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Habitat — (1) Living place, includes provisions for life. (2) The native environment or specific surroundings where a plant or animal naturally grows or lives. The surroundings include physical factors such as temperature, moisture, and light together with biological factors such as the presence of food or predator organisms. The term can be employed to define surroundings on almost any scale from marine habitat, which encompasses the oceans, to microhabitat in a hair follicle of the skin.

Habitat Conservation Plan (HCP) — A requirement under the *Endangered Species Act (ESA)* when economic development may result in harm to *Threatened* or *Endangered Species*. The plan does allow for some loss of individual animals or habitat of a species in exchange for a commitment that will insure long-term survival. Its intent is to better balance economic development and conservation.

Habitat Indicator — A physical attribute of the environment measured to characterize conditions necessary to support an organism, population, or community in the absence of pollutants, e.g., salinity of estuarine waters or substrate type in streams or lakes.

Habitat Type — The collective term for all land areas potentially capable of supporting the same climax, biotic community.

Hail — (1) Solid ice precipitation that has resulted from repeated cycling through the freezing level within a *Cumulonimbus Cloud*. (2) Precipitation which forms into balls or lumps of ice over 0.2 inch (5.08 mm) in diameter. Hail is formed by alternate freezing and melting as it is carried up and down by turbulent air currents within a cloud.

Hailstone — A hard pellet of snow and ice.

Hailstorm — A storm with *Hail*.

Hail Suppression — Any method of reducing the damaging effects of hailstorms by modifying the characteristics of the hail-producing cloud. The currently prevailing hypothesis is that silver iodide seeding provides more hailstone nuclei (and, at the same time, reduces the amount of supercooled water available to build up large hailstones) with the net effect that the hail that reaches the ground is smaller and less damaging, and also has a high probability of melting before reaching the ground.

Hair Hygrometer (Hygrograph) — An instrument for measuring humidity which makes use of the fact that the length of hair varies with relative humidity.

Halcyon Days (Water) — With respect to water, generally refers to idyllic by-gone days when supplies of an area's fresh water were relatively abundant with respect to the demands of man.

Half-Flow Interval — The shortest period of time in days (typically) during which one-half of the annual runoff occurs.

Haline — Term used to indicate dominance of ocean salt.

Haline Marshes — A saturated, poorly drained area, intermittently or permanently water covered, having aquatic and grasslike vegetation, influenced predominately by ocean salts.

Halo — A circular band of colored light around a light source, as around the sun or moon, caused by the refraction and reflection of light by ice particles suspended in the intervening atmosphere. Also see *Rainbow* for a similar refraction and reflection principal using water.

Halocline — The boundary between surface fresh water and underlying saltwater in a stratified coastal environment. A location where there is a marked change in salinity.

Halophytes — A group of salt-tolerant plants ranging from cacti to sea grass that can absorb salt and heavy metals such as cadmium and arsenic from the wastewater of power plants, particularly coal-fired generating plants which is typically laden with heavy-metal byproducts of coal combustion.

Hammock, also Hummock — (1) In the southern United States, especially Florida, an area characterized by hardwood vegetation, the soil being of a greater depth and containing more humus than that of the flatwoods or pinelands, hence being more suitable for cultivation. Particularly, a tract of forested land that rises above an adjacent marsh. (2) A ridge or hill of ice in an ice field.

Hanging Valleys — Hanging valleys can be created when smaller tributary glaciers join the main ice sheet. Since the

main glacier is larger and heavier than the tributary one(s), the main glacier will erode more deeply into its valley than will the tributary into its own valley. After the ice melts, the tributary valley will be left hanging part of the way up the wall of the larger canyon that it intersects. Many waterfalls in the high Sierras, including well-known ones at Yosemite National Park, occur at the juncture of a hanging valley with a larger canyon.

Harbor — A sheltered anchorage for ships and boats. Also see *Port*.

Hardness — (1) A characteristic of water which describes the presence of dissolved minerals. Carbonate hardness is caused by calcium and magnesium bicarbonate; noncarbonate hardness is caused by calcium sulfate, calcium chloride, magnesium sulfate, and magnesium chloride. (2) A property of water which causes an increase in the amount of soap that is needed to produce foam or lather and that also produces scale in hot water pipes, heaters, boilers and other units in which the temperature of water is increased materially. Hardness is produced almost completely by the presence of calcium and magnesium salts in solution. The following scale may assist in appraising water hardness, measured by weight of dissolved salts (in milligrams) per unit (in liters) of water:

[1] **Soft** — 0–60 milligrams/liter (mg/l);

[2] **Moderately Hard** — 61–120 mg/l;

[3] **Hard** — 121–180 mg/l; and

[4] **Very Hard** — over 180 mg/l.

Hardpan — (1) A layer of nearly impermeable soil beneath a more permeable soil, formed by natural chemical cementation of the soil particles. (2) A hard impervious layer composed chiefly of clay or organic materials cemented by relatively insoluble materials, which does not become plastic when wet, and definitely limits the downward movement of water and roots.

Hard Water — Water which forms a precipitate with soap due to the presence of calcium, magnesium, or ferrous ions in solution.

Harvested Rainwater — The rain that falls on a roof or yard and is channeled by gutters or channels to a storage tank. The first wash of water on a roof is usually discarded and the subsequent rainfall is captured for use if the system is being used for potable water.

Haystack — A vertical standing wave in turbulent river waters.

Hazard Adjustment — See *Structural Floodplain Management Measures* and *Nonstructural Floodplain Management Measures*.

Hazard Mitigation — Action taken to reduce or eliminate long-term risk to people and property from hazards such as floods, earthquakes, and fires.

Hazard Ranking System (HRS) — A method for ranking hazardous waste disposal sites for possible placement on the *National Priorities List (Superfund List)*, as provided for by the *Comprehensive, Environmental Response, Compensation, and Liability Act (CERCLA)*. The ranking uses information gathered by the preliminary assessment and site inspection and the listing site inspection. The need for remedial action is scored on the basis of potential harm to human health resulting from: (1) releases into groundwater, surface water, or the atmosphere; (2) fire and explosion; and/or (3) direct contact with hazardous materials. The HRS evaluation assigns an overall numerical value to each site, which determines its priority for cleanup. Also see *Hazardous Substance* and *Hazardous Substances Superfund*.

Hazardous Material (EPA) — A substance, pollutant or contaminant listed as hazardous under the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* of 1980, as amended, and the regulations promulgated pursuant to that act.

Hazardous Substance — (1) Any material that poses a threat to human health and/or the environment. Typical hazardous substances are toxic, corrosive, ignitable, explosive, or chemically reactive. (2) Any substance designated by the *U.S. Environmental Protection Agency (EPA)* to be reported if a designated quantity of the substance is spilled in the waters of the United States or if otherwise released into the environment. Also referred to as *Hazardous Waste*.

Hazardous Substances Superfund — A federal trust fund for use in the cleanup of spills or sites containing hazardous waste that pose a significant threat to the public health or the environment. The fund, originally called the *Hazardous Substances Response Trust Fund*, was established by the *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)* in 1980. Beginning that year \$1.5 billion was to be collected over five years, mainly from taxes on crude oil, petroleum products, petrochemicals, and certain inorganic chemicals. The 1986 re-authorization of the law, which changed the fund's name to the *Hazardous Substances Superfund* (or just "Superfund"), increased the fund to \$8.5 billion and broadened the tax base to include a general corporate Superfund tax. Another one-half billion dollars was included to clean up leaks from underground storage tanks. Also see *U.S. Environmental Protection Agency (EPA)*.

Hazardous Waste — Solid, liquid, or gaseous substances which because of their source or measurable characteristics, are classified under state or federal law as potentially dangerous and are subject to special handling, shipping, and disposal requirements. Also see *Hazardous Substance*.

Haze — Atmospheric moisture, dust, smoke, and vapor that diminishes visibility.

Head — Difference in elevation between intake and discharge points for a liquid. In geology, most commonly of interest in connection with the movement of underground water.

Head Cut — A break in slope at the top of a gully or section of gully that forms a “waterfall,” which in turn causes the underlying soil to erode and the gully to expand uphill.

Head Cutting — (1) The action of a bedscarp or headward erosion of a locally steep channel or gully. (2) A natural process of active erosion in a water channel caused by an abnormal and abrupt change in channel gradient. This change causes a “waterfall” action as water tumbles from the upper level vertically to the lower. The turbulence erodes the channel by undercutting the substrate material. This causes the collapse of the upper level (head). The “undercut-collapse” process advances up the channel whenever water is present or until bedrock is reached.

Head Ditch — The water supply ditch at the head end of an irrigated field.

Header — (1) A pipe that serves as a central connection for two or more smaller pipes. (2) A raised tank or hopper that maintains a constant pressure or supply to a system, especially the small tank that supplies water to a central heating system.

Headgate — The gate that controls water flow into irrigation canals and ditches; the control works or gate at the entrance to a canal or conduit system. A watermaster regulates the headgates during water distribution and posts headgate notices declaring official regulations. Headgate also refers to a diversion structure which controls the flow rate from a conveyance system (canals and laterals) into the farm conveyance system.

Headgate Entitlement — The amount of water (expressed in acre feet per year) to which a particular water right is entitled.

Headland — (1) A point of land, usually high and with a sheer drop, extending out into a body of water; a promontory. (2) The unplowed land at the end of a plowed furrow.

Head Loss — (1) The decrease in total head caused by friction. (2) The effect of obstructions, such as narrow bridge openings or buildings, that limit the area through which water must flow, raising the surface of the water upstream from the obstruction.

Headrace — A channel that carries water to a water wheel or turbine; a forebay.

Headslope — See *Sideslope*.

Head, Static — The height above a standard datum of the surface of a column of water (or other liquid) that can be supported by the static pressure at a given point. The static head is the sum of the *Elevation Head* and the *Pressure Head*.

Head, Total — The sum of the *Elevation Head* (distance of a point above datum), the *Pressure Head* (the height of a column of liquid that can be supported by static pressure only at the point), and the *Velocity Head* (the height to which the liquid can be raised by its own kinetic energy). Also see *Hydraulic Head*.

Head Wall — A steep slope or precipice rising at the head of a valley or glacial *Cirque*.

Headward Erosion — Erosion which occurs in the upstream end of the valley of a stream, causing it to lengthen its course in that direction.

Headwater(s) — (1) The source and upper reaches of a stream; also the upper reaches of a reservoir. (2) The water upstream from a structure or point on a stream. (3) The small streams that come together to form a river. Also may be thought of as any and all parts of a river basin except the mainstream river and main tributaries.

Headworks — The diversion structures at the head of a conduit.

Heap Leaching (Mining) — Heap leaching is a chemical process used to extract precious and other metals from vast amounts of earth and rock material. Tiny gold and silver particles dispersed throughout massive ore bodies can be economically recovered by leaching operations. However, due to the reactive nature of the chemicals used, environmental hazards may be created if care is not taken. Large quantities of naturally-occurring heavy metals and mineral salts are exposed and concentrated through this mining process. In the case of gold mining, a dilute cyanide solution is sprinkled over heaps of crushed rock, underlain by synthetic liners. The cyanide chemically bonds with the microscopic gold particles, which are then collected at the bottom of the heap in plastic liners for further processing. When the gold has been removed by this process, the heaps become a waste product requiring management and control well into the future. Heaps are typically full of residual dilute cyanide solution which, along with precipitation directly on the heap, will continue to drain through the heap. Because the heaps may contain residual cyanide, selenium, arsenic, mercury and various salts, the drainage solution may be hazardous to surface and groundwater supplies and the environment. Quite often, the least-costly manner in which to dispose

of this continuous heap drainage is through a leach field and into the ground, where it may have adverse effects on the quality of groundwater, potentially contaminating water supplies for agriculture, human consumption and wildlife.

Heat Budget, Annual (of a Lake) — The amount of heat necessary to raise the water from the minimum winter temperature to the maximum summer temperature.

Heat Exchangers — Any mechanical device designed to transfer heat energy from one medium to another. In many such exchangers water is used as the primary medium of transfer.

Heath — A tract of waste land; especially in Great Britain, an open, level area clothed with a characteristic vegetation consisting principally of undershrubs of the genus *Erica*, or a large genus of low evergreen shrubs. Also see *Peatland*.

Healthy Ecosystem — An *Ecosystem* in which structure and functions allow the desired maintenance over time of biological diversity, biotic integrity, and ecological processes.

Heat of Condensation — The heat released when a vapor changes state to a liquid. See *Heat of Vaporization*.

Heat of Vaporization — The heat energy (calories) required to convert one gram of liquid to vapor without a change in temperature of the substance which is being vaporized. For water at 100°C (212°F) and standard atmospheric pressure, the heat of vaporization is 540 calories per gram. Conversely, when a liquid condenses, it loses the heat absorbed upon vaporization, giving off *Heat of Condensation*.

Heat Pump — An apparatus for heating or cooling a building by transferring heat by mechanical means from or to a reservoir (as the ground, water, or air) outside the building.

Heat Sink — Any material used to absorb heat. In the environment, this is usually air or water that absorbs waste heat produced in the operation of electric power plants or other industrial facilities.

Heat Transfer Agent — A liquid or gas that functions in a *Heat Exchanger* to facilitate the movement of heat from one location to another. For example, the engine coolant in an automobile serves to transfer heat from the engine block to the atmosphere. Likewise, water facilitates the movement of heat from the reactor core to the outside of a nuclear reactor.

Heavy Metals — (1) Those metals that have high density; in agronomic usage these include copper, iron, manganese, molybdenum, cobalt, zinc, cadmium, mercury, nickel and lead. These substances are considered toxic at specified concentrations. (2) Metals having a specific gravity of 5.0 or greater; generally toxic in relatively low concentrations to plant and animal life and tend to accumulate in the food chain. Examples include lead, mercury, cadmium, chromium, and arsenic.

Heavy Water — Water composed of isotopes of hydrogen of atomic weight greater than 1 or of oxygen of atomic weight greater than 16, or both; especially water composed of ordinary oxygen and the isotope of hydrogen of atomic weight 2; *Deuterium Oxide* (D₂O). Typically used as a moderator in certain nuclear reactors. Also see *Heavy Water Moderated Reactor*.

Heavy Water (Moderated) Reactor — A nuclear reactor that uses heavy water as its moderator. Heavy water is an excellent moderator and thus permits the use of inexpensive (unenriched) uranium as a fuel.

Hectare — (Abbreviation ha) A metric unit of area equal to 100 *Ares* (2.471 acres) and equivalent to 10,000 square meters (107,639 square feet). Also see *Metric System*.

Hemihydrate — A hydrate in which the molecular ratio of water molecules to anhydrous compound is 1:2.

Hepatitis — Inflammation of the liver. A virus-caused disorder transmitted to humans by the consumption of raw oysters taken from water contaminated with sewage.

Hepatitis A — A form of hepatitis caused by an RNA virus that does not persist in the blood serum and is transmitted by ingestion of infected food and water. The disease has a shorter incubation and generally milder symptoms than *Hepatitis B*. Also referred to as *Infectious Hepatitis*.

Herbaceous — With the characteristics of an herb; having the texture and color of a foliage leaf; a plant with no persistent woody stem above ground.

Herbicide — Chemicals used to destroy undesirable plants and vegetation. Pre-emergent herbicides, applied to bare soil, prevent germination of weed seeds.

Herding Agent — A chemical applied to the surface of water to control the spread of a floating oil spill.

Heterogeneity — Characteristic of a medium in which material properties vary from point to point. Contrast with *Homogeneity*.

Heterotrophic — Pertains to a system in which respiratory demand exceeds *Photosynthesis*. In a heterotrophic system biological fertility is based upon past production, organic matter accumulation and material imported from other systems (e.g., *Allochthonous Material* falling from terrestrial systems into aquatic systems.)

Hierarchical — (Ecology) A description of *Ecosystems* referring to their nested and scale-dependent organization.

Higher Aquatic Plants — Those plants whose seeds germinate in the water phases or substrate of a body of water and which must spend part of their life cycle in water. Includes plants which grow completely submerged as well as a variety of emersed and floating leaf types.

“Highest and Best Use” — The classification of water based on an analysis of the greatest needs of the future. Certain quantities of water (rights) are reserved for appropriation according to this classification.

Highest Annual Mean — A value used for river flow readings representing the highest total annual volume (in acre-feet per year) and the corresponding highest annual average rate of flow (in cubic feet per second) recorded at a specific gaging station location over a specific period of record. Also referred to as the *High Water Year*.

High-Grading — (Ecology) A harvesting practice in which the most valuable trees are removed with little provision for regeneration or subsequent entries.

High-Line Jumpers — Pipes or hoses connected to fire hydrants and laid on top of the ground to provide emergency water service for an isolated portion of a distribution system.

High Sea — The open part of a sea or ocean, especially outside territorial waters; usually used in plural.

High Tide (HT) — (1) The tide at its fullest extent, when the water reaches its highest level. (2) The time at which this tide occurs. The high-high and low-high tides are the higher and lower of the two high tides, respectively, of each tidal day.

High Water (HW) — (1) High tide. (2) The state of a body of water that has reached its highest level.

High Water Mark (HWM) — A mark indicating the highest level reached by a body of water.

Historical Geomorphology — See *Geomorphology, Historical*.

Historic Variability — (Ecology) The variation in spatial, structural, compositional, and temporal characteristics of ecosystem elements during a reference period prior to intensive resource use and management. In the Southwest United States, this reference period is typically considered the recent climatic and ecological era before the territorial period (resource use and management by native and Hispanic cultures are integrated with other ecological process).

Histosols — Organic soils.

Hoarfrost — A silvery-white deposit of ice needles formed by direct condensation at temperatures below freezing due to nocturnal radiation. Hoarfrost forms during still, clear nights, is small in amount, needlelike in texture, the “needles” approximately perpendicular to the objects on which they occur, and most abundant along the edges. Sometimes confused with *Rime*.

Hogback Ridge — Any ridge with a sharp summit and steep slopes of nearly equal inclination on both flanks, and resembling in outline the back of a hog.

Hogshead — Any of various units of volume or capacity ranging from 63 to 140 gallons (238 to 530 liters), especially a unit of capacity used in liquid measure in the United States equal to 63 gallons (238 liters).

Holding Medium — (Water Quality) A special fluid employed for maintaining fecal bacteria in a viable state between the time that water samples are processed by filtration and the time that the filters used to remove the bacteria from water can be incubated properly. The medium protects viability between sampling and analysis.

Holding Pond — A small basin or pond designed to hold sediment laden or contaminated water until it can be treated to meet water quality standards or be used in some other way.

Holding Tank — A prefabricated structure of concrete or steel or like materials constructed to store liquid manure from animals.

Holding Time — (Water Quality) The time allowed between removal of samples from water sources for bacteriological analysis and the processing of those samples.

Hole — A deep place in a body of water.

Holistic — Of, concerned with, or dealing with wholes or integrated systems rather than with their parts. With respect to water-related issues, the term most typically describes an analytical and planning approach which examines and considers the inter-related linkages and interdependencies of a socioeconomic system with resource use, pollution, environmental impacts, and preservation of an entire ecosystem.

Holocene — (Geology) The present epoch of time, beginning about 10,000 years ago. Also see *Quaternary*.

Holothurian — A group of marine, bottom-dwelling animals related to the sea stars and sand dollars (echinoderms). Unlike these relatives, the holothurians have soft bodies and are long and slender in shape, such as the sea cucumber.

Homeostasis — (Ecology) The maintenance of a steady state by use of feedback control processes. In homeostatic systems, a change outside the normal range is seen as a decline in the health of that system.

Homeowner Water System — Any water system which supplies piped water to a single residence.

Homogeneity — Characteristic of a medium in which material properties are identical throughout. A material is

homogeneous if its hydrologic properties are everywhere identical. Although no known aquifer is homogeneous in detail, models based on the assumption of homogeneity have proven to be valuable tools for predicting the approximate relationship in aquifers between discharge and potential. Contrast with *Heterogeneity*

Hookah — An Eastern smoking pipe designed with a long tube passing through an urn of water that cools the smoke as it is drawn through. Also referred to as a *Hubble-Bubble* and *Narghile*.

Hook Gage — A pointed, U-shaped hook attached to a staff or vernier scale, used in the accurate measurement of the elevation of a water surface. The hook is submerged, and then raised, usually by means of a screw, until the point just makes a pimple on the water surface.

Horizontal and Vertical Control Points — See *Control Points (Horizontal and Vertical)*.

Horn — A body of land or water shaped like a horn.

Horsepower (HP) — A unit of power, numerically equal to a rate of 33,000 foot-pounds of work per minute (or 550 foot-pounds per second), used in stating the power of an engine or any other prime mover, or in estimating the power required to drive machinery, or the like. The term horsepower was originated by Boulton and Watt to state the power of their steam engines. In a practical test it was found that the average horse could work constantly at a rate of 22,000 foot-pounds per minute. This was increased by one half (50 percent) in making this arbitrary, and now universal, unit of power. *Electrical Horsepower* is horsepower calculated from electric units whereby 746 watts of electrical energy is equivalent to one horsepower.

Horsepower, Electrical — Horsepower calculated from electric units whereby 746 watts of electrical energy is equivalent to one horsepower.

Hose — (1) A flexible tube for conveying liquids or gases under pressure. (2) To water, drench, or wash with a hose.

Hot Rock Reservoir — A potential source of geothermal power. The “hot rock” system requires drilling deep enough to reach heated rock, then fracturing it to create a reservoir into which water can be pumped. This technique has not yet been perfected.

Hot Spring — A spring that brings hot water to the surface. A thermal spring. Water temperature usually 15°F (8°C) or more above the mean air temperature.

Hovercraft — A vehicle that is supported above the surface of land or water by a cushion of air produced by downwardly directed fans.

Human Dimension — (Ecology) An integral component of *Ecosystem Management* that recognizes people are part of *Ecosystems*; that people’s pursuits of past, present, and future desires, needs, and values (including perceptions, beliefs, attitudes, and behaviors) have and will continue to influence ecosystems; and that ecosystem management must include consideration of the physical, emotional, mental, spiritual, social, cultural, and economic well-being of people and communities.

Human Ecology — (1) A branch of sociology dealing particularly with the spatial and temporal interrelationships between humans and their economic, social, and political organization; (2) The ecology of human communities and populations, especially as concerned with preservation of environmental quality (as of air or water) through proper application of conservation and civil engineering practices.

Human Environment — Natural and physical environment and the relationship of people with that environment including physical, biological, cultural, social, and economic factors in a given area.

Humid — Containing or characterized by perceptible moisture. Usually refers to the atmosphere.

Humidity — The degree of moisture in the air.

Humidor — (1) A device used to create moistened air for the storage of tobacco products. (2) A jar, case, room or storage area using such a device where tobacco products are stored.

Hummock — (1) A small but steep, irregular hill rising above the general level of the surrounding land; a low mound or ridge of earth, a knoll. (2) Also *Hammock*. A tract of forested land that rises above an adjacent marsh in the southern United States. (3) A ridge or hill of ice in an *Ice Field*.

Hummocky — Hilly, uneven landscape resulting from deep-seated soil movement, usually of a rotational nature.

Humus — (1) Organic materials resulting from decay of plant or animal matter. (2) A brown or black organic substance consisting of partially or wholly decayed vegetable or animal matter that provides nutrients for plants and increases the ability of soil to retain water. Also referred to as *Compost*.

Hundred-Year Flood — The magnitude of a flood which has one chance in one hundred (i.e., one percent) of occurring in any one-year period. As the occurrence of floods is random in time, there is no guarantee that there will not be two one hundred-year floods within a given year, or that there will be one such flood within a given century (100 years). The boundary of the one hundred-year flood zone is used by the *Federal Emergency Management Agency (FEMA)* to designate *Special Flood Hazard Areas*. These areas are plotted on *Flood Insurance Rate Maps (FIRMs)*, which are used in determining the flood risk to structures in the *Flood Plain* for

flood insurance purposes. Also see *X-Year Flood*.

Hungry Water — Clear water minus its expected suspended sediment, usually released from an impoundment that has excess energy, which erodes sediment from the downstream channel.

Hurricane — (1) A severe tropical cyclone originating in the equatorial regions of the Atlantic Ocean or Caribbean Sea, traveling north, northwest, or northeast from its point of origin, and usually involving heavy rains. (2) A wind with a speed greater than 74 miles (119 kilometers) per hour, according to the Beaufort scale. Also see *Cyclone* and *Typhoon*.

Hurricane Forecasting — (Meteorology and Statistics) Hurricane tracking and estimation in the United States is centered in the federal government’s National Hurricane Center in Coral Gables, Florida. However, one pioneering effort in the application of statistical analysis and econometric techniques to hurricane analysis and forecasting has been undertaken by William Gray, professor of meteorology at Colorado State University in Fort Collins, Colorado. Dr. Gray’s research is based on the foundation that hurricanes are caused by global, rather than local factors, to include the influence of *El Niño* (*El Niño Effect*, resulting in reduced hurricane activity as opposed to the *La Niña* when hurricanes tend to be more common) in the eastern equatorial Pacific Ocean as well as wind directions (pressure differentials) and precipitation levels. His research has led to an extensive quantitative expression to estimate both the number and intensity of hurricanes in the western Atlantic region (to include the Caribbean and Gulf of Mexico) during the usual peak hurricane season of mid-August through mid-October. The following relationship represents an *Econometric Model* for forecasting hurricane activity based upon a number of climatological explanatory factors covering a vast geographic range.

Hurricane Activity =

$$\begin{aligned} &\hat{a}_0 + \hat{a}_1(\hat{a}_1U_{50} + \hat{a}_2U_{30} + \hat{a}_3|U_{50} - U_{30}|) \\ &+ \hat{a}_2(\hat{a}_4R_s + \hat{a}_5R_g + \hat{a}_6\ddot{A}_xP + \hat{a}_7\ddot{A}_xT) \\ &+ \hat{a}_3(\hat{a}_8SLPA + \hat{a}_9ZWA + \hat{a}_{10}SST + \hat{a}_{11}\ddot{A}_4SST + \hat{a}_{12}SOI + \hat{a}_{13}\ddot{A}_4SOI) \end{aligned}$$

where:

- The \hat{a} 's and \hat{a} 's are empirically derived coefficients (parameters) for prior years of data;
- U_{50} and U_{30} are extrapolated September quasi-biennial oscillation (QBO — the tendency for equatorial winds 13 to 16 miles above the earth to change direction from east to west and vice versa) zonal winds at 30 and 50 mb at 10°N latitude;
- $|U_{50} - U_{30}|$ is the absolute value of the extrapolated vertical wind shear between 50 and 30 mb;
- R_s is the western Sahel (western portion of Africa’s Sahara desert) precipitation in the previous August and September;
- R_g is the previous year August to November precipitation in the Gulf and Guinea region;
- \ddot{A}_xP is West African anomalous east-west pressure gradient deviation in February through May;
- \ddot{A}_xT is West African anomalous west-east temperature deviation in February through May;
- $SLPA$ is the April–May Sea Level Pressure Anomaly in the lower Caribbean basin;
- ZWA is the April–May Zonal Wind Anomaly in the Caribbean basin;
- SOI is the April–May normalized Tahiti minus Darwin Sea Level Pressure differences;
- $SSTA$ is the April–May Sea Surface Temperature Anomaly in Nino 3 (*El Niño*);
- \ddot{A}_4SOI is the recent months change in SOI from January–February to April–May;
- \ddot{A}_4SSTA is the recent months change in SSTA from January–February to April–May.

Husbandry — (Agriculture) The act or practice of cultivating crops and breeding and raising livestock. Also, the application of scientific principles to agriculture, especially to animal breeding. (Ecology) The careful management or conservation of resources.

Hyades — (Astronomy) A cluster of stars in the constellation Taurus, the five brightest of which form a V, supposed by ancient astronomers to indicate rain when they rose with the sun.

Hybrid System — A popular term for a system of water allocation incorporating both the *Doctrine of Prior Appropriation* and the *Riparian Doctrine*.

Hydathode — (Botany) A water-excreting microscopic epidermal structure in many plants.

Hydrant — A discharge pipe with a valve and spout at which water may be drawn from a water main (as for fighting fires) called also fireplug; (2) Faucet.

Hydrate — A solid compound containing water molecules combined in a definite ratio as an integral part of the crystal.

Hydrated — Chemically combined with water, especially existing in the form of a *Hydrate*.

Hydration — The chemical combination of water with another substance.

Hydraulic — (1) Of, involving, moved by, or operated by a fluid, especially water, under pressure. (2) Able to set and harden under water, as Portland cement. (3) Of or relating to hydraulics.

Hydraulic Barrier — (1) Modifications to a ground-water flow system that restrict or impede movement of water and contaminants. (2) Also, a barrier developed in the *Estuary* by the release of fresh water from upstream reservoirs to prevent intrusion of sea water into the body of fresh water. (3) A barrier created by injecting fresh water to control seawater intrusion in an aquifer, or created by water injection to control migration of contaminants in an aquifer.

Hydraulic Conductivity (\hat{E}) — Simply, a coefficient of proportionality describing the rate at which water can move through an aquifer or other permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity. More specifically, the volume of water at the existing kinematic viscosity that will move, in unit time, under a unit *Hydraulic Gradient* through a unit area measured at right angles to the direction of flow, assuming the medium is isotropic and the fluid is homogeneous. In the Standard International System, the units are cubic meters per day per square meter of medium ($\text{m}^3/\text{day}/\text{m}^2$) or m/day (for unit measures).

Hydraulic Conductivity, Effective — The rate of water flow through a porous medium that contains more than one fluid (such as water and air in the unsaturated zone), which should be specified in terms of both the fluid type and content and the existing pressure.

Hydraulic Earthfill Dam — An embankment built up from waterborne clay, sand, and gravel carried through a pipe or flume.

Hydraulic Fracturing — Any technique involving the pumping of fluid under high pressure into an oil or gas formation to create fissures and openings in the reservoir rock and increase the flow of oil or gas.

Hydraulic Geometry — The interrelations between width, depth, velocity, and suspended load of a channel system and how these factors vary with discharge. These relations can be considered at a given station with varying discharge (at-a-station hydraulic geometry), or across many stations whose discharges are indexed at a fixed recurrence interval (downstream hydraulic geometry).

Hydraulic Grade Line (HGL) — A line whose plotted ordinate position represents the sum of pressure head plus elevation head for the various positions along a given fluid flow path, such as a pipeline or ground-water streamline.

Hydraulic Gradient (I) — (1) The slope of the water surface. (2) The gradient or slope of a water table or *Piezometric Surface* in the direction of the greatest slope, generally expressed in feet per mile or feet per feet. Specifically, the change in static head per unit of distance in a given direction, generally the direction of the maximum rate of decrease in head. The difference in hydraulic heads ($h_1 - h_2$), divided by the distance (L) along the flowpath, or, expressed in percentage terms:

$$I = (h_1 - h_2) / L \times 100$$

A hydraulic gradient of 100 percent means a one foot drop in head in one foot of flow distance.

Hydraulic Gradient Pivot Point — A location along the water surface in a canal reach where the water level remains essentially constant during changes in flow.

Hydraulic Head — (1) The height of the free surface of a body of water above a given point beneath the surface. (2) The height of the water level at the headworks or an upstream point of a waterway, and the water surface at a given point downstream. (3) The height of a hydraulic grade line above the center line of a pressure pipe, at a given point.

Hydraulic Jump — The rapid change in the depth of flow from a low stage to a high stage, resulting in an abrupt rise of water surface.

Hydraulic Loading — (Water Quality) For a sand filter wastewater treatment unit, the volume of wastewater applied to the surface of the filtering medium per time period. The loading is often expressed in gallons per day per square foot (gpd/ft^2), or cubic meters per square meter per day ($\text{m}^3/\text{m}^2\text{d}$).

Hydraulic Mining — Mining by washing sand and dirt away with water, leaving the desired mineral.

Hydraulic Permeability — The flow of water through a unit cross-sectional area of soil normal to the direction of flow when the *Hydraulic Gradient* is unity.

Hydraulic Radius — (1) Cross-sectional area divided by the wetter perimeter. (2) The cross-sectional area of a stream of water divided by the length of that part of its periphery in contact with its containing conduit; the ratio of area to wetted perimeter. Also referred to as *Hydraulic Mean Depth*.

Hydraulic Ram — A device which uses the energy of falling water to force a small portion of the water to a height greater than the source. A water pump in which the downward flow of naturally running water is intermittently halted by a valve so that the flow is forced upward through an open pipe into a reservoir.

Hydraulics — (1) Water in motion. (2) The study of liquids, particularly water, under all conditions of rest and motion. (3) The branch of physics having to do with the mechanical properties of water and other liquids in motion and with the application of these properties in engineering.

Hydraulic Transient — (1) Interim stage when a flow changes from one steady-state condition to another steady-state condition because of a sudden acceleration or deceleration of flow. (2) A wave or pressure change propagated through a canal or pipeline during unsteady flow.

Hydric — Characterized by, relating to, or requiring an abundance of moisture; referring to a habitat characterized by wet or moist conditions rather than *Mesic* (moderate moisture conditions) or *Xeric* (dry conditions).

Hydric Soil — A soil that, in its undrained condition, is saturated, flooded, or ponded long enough during the growing season to develop *Anaerobic* conditions that favor the growth and regeneration of hydrophytic vegetation (*Hydrophytes*).

Hydrilla — An exotic (nonnative) aquatic weed, hydrilla (*Hydrilla verticillata*) has come to represent a serious threat to lakes, reservoirs, streams and canals in the United States. A native of Asia, Africa, and Australia, hydrilla is part of a group of rooted aquatic plants well adapted to growth under water. Hydrilla was first introduced to the U.S. in Florida during the 1950s, probably for use in aquariums. Hydrilla is capable of prodigious growth, expanding from a few acres to several thousand acres in two to three years. Due to its ability to photosynthesize under very low light conditions, hydrilla becomes easily established in turbid waters and at greater depths than other aquatic plants. Most populations in the U.S. comprise *dioecious* female plants; reproduction is asexual, including fragmentation and the formation of hardy, long-lived *propagules*, called turions or tubers, which form deep in the sediment and remain viable for as long as ten years. Once hydrilla has invaded a site, the diversity of other rooted, submersed aquatic plants plummets, resulting in monospecific stands of hydrilla and loss of biodiversity. At its peak population, hydrilla has reduced water flows in canal systems by up to 80 percent and in small, standing-water impoundments, such as lakes and ponds, hydrilla can often completely cover the water surface within two to three years.

Hydro — The prefix denoting water or hydrogen.

Hydrobiology — The biological study of bodies of water, especially studies by *Limnology Hydrobiologist*.

Hydrocarbons — Chemical compounds that consist entirely of carbon and hydrogen, such as petroleum, natural gas, and coal.

Hydrocolloid — A substance that forms a gel with water.

Hydrocompaction — The settling and hardening of land due to application of large amounts of water for irrigation.

Hydrodynamic Dispersion — (1) Spreading (at the macroscopic level) of the solute front during transport resulting from both mechanical dispersion and molecular diffusion. (2) The process by which ground water containing a solute is diluted with uncontaminated ground water as it moves through an aquifer. Also see *Dispersion Coefficient*.

Hydrodynamic Force — The force exerted by moving water. Contrast with *Hydrostatic Force*.

Hydrodynamic Loads — Forces imposed on structures by floodwaters due other impacts of moving water on the upstream side of the structure, drag along its sides, and eddies or negative pressures on its downstream side.

Hydrodynamics — The branch of science that deals with the dynamics of fluids, especially incompressible fluids, in motion.

Hydroelectric — Having to do with production of electricity by water power from falling water.

Hydroelectric Plant (Conventional) — A hydroelectric power plant which utilizes streamflow only once as the water passes downstream; electric power plant in which the energy of falling water is used to spin a turbine generator to produce electricity..

Hydroelectric Plant (Pumped Storage) — A hydroelectric power plant which generates electric power during peak load periods by using water pumped into a storage reservoir during off-peak periods.

Hydroelectric Power — Power (hydroelectricity) produced using water power as a source of energy. Electrical energy generated by means of a power generator coupled to a turbine through which water passes.

Hydroelectric Power Water Use (Withdrawals) — The use of water in the generation of electricity at plants where the turbine generators are driven by falling water. This constitutes an *Instream Use* of water and is a nonconsumptive use of water. The terms “water use” and “water withdrawals” are equivalent, but not the same as *Consumptive Use* as they do not account for return flows.

Hydroelectricity — Electric energy production by water powered turbine generators.

- Hydrofoil** — (Nautical) (1) A wing-like structure attached to the hull of a boat that raises all or part of the hull out of the water when the boat is moving forward, thus reducing drag. (2) A boat equipped with hydrofoils. In this sense, also referred to as a *Hydroplane*.
- Hydrogen** — (Chemical symbol H) An element commonly isolated as a colorless, tasteless, odorless gas, inflammable (burning with a hot, almost nonluminous flame to form water), and lighter than any other known substance. Free hydrogen occurs only very sparingly on the earth, though it is abundant in the atmospheres of the sun and many stars. Hydrogen is combined with *Oxygen in Water* (H₂O), of which it constitutes 11.188 per cent by weight. It is also a constituent of most organic compounds, of acids and bases. Ordinary hydrogen gas is diatomic (its molecules consisting of two atoms, H₂), but dissociates into free atoms at high temperatures. The hydrogen atom is the simplest of all atoms, the ordinary isotope (H¹) consisting of a single proton and a single valence electron. It is accompanied by a minute amount of a heavier isotope called Deuterium (H² or D) which is used in *Heavy Water* (D₂O). Atomic number 1; atomic weight 1.00797; melting point -259.14°C (-434.45°F); boiling point -252.8°C (-423.04°F); density at 0°C (32°F) 0.08987 gram per liter.
- Hydrogen Bond** — A type of chemical bond caused by electromagnetic forces, occurring when the positive pole of one molecule (e.g., water) is attracted to and forms a bond with the negative pole of another molecule (e.g., another water molecule).
- Hydrogen Sulfide (Gas)** — Chemical symbol H₂S, hydrogen sulfide is produced naturally by the *Anaerobic Decomposition* of any type of organic or inorganic matter that contains sulfur, e.g., rotting eggs, wallboard decomposition in landfills, the formation of natural gas from decomposing plant life, sulfate decomposition in sewers, etc. However produced, hydrogen sulfide presents severe health and corrosion hazards as well as being an odor nuisance. Few gases are as potent as hydrogen sulfide to the human olfactory senses. The human nose can detect the rotten egg odor at a level of only 0.4 parts per billion (ppb); few other compounds can be detected at such low levels of concentration.
- Hydrogeologic** — Those factors that deal with subsurface waters and related geologic aspects of surface waters.
- Hydrogeologic Parameters** — Numerical parameters that describe the hydrogeologic characteristics of an aquifer such as *Porosity*, *Permeability*, and *Transmissivity*.
- Hydrogeologic Unit** — Any soil or rock unit or zone that because of its hydraulic properties has a distinct influence on the storage or movement of ground water.
- Hydrogeological Cycle** — The natural process recycling water from the atmosphere down to (and through) the earth and back to the atmosphere again. Also see *Hydrologic Cycle*.
- Hydrogeology** — The part of geology concerned with the functions of water in modifying the earth, especially by erosion and deposition; geology of ground water, with particular emphasis on the chemistry and movement of water.
- Hydrogeomorphic Unit** — A land form characterized by a specific origin, geomorphic setting, water source, and hydrodynamic.
- Hydroglider** — A hydroplane.
- Hydrognosy** — The history and description of the waters of the earth.
- Hydrograph** — (1) A graphic representation or plot of changes in the flow of water or in the elevation of water level plotted against time. (2) The trace of stage (height) or discharge of a stream over time, sometimes restricted to the short period during storm flow. (3) A graph showing stage, flow, velocity, or other hydraulic properties of water with respect to time for a particular point on a stream. Hydrographs of wells show the changes in water levels during the period of observation.
- Hydrographic** — (1) Of or pertaining to hydrography as in the description and study of seas, lakes, rivers, and other waters.
- Hydrographic Apex** — The highest point on an *Alluvial Fan* where flow is last confined.
- Hydrographic Area** — In its most general sense, may refer to an defined geographic area, sub-area, sub-basin, basin, region or watershed encompassing the drainage area or catchment area of a stream, its tributaries, or a portion thereof. Typically defined as a study area for analysis or planning purposes in which the land or undersea contours results in surface water flows or measures of elevation draining to a single point. At its smallest extent, a hydrographic area may encompass a single valley containing a single stream system, or a portion of a valley or stream system with distinctive drainage characteristics. At its greatest extent, a hydrographic area may encompass the entire drainage area of a major river system, e.g., the Mississippi River hydrographic area, including all tributary rivers, streams and other sources of surface water flow. Conventionally, a number of hydrographic sub-areas comprise a hydrographic area whereas a number of hydrographic areas comprise a hydrographic basin or region.

Hydrographic Area [Nevada] — The 232 subdivisions (256 *Hydrographic Areas* and *Hydrographic Sub-Areas*) of the 14 Nevada *Hydrographic Regions* as defined by the State Engineer's Office, Department of Conservation and Natural Resources, Division of Water Resources. Primarily these are sub-drainage systems within the 14 major drainage basins. Hydrographic areas (valleys) may be further subdivided into hydrographic sub-areas based on unique hydrologic characteristics (e.g., differences in surface flows) within a given valley or area. [A listing of Nevada's Hydrographic Regions, Areas and Sub-Areas is presented in Appendix A-1 (hydrographic regions, areas and sub-areas), Appendix A-2 (listed sequentially by area number) Appendix A-3 (listed alphabetically by area name), and Appendix A-4 (listed alphabetically by principal Nevada county(ies) in which located).]

Hydrographic Region [Nevada] — Nevada has been divided into 14 hydrographic regions or basins, which are now used by the Nevada Division of Water Resources, Department of Conservation and Natural Resources, and the U.S. Geological Survey (USGS) to compile information pertaining to water resources and water use. These regions are also further subdivided into 232 *Hydrographic Areas* (256 Hydrographic Areas and Sub-Areas, combined) for more detailed study. See *Basins [Nevada]*, for a complete listing and description of Nevada's 14 Hydrographic Regions.

Hydrographic Study Area — An area of hydrological and climatological similarity so subdivided for study purposes.

Hydrographic Survey — An instrumental survey to measure and determine characteristics of streams and other bodies of water within an area, including such things as location, areal extent, and depth of water in lakes or the ocean, the width, depth, and course of streams; position and elevation of high water marks; location and depth of wells.

Hydrography — (1) The study, description, and mapping of oceans, lakes, and rivers, especially with reference to their navigational and commercial uses. Specifically includes the measurement of flow and investigation of the behavior of streams, especially with reference to the control or utilization of their waters, as well as the surveying, sounding, and charting of water bodies. (2) That branch of surveying which embraces the determination of the contour of the bottom of a harbor or other sheet of water, the dept of soundings, the position of channels and shoals, with the construction of charts exhibiting these particulars.

Hydrokinetics — The branch of physics having to do with fluids in motion.

Hydrologic — Of or pertaining to hydrology, that is the science dealing with water, its properties, phenomena, and distribution over the earth's surface.

Hydrologic Alteration — Modification of the amount or movement of water through an ecosystem. This includes drainage of wetlands, dams, levees, aquifer mining, reservoirs, and channelization of rivers and streams.

Hydrologic Balance — An accounting of all water inflows to, water outflows from, and changes in water storage within a hydrologic unit over a specified period of time.

Hydrologic Basin — The complete drainage area upstream from a given point on a stream.

Hydrologic Benchmark — A hydrologic unit, such as a basin or a ground-water body, that because of its expected freedom from the effects of man, has been designated as a benchmark. Data from such basins may provide a standard with which data from less independent basins can be compared so that changes wrought by man's interference can be distinguished from changes caused by variations in the natural regimen.

Hydrologic Benchmark Station — A station that provides hydrologic data for a basin in which the hydrologic regimen will likely be governed solely by natural conditions. Data collected at a benchmark station may be used to separate effects of natural from human-induced changes in other basins that have been developed and in which the physiography, climate, and geology are similar to those in the undeveloped benchmark basin..

Hydrologic Budget — An accounting of the inflow, outflow, and storage in a hydrologic unit, such as a drainage basin, aquifer, soil zone, lake, reservoir, or irrigation project.

Hydrologic Condition — The runoff potential of a particular cropping practice. A crop under good hydrologic condition will have a higher infiltration rate and lower runoff potential than one under poor conditions.

Hydrologic Cycle — (1) The cycling of water from the atmosphere, onto and through the landscape and eventually back into the atmosphere. (2) The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transportation. Also referred to as the *Water Cycle* and *Hydrogeologic Cycle*.

Hydrologic Equation — The water inventory equation: $\text{Inflow} = [\text{Outflow} + \Delta \text{Storage}]$, which balances the *Hydrologic Budget* and expresses the basic principle that during a given time interval the total inflow to an area must equal the total outflow plus the net change in storage.

Hydrologic Equilibrium — An expression of the law of mass conservation for water budgets in which inflows equal outflows, corrected for changes in storage.

Hydrologic Model — Mathematical formulations that simulate hydrologic phenomenon considered as processes or as systems.

Hydrologic Processes — Physical operation or series of operations that result in movement of water within a

hydrologic system.

Hydrologic Region — A study area, consisting of one or more planning subareas, used to analyze water use and hydrologic conditions. Typically such areas are based on *Watersheds*.

Hydrologic Regions [California] — For water planning and conservation purposes, the California *Department of Water Resources (DWR)* and the *State Water Resources Control Board (SWRCB)* have divided the state into 10 *Hydrologic Regions*, also referred to as a *Hydrologic Study Area (HSA)*, and are based on the *Watershed* or *Water Basin* concept. These California HSAs include:

- [1] **North Coast Region** — Comprises all of the California area tributary to the ocean from the mouth of Tomales Bay north to the Oregon border and east along the border to a point near Goose Lake, consisting of 19,590 square miles (12 percent of the state's total area), 571,750 persons (1.9 percent of the state's total population — all populations as of 1990), with average annual precipitation of 53 inches (range: 15 to over 100 inches), and average annual runoff of 28,886,000 acre-feet (40.8 percent of total state runoff);
- [2] **San Francisco Bay Region** — Extends from Pescadero Creek in southern San Mateo County to the mouth of Tomales Bay in the north and inland to the confluence of the Sacramento and San Joaquin rivers near Collinsville, consisting of 4,400 square miles (3 percent of the state's total area), 5,484,000 persons (18 percent of the state's total population), with average annual precipitation of 31 inches (range: 14 to almost 48 inches), and average annual runoff of 1,245,500 acre-feet (1.8 percent of total state runoff);
- [3] **Central Coast Region** — Encompasses the area adjacent to the Pacific Ocean including Santa Cruz County in the north through Santa Barbara County in the south to the Diablo and Temblor mountain ranges on the east, consisting of 11,280 square miles (7 percent of the state's total area), 1,292,900 persons (4 percent of the state's total population), with average annual precipitation of 20 inches (range: 14 to 45 inches), and average annual runoff of 2,477,000 acre-feet (3.5 percent of total state runoff);
- [4] **South Coast Region** — Extending eastward from the Pacific Ocean, the region is bounded by the Santa Barbara–Ventura county line and the San Gabriel and San Bernardino mountains on the north, the Mexican border on the south, and a combination of the San Jacinto Mountains and low-elevation mountain ranges in central San Diego County on the east, consisting of 10,950 square miles (7 percent of the state's total area), 16,292,800 persons (54 percent of the state's total population), with average annual precipitation of 18.5 inches (range: 10 to 45 inches), and average annual runoff of 1,227,000 acre-feet (1.7 percent of total state runoff);
- [5] **Sacramento River Region** — Contains the entire drainage area of the Sacramento River and its tributaries and extends almost 300 miles from Collinsville in the Sacramento–San Joaquin Delta north to the Oregon border to the crest of the Sierra Nevada and Cascade Ranges which form the eastern border to the crest of the Coast Range forming the western side, consisting of 26,960 square miles (17 percent of the state's total area), 2,208,900 persons (7 percent of the state's total population), with average annual precipitation of 36 inches (range: 10 to 80 inches), and average annual runoff of 22,389,700 acre-feet (31.6 percent of total state runoff);
- [6] **San Joaquin River Region** — Located in the heart of California bordered on the east by the crest of the Sierra Nevada and on the west by the coastal mountains of the Diablo Range, extending from the Delta and the Cosumnes River drainage south to include all of the San Joaquin River watershed, consisting of 15,950 square miles (10 percent of the state's total area), 1,430,200 persons (5 percent of the state's total population), with average annual precipitation of 13 inches (range: 9 to 35 inches), and average annual runoff of 7,933,300 acre-feet (11.2 percent of total state runoff);
- [7] **Tulare Lake Region** — Including the southern San Joaquin Valley from the southern limit of the San Joaquin River watershed to the crest of the Tehachapi Mountains, stretching from the Sierra Nevada Crest in the east to the Coast Range in the west, consisting of 16,520 square miles (10 percent of the state's total area), 1,554,000 persons (5 percent of the state's total population), with average annual precipitation of 14 inches, and an average annual runoff of 3,313,500 acre-feet (4.7 percent of total state runoff);
- [8] **North Lahontan Region** — Comprises the eastern drainages of the Cascade Range and the eastern Sierra Nevada, north of the Mono Lake drainage, consisting of 3,890 square miles (less than 3 percent of the state's total area), 78,000 persons (less than 0.3 percent of the state's total population), with average annual precipitation of 32 inches (range: 4 to 70 inches), and average annual runoff of 1,842,000 acre-feet (2.6 percent of total state runoff);

- [9] **South Lahontan Region** — Encompassing the area from the mountain divide north of Mono Lake to the divide south of the Mojave River, which runs through the Mojave Desert, bordered on the east by the Nevada state line and on the west by the crest of the Sierra Nevada, consisting of 29,020 square miles (18 percent of the state's total area), 599,900 persons (2 percent of the state's total population), with average annual precipitation of 8 inches (range: 4 to 10 inches, with extremes of 1.9 inches in Death Valley and over 120 inches at Mammoth Lakes), and an average annual runoff of 1,334,000 acre-feet (1.9 percent of total state runoff);
- [10] **Colorado River Region** — Encompassing the southeastern corner of California with the region's northern boundary, a drainage divide, beginning along the southern edge of the Mojave River watershed in the Victor Valley area of San Bernardino County and extending northeast across the Mojave Desert to the Nevada state line. The southern boundary is the Mexican border while a drainage divide forms the jagged western boundary through the San Bernardino, San Jacinto, and Santa Rosa mountains and the Peninsular ranges and the Nevada state line and the Colorado River form the region's eastern boundary, consisting of 19,730 square miles (12 percent of the state's total area), 464,200 persons (less than 2 percent of the state's total population), with average annual precipitation of 5.5 inches (range: 3 to 36 inches), and an average annual runoff of 178,700 acre-feet (less than 0.3 percent of total state runoff);

Hydrologic Soil Groups — The classification of soils by their reference to the intake rate of infiltration of water, which is influenced by texture, organic matter content, stability of the soil aggregates, and soil horizon development.

Hydrologic Study Approach — The study of a project's water distribution based upon a hydrological balance, where inflow (diversion into project) is balanced with outflow (precautionary drawdowns, crop consumptive use, deep seepage, surface return flows, and undefined "losses").

Hydrologic Study Area (HSA) — See *Hydrologic Regions [California]*.

Hydrologic System — A complex structure of related parts – physical, conceptual, or both – forming an orderly working body of hydrologic units and interacting hydrologic processes.

Hydrologic Unit — (1) A geographic area representing part or all of a surface drainage basin or distinct hydrologic feature. (2) (USGS) A geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as defined by the former Office of Water Data Coordination and delineated on the State Hydrologic Unit Maps by the U.S. Geological Survey. Each hydrologic unit is identified by an 8-digit number. (3) A classification of soils concerning water infiltration characteristics used in hydrologic analyses. See *Hydrologic Unit Maps*.

Hydrologic Unit Maps [USGS] — A set of maps developed by the U.S. Geological Survey (USGS) that present information on drainage, culture, hydrography, and hydrologic boundaries and codes of (1) the 21 major water-resources regions and the 222 subregions designated by the U.S. Water Resources Council, (2) the 352 accounting units of the U.S. Geological Survey's National Water Data Network, and (3) the 2,149 cataloging units of the U.S. Geological Survey's "Catalog of Information on Water Data." The hydrologic unit map series was initiated in the fall of 1972 by the U.S. Geological Survey's Office of Water Data Coordination, in cooperation with the U.S. Water Resources Council and supported by the U.S. Geological Survey's Resources and Land Information program. These maps and associated codes provide a standardized base for use by water-resources organizations in locating, storing, retrieving, and exchanging hydrologic data, in indexing and inventorying hydrologic data and information, in cataloging water-data acquisition activities, and in a variety of other applications. Because the maps have undergone extensive review by all principal federal, regional and state water-resource agencies, they are widely accepted for use in planning and describing water-use and related land-use activities, and in geographically organizing hydrologic data. The maps depict a hydrologic system that divides the United States into 21 major regions. These regions are further subdivided into 222 subregions, 352 accounting units, and finally, into 2,149 cataloging units. These four levels of subdivisions, used for the collection and organization of hydrologic data, are referred to as *Hydrologic Units*. Also see *Water Resources Regions [United States]*.

Hydrologic Units (Classification Codes) [USGS] — A means by which the United States has been divided and subdivided into successively smaller *Hydrologic Units* which have been classified into four levels consisting of 21 major water resources regions, 222 subregions, 352 accounting units and 2,149 cataloging units. The first level of this U.S. Geological Survey (USGS) classification system divides the U.S. into 21 major geographic areas, or regions. These geographic areas (hydrologic areas based on surface topography) contain either the drainage area of a major river or the combined drainage areas of a series of rivers. Eighteen of the regions occupy the land area of the conterminous U.S.; Alaska is region 19, the Hawaiian Islands constitute region 20, and Puerto Rico and other outlying Caribbean areas are region 21. (The Pacific Trust Territories are a potential region 22.) The second level

of classification divides the 21 regions into 222 subregions. A subregion includes the area drained by a river system, a reach of a river and its tributaries in that reach, a closed basin(s), or a group of streams forming a coastal drainage area. The third level of classification subdivides many of the subregions into accounting units. These 352 hydrologic accounting units nest within, or are equivalent to, the subregions. The accounting units are used by the USGS for designing and managing the National Water Data Network. The fourth level of classification is the cataloging unit, the smallest element in the hierarchy of hydrologic units. A cataloging unit is a geographic area representing part or all of a surface drainage basin, a combination of drainage basins, or a distinct hydrologic feature. These units subdivide the subregions and accounting units into smaller areas (2,149 in the U.S.) that are used by the USGS for cataloging and indexing water-data acquisition activities in the "Catalog of Information on Water Data." An eight-digit code uniquely identifies each of the four levels of classification within four two-digit fields. The first two digits identify the water resources region; the first four digits identify the subregions; the first six digits identify the accounting unit; and the addition of two more digits identify the cataloging unit. See *Water Resources Regions [United States]* for a complete listing of the 21 major water resources regions.

Hydrological Drought — The onset of this form of drought is signified by the occurrence and/or persistence of *Meteorological Drought*, causing shortage of surface water in streams, lakes, reservoirs and/or groundwater supplies. Also see *Agricultural Drought*.

Hydrologist — A person who studies or is trained in the field of *Hydrology*.

Hydrology — (1) The science of waters of the earth, their occurrence, distribution, and circulation; their physical and chemical properties; and their reaction with the environment, including living beings. (2) The study of the movement and storage of water in the natural and disturbed environment. (3) The condition of the aquatic environment at some specified time and place. Most frequently, the term is used in reference to water on the surface of the land, in the soil and underlying rocks, and in the atmosphere.

Hydrolysis — The splitting (lysis) of a compound by a reaction with water. Examples are the reaction of salts with water to produce solutions which are not neutral, and the reaction of an ester with water.

Hydromancy — Divination by the observation of water, as in observing the ebb and flow of tides, by crystal vision, or mechanical contrivance. A form of divination, especially common in Egypt, in which a medium, regularly a young boy, reported on images visible to him in water, supposedly manifestations of the Gods.

Hydromania — A mania or morbid craving for water.

Hydrome — Water-conducting tissue.

Hydromechanics — The branch of physics having to do with the laws governing the motion and equilibrium of fluids.

Hydrometeor — Any type of condensation or frost formed from atmospheric water vapor, as rain, snow, fog, dew, etc. Contrasts with *Lithometeor*.

Hydrometeorology — The science of the application of meteorology to hydrologic problems; the branch of meteorology that deals with the occurrence, motion, and changes of the state of atmospheric water. The combination of snowpack measurements and climatic forecasts to predict runoff.

Hydrometer — An instrument used to determine specific gravity, especially a sealed, graduated tube, weighted at one end, that sinks in a fluid to a depth used as a measure of the fluid's specific density.

Hydrometric Network — Network of stations at which measurement of hydrological parameters is performed.

Hydronic — Of, relating to, or being a system of heating or cooling that involves transfer of heat by a circulating fluid (as water or vapor) in a closed system of pipes.

Hydrotherapy — Internal and external use of water as a therapeutic treatment for all forms of disease. Compare to *Hydrotherapy*.

Hydroperiod — The seasonal and cyclical pattern of water in a *Wetland*.

Hydrophile (Hydrophilic) — Having or denoting a strong affinity for water; said of *Colloids* which swell in water and which are not easily coagulated.

Hydrophilous — (Botany) (1) Growing or thriving in water. (2) Pollinated by water, as the flowers of ribbon grass and hornwort.

Hydrophobe (Hydrophobic) — Lacking strong affinity for water; said of *Colloids* which are easily coagulated.

Hydrophobia — (1) An abnormal fear of water. (2) Rabies.

Hydrophone — An electrical instrument for detecting or monitoring sound transmitted through water.

Hydrophyte — (1) A perennial vascular aquatic plant having its overwintering buds under water. (2) A plant growing in water or in soil too waterlogged for most plants to survive. (3) A plant adapted to grow in water. (4) Any plant growing only in water or very wet earth, requiring large quantities of water for growth. Also see *Mesophyte*, *Phreatophyte*, *Xerophyte*.

Hydrophytic (Vegetation) — Plants that grow in water or in saturated soils that are periodically deficient in oxygen

as a result of high water content. Examples include cattails, bulrushes, sedges, and rushes.

Hydroplane — (Nautical) (1) A motorboat designed so that the prow and much of the hull lift out of the water and skim the surface at high speeds. Also referred to as a *Hydrofoil*. (2) Seaplane. (3) A horizontal rudder on a submarine.

Hydropneumatic — A water system, usually small, in which a water pump is automatically controlled by the pressure in a compressed air tank.

Hydroponics — Cultivation of plants in nutrient solution rather than in soil.

Hydropower — Power (e.g., electrical energy) produced by falling water; the utilization of the energy available in falling water for the generation of electricity.

Hydroscope — An optical device used for viewing objects far below the surface of water.

Hydroseeding — Dissemination of seed under pressure, in a water medium. Mulch, lime, and fertilizer can be incorporated in the spraying mixture.

Hydrosol — A disperse system (colloid) in which water is the disperse medium.

Hydrosphere — (1) The water on or surrounding the surface of the globe, as distinguished from those of the *Lithosphere* and the *Atmosphere*. (2) The region that includes all the earth's liquid water, frozen water, floating ice, frozen upper layer of soil, and the small amounts of water vapor in the earth's atmosphere. Together, the waters of the *Hydrosphere*, *Atmosphere*, *Lithosphere*, and *Biosphere*, constitutes the earth's *Ecosphere*.

Hydrostatic Force — The force exerted by water at rest, including lateral pressure on walls and uplift (buoyancy) on floors. Contrast with *Hydrodynamic Force*.

Hydrostatic Head — A measure of pressure at a given point in a liquid in terms of the vertical height of a column of the same liquid which would produce the same pressure.

Hydrostatic Loads — (1) Forces imposed on a flooded structure due to the weight of the water. (2) (Floods) Those loads or pressures resulting from the static mass of water at any point of floodwater contact with a structure. They are equal in all directions and always act perpendicular to the surface on which they are applied. Hydrostatic loads can act vertically on structural members such as floors, decks, and roofs, and can act laterally on upright structural members such as walls, piers, and foundations.

Hydrostatic Pressure — The pressure in a fluid in equilibrium which is due solely to the weight of fluid above.

Hydrostatics — The branch of physics that deals with fluids at rest and under pressure.

Hydrotherapy — External use of water in the medical treatment of diseases. Compare to *Hydrotherapy*.

Hydrothermal — (1) Having to do with hot water, especially having to do with the action of hot water in producing minerals and springs or in dissolving, shifting, and otherwise changing the distribution of minerals in the earth's crust. (2) (Geology) Of or relating to hot magmatic emanations rich in water. Of or relating to the rocks, ore deposits, and springs produced by such emanations.

Hydrothermal Deposit — (Geology) A mineral deposit formed when hot, aqueous solutions fill fractures or other open spaces in rocks or along faults. The minerals crystallize as the solutions cool.

Hydrothermal Reservoir — One of three geothermal reservoir systems. It consists of naturally circulating hot water or steam ("wet steam") or that which contains mostly vapor ("dry steam"). The latter type of reservoir is the most desirable type according to present technology. Also see *Geothermal Energy*.

Hydrothermal Solution — A hot, watery solution that usually emanates from a magma in the late stages of cooling. Frequently contains and deposits in economically workable concentrations minor elements that, because of incommensurate ionic radii or electronic charges, have not been able to fit into the atomic structures of the common minerals of igneous rocks (rocks formed by volcanic activity).

Hydro-Transport — (1) Mixing a crushed material, such as coal, gravel or sand, with water to facilitate its transport under pressure, through a pipes. (2) (Tar Sands) Mixing the crushed black sands containing bitumen — a heavy, molasses-like oil — with hot water in a "cyclo-feeder" to facilitate its transportation via pipeline to plants where the bitumen is separated from the water and then "cracked" in cokers into various hydrocarbon by-products, i.e., naphtha, kerosene, and heavy fuel oil.

Hydrotropism — Growth or movement in a sessile (fixed, root-bound) organism toward or away from water, as of the roots of a plant.

Hydrous — Containing water, especially water of crystallization or hydration.

Hyetal — Of or relating to rain or rainy regions.

Hyetograph — A chart showing the distribution of rainfall over a particular period of time or a particular geographic area.

Hyetography — The branch of meteorology having to do with the geographical distribution and annual variation of rainfall. Also see *Hyetograph*.

- Hygrometer** — Any of several instruments used to measure atmospheric humidity.
- Hygrophyte** — Plants extremely sensitive to dry air, growing only in habitats where relative humidity is always high.
Also see *Hydrophyte*.
- Hygroscope** — An instrument showing changes in humidity.
- Hygroscopic** — Describing a chemical substance with an affinity for water, one that will absorb moisture, usually from the air. Silica gel and zinc chloride are hygroscopic materials that are used as drying agents.
- Hygroscopic Coefficient** — The level of tension at which water is considered to be “bound” to the soil particles, 31 atmospheres.
- Hygroscopic Nuclei** — A piece of dust or other particle around which water condenses in the atmosphere. These tiny droplets then collide and coalesce, with numerous other nuclei, contributing to the formation of a raindrop.
- Hygroscopic Water** — Water which is absorbed from the air.
- Hygrothermograph** — An instrument which combines the features of the *Hair Hygograph* and the *Thermograph*, recording both relative humidity and temperature on one chart.
- Hypereutrophic (Water)** — Pertaining to a lake or other body of water characterized by excessive nutrient concentrations such as nitrogen and phosphorous and resulting high productivity. Such waters are often shallow, with algal blooms and periods of oxygen deficiency. Slightly or moderately eutrophic water can be healthful and support a complex web of plant and animal life. However, such waters are generally undesirable for drinking water and other needs. Degrees of *Eutrophication* typically range from *Oligotrophic* water (maximum transparency, minimum chlorophyll-a, minimum phosphorus) through *Mesotrophic*, *Eutrophic*, to *Hypereutrophic* water (minimum transparency, maximum chlorophyll-a, maximum phosphorus). Also see *Carlson’s Trophic State Index (TSI)* and *(Mean) Trophic State Index (TSI)*.
- Hyperhaline** — Term used to characterize waters with salinity greater than 40‰ (parts per thousand), due to ocean-derived salts.
- Hypersaline** — Term used to characterize waters with salinity greater than 40‰ (parts per thousand), due to land-derived salts.
- Hypochlorous Acid** — An unstable strongly oxidizing but weak acid, HClO, obtained in solution along with hydrochloric acid by reaction of chlorine with water and used especially in the form of salts as an oxidizing agent, bleaching agent, disinfectant, and chlorinating agent.
- Hypolimnetic Discharge** — The process of removing nutrient-rich, oxygen-deficient water from the bottom of a lake or reservoir to improve water quality conditions.
- Hypolimnetic** — Refers to the cold bottom water zone below the *Thermocline* in a lake.
- Hypolimnion** — The lowermost, non-circulating layer of cold water in a thermally stratified lake or reservoir that lies below the *Thermocline*, remains perpetually cold and is usually deficient of oxygen. Also see *Thermal Stratification*.
- Hyporheic Zone** — Zone of substrate in a stream bottom extending 1 to 2 meters (3.3 to 6.6 feet) below the surface of the stream bed. In gaining and in losing streams, water and dissolved chemicals can move repeatedly over short distances between the stream and the shallow subsurface below the streambed. The hyporheic zone is comprised of the resulting subsurface environments, which contain variable proportions of water from groundwater and surface water. These zones can be active sites for aquatic life, for example, the spawning success of fish may be greater where flow from the stream brings oxygen into contact with eggs that were deposited within the course bottom sediment or where stream temperatures are modulated by groundwater flows.
- Hypothermal** — (1) Moderately warm; tepid. (2) Pertaining or tending to reduction of temperature.
- Hypothermia** — Subnormal temperature of the body.
- Hypothesis** — (Statistics) A statement made about the condition or behavior of a variable or event which lends itself to rigorous testing for validity. An informed theory that best describes a set of available data. The assumption is stated in such a way that subsequent experimentation or observations can test the validity of the theory.
- Hypothesis Testing** — (Statistics) The condition whereby the *Null Hypothesis*, which argues against the validity of the model’s structure (*Specification*) is tested using various statistical criteria, e.g., *Coefficient of Determination*, or R^2 , *t-Statistic*, *F-Statistic*, etc., against the *Alternative Hypothesis* that there exists a significant relationship or correlation between the dependent variable, or variable to be explained, and the independent, or explanatory variable(s). In hypothesis testing, a rule for acceptance and rejection must be chosen, e.g., 5 percent level of significance, that is, there exists a 5 percent chance that in rejecting the null hypothesis, which states that the disturbances in the dependent variable are purely random, we will be wrong. Inversely, there is a 95 percent chance that by rejecting the null hypothesis and accepting the alternative hypothesis, we will be right.
- Hypoxia** — A condition in which natural waters have a low concentration of dissolved oxygen (about 2 milligrams

per liter as compared with a normal level of 8 to 10 milligrams per liter). Most game and commercial species of fish avoid waters that are *Hypoxic*.

Hypsography — (1) The science or art of describing elevations of land surfaces with reference to a datum, usually *Mean Sea Level (MSL)*. (2) That part of topography dealing with relief or elevation of terrain.

Hypsometer — An instrument using the atmospheric pressure as measured by the change in the boiling point of water to determine land elevations.