi-permeable Membrane* to separate waters from pollutants. An external force is used to reverse the normal osmotic process resulting in the solvent moving from a solution of higher concentration to one of lower concentration.

**Revetment** — (1) A facing of stone, bags, blocks, pavement, concrete, or sandbags, or other materials, used to protect a bank of earth from erosion. (2) A retaining wall. (3) A structure built along the coast to prevent erosion and other damage by wave action; similar to a sea wall.

**Revetted Levee** — An embankment faced with an erosion protection layer, built to prevent a river from overflowing.

**Reynolds Number [Re or ]** — A dimensionless number used as an index of fluid flow characteristics in a pipe, duct, or around an obstacle. The expression for fluid flow in a pipe or duct is equal to:

$$= (V \times d \times \tilde{n})/\mu$$

where:

- V is the fluid velocity;
- d is the pipe or duct diameter;
- $\tilde{n}$  is the fluid density; and
- $\mu$  is the fluid dynamic viscosity.

For fluid flow around a particle it takes the form:

$$= (d_p \times v_r \times \tilde{n})/\mu$$

where:

- $d_p$  is the particle diameter;
- $v_r$  is the velocity of the particle relative to the fluid;
- $\tilde{n}$  is the fluid density; and
- $\mu$  is the fluid viscosity.

For fluid flow in a pipe or duct, a Reynolds number below about 2,100 is considered to be streamline, smooth, or *Laminar Flow*; above 4,000 the flow is turbulent; 2,100–4,000 is a transition zone. For the flow of fluid around a particle, a Reynolds number less than 1.0 is considered laminar flow and as the value increases above 1.0 turbulence increases. The difference between the conditions for laminar flow around particles and in pipes is explained by the impact of inertial forces as the fluid flows around a particle compared to the straight flow in a pipe or duct.

**Rhodomancy** — Divination by means of a wand or rod, especially for discovering underground water or ores. Also see *Douse (also Dowse)* and *Divining Rod*.

**Rheology** — The study of the deformation and flow of matter.

**Rheotaxis** — Movement of an organism in response to a current of water or air.

**Rhithron Zone** — A stream reach at higher elevations, characterized by rapid flow, low temperature, and high dissolved oxygen levels. Also see *Potamon Zone*.

**Richness** — (Biological) The total number of species in an area, usually expressed as the number of species divided by the total number of individuals, or the number of species per unit area.

**Ridge Lines** — Points of higher ground that separate two adjacent streams or *Watersheds*. Also referred to as *Divides*.

**Ridgeline Remnant** — A narrow ridge with a fully rounded crest that is accordant with the crests of similar nearby ridges. Together these accordant crests approximately mark the position of a preexisting land surface that has been destroyed by dissection.



**Riffle** — (1) A shallow rapids, usually located at the crossover in a meander of the active channel. (2) Shallow rapids in an open stream, where the water surface is broken into waves by obstructions such as shoals or sandbars wholly or partly submerged beneath the water surface. (3) Also, a stretch of choppy water caused by such a shoal or sandbar; a rapid; a shallow part of the stream.

**Rift** — A shallow or rocky place in a stream, forming either a ford or a rapid.

**Right** — A claim or title to anything that is enforceable by law, such as a right to use water.

**Right Abutment** — That part of the right-hand side of a valley side wall against which a dam is constructed. The right abutment is viewed by an observer looking downstream.

**Right Bank** — The right-hand side of a stream, river, or channel when facing in the direction of the flow.

**“Right of Free Capture”** — The idea or concept that the water under a person’s land belongs to that person and they are free to capture and use as much as they want. Also called the “law of the biggest pump.” Does not apply where both surface water and ground water are regulated. Also referred to as the “Right of Capture.”

**Rill, also Rille** — (1) A small brook; a rivulet. Also small, water-formed ridges that generally may be smoothed by normal tilling methods. (2) A small, intermittent watercourse with steep sides; usually only several centimeters deep; caused by waterborne soil erosion.

**Rill Erosion** — (1) Removal of soil by running water with formation of shallow channels that can be smoothed out completely by normal tillage. (2) Removal of soil particles from a bank slope by surface runoff moving through relatively small channels. The water collecting from these small channels may then concentrate into a larger channel downhill to form the start of a gully.

**Rime** — (1) A coating of ice, as on grass and trees, formed when extremely cold water droplets freeze almost instantly on a cold surface. (2) A white frost of congealed dew or vapor. An accumulation of granular ice tufts on the windward sides of exposed objects, particularly on grass and trees, slightly resembling *Hoarfrost*, but formed only from undercooled fog or cloud and always built out directly against the wind.

**Riparian** — Pertaining to the banks of a river, stream, waterway, or other, typically, flowing body of water as well as to plant and animal communities along such bodies of water. This term is also commonly used for other bodies of water, e.g., ponds, lakes, etc., although *Littoral* is the more precise term for such stationary bodies of water. Also refers to the legal doctrine (*Riparian Doctrine* and *Riparian Water Rights*) that says a property owner along the banks of a surface water body has the primary right to withdraw water for reasonable use. Also see *Riverine*.

**Riparian Areas (Habitat)** — (1) Land areas directly influenced by a body of water. Usually such areas have visible vegetation or physical characteristics showing this water influence. Stream sides, lake borders, and marshes are typical riparian areas. Generally refers to such areas along flowing bodies of water. The term *Littoral* is generally used to denote such areas along non-flowing bodies of water. (2) (USFWS) Plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent *Lotic* and *Lentic* water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics: (a) distinctively different vegetative species than adjacent areas, and (b) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between *Wetlands* and *Uplands*.

**Riparian Doctrine** — The system for allocating water used in England and the eastern United States, in which owners of lands along the banks of a stream or water body have the right to *Reasonable Use* of the waters and a *Correlative Right* protecting against unreasonable use by others that substantially diminishes the quantity or quality of water. The right is appurtenant to the land and does not depend on prior use. Under this doctrine, ownership of land along a stream or river (i.e., riparian lands) is an absolute prerequisite to a right to use water from that body of water and each such landowner has an equal right to withdraw “reasonable” amounts of water (whether or not he is presently using it or not) so long as downstream landowners are not unreasonably damaged. Contrast with *Prior Appropriation Doctrine*.

**Riparian Ecosystem** — A transitional ecosystem located between aquatic (usually *Riverine*) and terrestrial (upland) environments. Riparian ecosystems are identified by distinctive soil characteristics and vegetation communities that require free water.

**Riparian Habitat** — Areas adjacent to rivers and streams with a high density, diversity, and productivity of plant and animal species relative to nearby uplands.

**Riparian Land** — (1) Land situated along the bank of a stream or other, generally flowing bodies of water. (2) Land so situated with respect to a body of water that, because of such location, the possessor of the land is entitled to the benefits incident to the use of the water.

**Riparian Lease** — The written instrument setting forth the terms, conditions, and the date of expiration of the rights to use lands lying between the high water mark and the low water mark.

**Riparian Owner** — One who owns land on the bank of a river, or one who is the owner of land along, bordering upon,

bounded by, fronting upon, abutting, or adjacent and contiguous to and in contact with a river or stream.

**Riparian Proprietor** — An owner of land, bounded generally upon a stream or river, and as such having a qualified property in the soil to the thread of the stream or river with the privileges annexed thereto by law.

**Riparian Rights** — (1) Water rights based on the ownership of land bordering a river or waterway. (2) A concept of water law under which authorization to use water in a stream is based on ownership of the land adjacent to the stream and is normally not lost if not used. (3) The rights of the owners of lands on the banks of watercourses, relating to the water, its use, ownership of soil under the stream, accretion, etc. The term is generally defined as the right which every person through whose land a natural watercourse runs has to the benefit of the stream as it passes through his land for all useful purposes to which it may be applied. Such rights include those such as hunting, fishing, boating, sailing, irrigating, and growing and harvesting wild rice, which rights extend over lakes and wetlands. See *Riparian Doctrine*. Also see *Riparian Water Rights*.

**Riparian Vegetation** — Plants adapted to moist growing conditions found along waterways and shorelines. They are frequently important to wildlife habitat because of their greater density and succulence.

**Riparian Water** — Water which is below the highest line of normal flow of the river or stream, as distinguished from flood water.

**Riparian Water Rights** — The rights of an owner whose land abuts water. They differ from state to state and often depend on whether the water is a river, lake, or ocean. The doctrine of riparian rights is an old one, having its origins in English common law. Specifically, persons who own land adjacent to a stream have the right to make reasonable use of the stream's natural flow on those lands within the watershed. (The emphasis on natural flow means that riparian rights cannot be claimed for long-term storage of water in a reservoir.) Riparian users of a stream share the streamflow among themselves, and the concept of priority of use (*Prior Appropriation Doctrine*) is not applicable. Under drought conditions, the users share shortages. Riparian rights cannot be sold or transferred for use on nonriparian land. Riparian rights to the waters of a lake, as opposed to a flowing stream, are often referred to as *Littoral Water Rights*. Also see *Appropriative Water Rights*, *Prescribed Water Rights*, and *Reserved Water Rights*.

**Riparian Zone** — (1) Areas adjacent to a stream that are saturated by ground water or intermittently inundated by surface water at a frequency and duration sufficient to support the prevalence of vegetation typically adapted for life in saturated soil. (2) The transition area between the aquatic ecosystem and the nearby, upland terrestrial ecosystem. Zones are identified by soil characteristics and/or plant communities and include the wet areas in and near streams, ponds, lakes, springs and other surface waters. Also see *Riparian Areas*.

**Rip Current** — A strong, narrow surface current that flows rapidly away from the shore, returning the water carried landward by waves. Also referred to as *Rip Tide* and *Tiderip*.

**Rip Rap (also Riprap)** — A facing layer (protective cover) of stones placed to prevent erosion or the sloughing off of a structure or embankment. A layer of man-made hard, durable material for bank protection and stabilization usually consisting of rock or stone. On steeper inclines, the stones may be secured with wire on some form of link fencing material. Also, a layer of large stones, broken rock, or precast blocks placed in random fashion on the upstream slope of an *Embankment Dam*, on a reservoir shore, or on the sides of a channel as a protection against waves, ice action, and flowing water. Very large rip rap is sometimes referred to as *Armoring*.

**Rip Tide** — See *Rip Current*.

**Ripple** — (1) To form or display little undulations or waves on the surface, as disturbed water does. (2) To flow with such undulations or waves on the surface.

**Ripple Mark** — One of a series of small ridges produced especially on sand by the action of wind, a current of water, or waves.

**Riser** — A vertical pipe as for water.

**Rising Limb** — The increasing portion of the storm *Hydrograph*. Contrast to *Falling Limb*.

**Rising Sludge** — (Water Quality) The rising of previously settled solids in the settling tank of an activated sludge system. The immediate cause is denitrification, resulting in the formation of nitrogen gas and buoyancy of the sludge mass. The result is that solids are carried away with the effluent.

**River** — A natural stream of water of considerable volume, larger than a brook or creek. A river has its stages of development, youth, maturity, and old age. In its earliest stages a river system drains its basin imperfectly; as valleys are deepened, the drainage becomes more perfect, so that in maturity the total drainage area is large and the rate of erosion high. The final stage is reached when wide flats have developed and the bordering lands have been brought low.

**River Banks** — (1) The boundaries which confine the water to its channel throughout the entire width when the stream is carrying its maximum quantity of water. (2) The portion of the channel cross section that restricts lateral

movement of water at normal discharges. Banks often have a gradient steeper than 45 degrees and exhibit a distinct break in slope from the stream bed.

**River Basin** — (1) A term used to designate the area drained by a river and its tributaries. (2) The area from which water drains to a single point; in a natural basin, the drainage area contributing flow to a given point on a stream.

**River Basin Development** — A program to develop the use of the water and land resources of a river basin, so coordinated as to obtain a greater efficiency of use than would be possible if the resources were developed by uncoordinated, multiple-purpose projects.

**River Basin Plan** — A plan for the development of water and related land resources to make the best use of such resources to meet the basin needs and make the greatest long-term contribution to the economic growth and social well-being of the people of the basin and the nation.

**River Channels** — Natural or artificial open conduits which continuously or periodically contain moving water, or which forms a connection between two bodies of water.

**River Flooding** — Inundation of a normally dry area along a river (usually the mainstem) due to increased water level or discharge. Because the drainage areas of mainstem rivers are large, they do not *Flash Flood* as their smaller tributary streams do. River flooding occurs more than a few hours after the causative event (usually widespread heavy precipitation and/or snowmelt) of the flood. In many cases, the end of flash flooding along tributary streams may be followed by or coincident with river flooding (i.e., heavy precipitation which initially causes flash flooding on tributaries goes on to cause river flooding on the larger rivers). Because of the longer time factor, river flooding usually can be forecast with much greater accuracy than flash flooding. The forecasting of river flooding is one of the primary duties of the *National Weather Service River Forecast Centers*.

**River Flow Model** — A simulation, generally mathematical, of a river's or drainage basin's *Hydrologic Cycle*, through a series of mathematical equations quantifying system inflows and outflows. Whenever possible, actual flow measurements for calibration purposes will be used.

**River Gage Reach** — That stretch of a river on which the stage and/or flow at a particular gage is characteristic of stage and/or flow along that entire reach. Consequently, streamflow, depth, drainage area and slope are fairly uniform along this stretch and there are no major inflows, diversions, dams, etc.

**Riverine** — (1) Relating to, formed by, or resembling a river including tributaries, streams, brooks, etc. (2) Pertaining to or formed by a river; situated or living along the banks of a river, for example, a "riverine ore deposit." Also see *Riparian*.

**Riverine (Systems)** — Open-water habitats. Typically include all open water areas that occur within a defined channel of a stream as well as along perennial and intermittent stretches of streams and along some major dry washes. In some cases, riverine systems are bounded by *Palustrine Wetlands* that develop in the floodplain on either side of the defined channel. The riverine system and the adjacent palustrine wetlands are often referred to as *Riparian Habitat*. Also see *Wetlands* and *Wetlands, Palustrine*. [See Appendix D-2 for an explanation of the Wetland and Deepwater Habitat Classification System and more detailed information on these Systems.]

**River Mile** — The distance of a point on a river measured in miles from the river's mouth along the low-water channel.

**River Mileage** — The linear distance along the meandering path of a stream channel determined in accordance with Bulletin No. 14 (October 1968) of the Water Resources Council.

**River Reach** — Any defined length of a river.

**Rivers, Classifications** — Classifications of waterways included in the *National Wild and Scenic Rivers System* are as follows:

- [1] **Recreational Rivers** — Rivers or sections of rivers that are readily accessible by road or railroad, that may have some development along their shoreline, and that may have undergone some impoundment or diversion in the past.
- [2] **Scenic Rivers** — Rivers or sections of rivers that are free of impoundments, with shorelines or watersheds still largely primitive, and shorelines largely undeveloped but accessible in places by roads.
- [3] **Wild Rivers** — Rivers or sections of rivers that are free of impoundments and generally inaccessible except by trail, with watersheds or shorelines essentially primitive and waters unpolluted.

**River Stage** — The elevation of the water surface at a specified station above some arbitrary zero datum (level).

**Riverwash** — Barren alluvial land, usually coarse-textured, exposed along streams at low water, and subject to shifting during normal high water.

**Rivulet** — A small stream or brook; a streamlet.

**Robinson Projection** — (Geography) A compromise map projection showing the poles as lines rather than points and more accurately portraying high latitude lands and water to land ratio.

- Roche Moutonnée** — An elongated mound of bedrock worn smooth and rounded by glacial abrasion.
- Rock Varnish** — See *Desert Varnish*.
- Rockfill Dam** — An *Embankment Dam* in which more than 50 percent of the total volume comprises compacted or dumped pervious natural or crushed rock. Also see *Dam*.
- Rock Flour** — Finely ground rock particles produced by glacial abrasion. Also referred to as *Glacier Meal*.
- Roil** — To make a liquid cloudy, muddy, or unsettled by stirring up the sediment.
- Roily** — Water of a liquid that is turbid, muddy, agitated or disturbed.
- Rooster Tail** — A high arching spray of water thrown up behind a fast-moving motorboat.
- Root Hair** — (Botany) A thin, hairlike outgrowth of an epidermal cell of a plant root that absorbs water and minerals from the surrounding soil.
- Root Pressure** — Pressure exerted in the roots of plants as the result of *Osmosis*, causing exudation from cut stems and *Guttation* of water from leaves.
- Rootwad** — A tree stump with roots that are strategically placed in a stream bank as part of rebuilding or restoring the bank. The stump may be dead wood or live and capable of sprouting and rooting.
- Root Zone** — The subsurface zone from the land surface to the depth interwoven by plant roots.
- Rotating Biological Contractor (RBC)** — (Water Quality) A means of wastewater treatment in which large, closely-spaced plastic discs are rotated about a horizontal shaft. The discs alternately move through the wastewater and the air, developing a biological growth on their surface.
- Rotation** — (Irrigation) Water delivery where a relatively constant supply flow is rotated to different users at varying times.
- Rotation Delivery** — A method of delivering water to the headgate from the project conveyance system on a rotational time basis. This delivery method is usually associated with high head (cfs) deliveries.
- Rotation Management** — A type of livestock grazing management system where pastures are grazed for only a portion of the year or season and rested for the remainder.
- Rough Fish** — Those species of fish considered to be of either poor fighting quality when taken on tackle or of poor eating quality, such as carp, gar, suckers, etc. Most species in this group are more tolerant of widely fluctuating environmental conditions than *Game Fish*.
- Roughness** — A term used by hydraulic engineers and hydrologists designating a measurement or estimate of the resistance that streambed materials, vegetation, and other physical components contribute to the flow of water in the stream channel and floodplain. It is commonly measured as the Manning's roughness coefficient.
- Roughness Coefficient** — (Hydraulics) A factor in velocity and discharge formulas representing the effect of channel roughness on energy losses in flowing water.
- Routing (Hydraulics)** — (1) The derivation of an outflow *Hydrograph* of a stream from known values of upstream inflow, using the wave velocity and/or the storage equation. (2) A technique used to compute the effect of channel storage and translation on the shape and movement of a flood wave through a river reach.
- Ruby Lake National Wildlife Refuge (NWR) [Nevada]** — One of the nine National Wildlife Refuges (NWR) located in the State of Nevada, the Ruby Lake NWR was established in 1938 and covers an area of 37,632 acres (58.8 square miles) consisting of marshes, open ponds and islands, bordered by wet meadows and grass/sagebrush-covered uplands. The Ruby Lake NWR, which collects the waters from over 160 springs along the base of the Ruby Mountains, lies within a closed drainage basin in Ruby Valley of northeastern Nevada approximately 65 miles southeast of the town of Elko along the eastern flank of the rugged and scenic Ruby Mountains at an elevation of 6,000 feet above sea level. During the Pleistocene Epoch, the Ruby Marshes were part of a much larger body of water known as Franklin Lake, an Ice Age lake which covered some 470 square miles and was over 200 feet deep; however, today, only the Ruby and Franklin Lake marshes remain and provide an important refuge to nesting and migratory waterfowl and water birds using the migration corridors of both the Pacific and Central Flyways. Also see *National Wildlife Refuge (NWR) System* and *National Wildlife Refuges (NWR) [Nevada]*.
- Ruderal** — Plant species adapted to sites with recent disturbance. Some characteristics of ruderal species are: (1) a potentially high relative growth rate during the seedling phase; (2) early onset of flowering, self-pollination, rapid maturation and release of seeds; and (3) sustained seed production at the expense of ability for competition and tolerance to stress.
- Rugosity** — A term used to indicate the degree of roughness of a test-well caused by drilling and subsequent wash-outs. In some wells, rugosity is caused by the intersection of fractures with the test well and may be an indication of secondary *Porosity* development and possible zones of increased *Transmissivity*.
- Run** — (1) To flow, especially in a steady stream. (2) A pipe or channel through which something, i.e., water, flows. (3) A fall or slide, as of sand or mud. (4) The migration of fish, especially in order to spawn; a group or school of

fish ascending a river in order to spawn, i.e., the seasonal upstream migration of *Anadromous* fish. (5) (Irrigation) The distance of gravity flow from the point of release to the end of the area to be watered. (6) (Nautical) To sail or steer before the wind or on an indicated course. (7) (Geology) A vein or seam, as of ore or rock.

**Runlet** — A *Runnel* (see below).

**Runnel** — (1) A rivulet; a brook. (2) A narrow channel or course, as for water.

**Running Water** — Water distributed through pipes and fixtures as a house with hot and cold running water.

**Runoff** — (1) That portion of precipitation that moves from the land to surface water bodies. (2) That portion of precipitation which is not intercepted by vegetation, absorbed by the land surface or evaporated, and thus flows overland into a depression, stream lake or ocean (runoff called “immediate subsurface runoff” also takes place in the upper layers of the soil). (3) That part of the precipitation, snow melt, or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers. It is the same as streamflow unaffected by artificial diversions, imports, storage, or other works of man in or on the stream channels. Runoff may be classified according to speed of appearance after rainfall or melting snow as direct runoff or base runoff, and according to source as surface runoff, storm interflow, or ground-water runoff. (4) The total discharge described in (1), above, during a specified period of time. (5) Also defined as the depth to which a drainage area would be covered if all of the runoff for a given period of time were uniformly distributed over it.

***Meteorological Factors Affecting Runoff:***

- [1] Type of precipitation (rain, snow, sleet, etc.);
- [2] Rainfall intensity;
- [3] Rainfall amount;
- [4] Rainfall duration;
- [5] Distribution of rainfall over the drainage basin;
- [6] Direction of storm movement;
- [7] Antecedent precipitation and resulting soil moisture; and
- [8] Other meteorological and climatic conditions which affect evapotranspiration such as temperature, wind, relative humidity, and season.

***Physical Basic Characteristics Affecting Runoff:***

- [1] Land use;
- [2] Vegetation;
- [3] Soil type;
- [4] Drainage area;
- [5] Basin shape;
- [6] Elevation;
- [7] Slope;
- [8] Topography;
- [9] Direction of orientation;
- [10] Drainage network patterns; and
- [11] Ponds, lakes, reservoirs, sinks, etc. in the basin which prevent or alter runoff from continuing downstream.

**Runoff, Adjusted Mean Annual** — Average annual runoff adjusted for length of record by comparison with record at pivot stations.

**Runoff, Average Annual** — Average of water year runoff in inches or acre-feet for the total period of record.

**Runoff Curve Number** — A rainfall-runoff parameter commonly used in the U.S. Department of Agriculture, *Natural Resources Conservation Service (NRCS)*, formerly the *Soil Conservation Service (SCS)*, hydrologic procedures. The larger the runoff curve number, the greater the percentage of rainfall that will appear as runoff. The runoff curve number is a function of soil type, land use, and land management practices.

**Runoff Cycle** — That portion of the *Hydrologic Cycle* between incident precipitation over land areas and its subsequent discharge through stream channels or *Evapotranspiration*.

**Runoff, Direct** — The runoff entering stream channels most immediately after rainfall or snowmelt. It consists of surface runoff plus interflow and forms the bulk of the *Hydrograph* of a flood. Direct runoff plus *Base Runoff* compose the entire flood hydrograph.

**Runoff, Ground Water** — That part of the runoff which has passed into the ground, has become ground water, and has been discharged into a stream channel as spring or seepage water. Also referred to as *Base Runoff* or *Base Flow*.

**Runoff in Inches** — The depth, in inches, to which the drainage area would be covered if all the runoff for a given

time period were uniformly distributed on it.

**Runoff Percentage** — Runoff expressed as a percentage of the precipitation.

**Runoff Plots** — Areas of land, usually small, arranged so the portion of rainfall or other precipitation flowing off and perhaps carrying soluble materials and soil may be measured.

**Runoff Rate** — The volume of water running off in a unit of time from a surface, expressed as inches of rainfall per hour, cubic feet per second, or other units.

**Runoff, Surface** — (1) That part of the runoff which travels over the soil surface to the nearest stream channel. (2) That part of the runoff of a drainage basin that has not passed beneath the surface since precipitation. Surface runoff is not the same as direct runoff.

**Run-of-River Dam** — A hydroelectric generating power plant that operates based only on available streamflow and some short-term storage (hourly, daily, or weekly). Compare to *Storage Reservoir*.

**Runs** — An area of swiftly flowing water, without surface agitation or waves, which approximates uniform flow and in which the slope of the water surface is roughly parallel to the overall gradient of the stream reach.

**Rural-Domestic Water** — The rural domestic category includes water uses for domestic needs, stock watering, yard irrigation, etc., of individual homes, farms or ranches, and rural centers with a population of typically less than about 250 people.

**Rural Water Use** — Water used in suburban or farm areas for domestic and livestock needs. The water generally is self supplied (i.e., not supplied by a *Public Water Supply System*) and includes domestic use, drinking water for livestock, and other uses, such as dairy sanitation, evaporation from stock-watering ponds, and cleaning and waste disposal. Uses may also include suburban developments such as apartment houses, or trailer courts with their own wells, and tracts of homes served by a central cooperatively owned well, or small water company for which no other source is available. Also see *Self-Supplied Water*.