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- E. Coli (Escherichia Coli)** — A bacterial species which inhabits the intestinal tract of man and other warm-blooded animals. Although it poses no threat to human health, its presence in drinking water does indicate the presence of other, more dangerous bacteria. Also see *Bacteria*.
- Eagre** — A high, often dangerous wave caused by the surge of a flood tide upstream in a narrowing *Estuary* or by colliding tidal currents. Also referred to as a *Bore*.
- Early Seral Condition** — Synonymous with poor ecological conditions.
- Earthfill Dam** — A dam the main section of which is composed principally of earth, gravel, sand, silt, and clay. Also referred to as *Earth Dam*. Also see *Embankment Dam*.
- Easement** — A legal instrument enabling the giving, selling, or taking of certain land or water rights without transfer of title, such as for the passage of utility lines. An affirmative easement gives the owner of the easement the right to use the land for a stated purpose. A negative easement is an agreement with a private property owner to limit the development of his land in specific ways.
- Ebb** — (1) *Ebb Tide*. (2) To fall back from the *Flood Stage*.
- Ebb Tide** — That period of tide between a high water and the succeeding low water; falling tide. Also see *Tides*.
- Echard** — Soil water not available for absorption by plants.
- Echo Sounder** — A device for measuring the depth of water or the depth of an object below the surface by sending pressure waves down from the surface and recording the time until the echo returns from the bottom.
- Ecohydraulics** — A multi-disciplinary research focus among biologists and engineers aimed at improving sampling and modeling techniques, which integrates physical, chemical and ecological processes in aquatic ecosystems. The principal focus involves aquatic model development, verification and validation studies, multi-disciplinary assessment frameworks, river restoration and monitoring strategies, and applications of multi-disciplinary integrated assessment methodologies utilizing geographic information systems (GIS), remote sensing and decision support systems.
- Ecological Approach** — A method of natural resource planning and management that provides due consideration for the interrelationships between all species, including humans, and their environment.
- Ecological Assessment** — A process for describing the status of ecosystems, their components, related processes and effects, and associated interactions. An ecological assessment should address social, cultural, and political issues relevant to resource management and use scientifically supportable data.
- Ecological Impact** — The effect that a man-made or natural activity has on living organisms and their non-living (abiotic) environment.
- Ecological Indicator** — An individual species or a defined assemblage of organisms that serves as a gauge of the condition of the environment. The term is a collective term for response, exposure, habitat, and stressor indicators. For example, the bacterium *Escherichia coli* indicates the presence of sewage in water, and the mussel, *Mytilus edulis* lives in polluted waters.
- Ecological Risk Assessment** — The application of a formal framework, analytical process, or model to estimate the effects of human actions on a natural resource and to interpret the significance of those effects in light of the uncertainties identified in each component of the assessment process. Such analysis includes initial hazard identification, exposure and dose-response assessments, and risk characteristics.
- Ecological Succession** — An orderly, directional and therefore predictable process of development that involves changes in species structure and community processes over time. It results from a modification of the physical environment by the community and culminates in a stabilized ecosystem in which maximum biomass and symbiotic functions are maintained.
- Ecology** — The study of the inter-relationships of living things to one another and to the environment.
- Econometric Model Building** — (Statistics) An iterative process for developing a model beginning with some information about the form and structure of the problem and with relevant data. The model building process typically follows a sequence of inter-related steps to include:
- [1] **Problem Identification and Data Selection** – Data is selected, compilation, screened, and analyzed, and

the various series tested based on hypotheses of probable causation;

- [2] **Model Identification (or Specification)** – Selection of a general model structure is made based on the nature of the data and the types of outputs desired. Some of these include, for example, a simple single mathematical equation, or multiple (sequential) equations, statistically-based univariate (deterministic) autoregressive functions, multivariate analysis, simple ordinary least squares (OLS) regression, multiple regression, simultaneous equation, etc.;
- [3] **Estimation (Model Fitting)** – Based on the selection of a model structure, the data is used to best describe the behavior of the variable under observation, e.g., stream flows, reservoir levels, runoff, economic output, employment, consumer spending, etc.;
- [4] **Model Testing (and Refinement, as Necessary)** – The model’s structure and variables chosen are then validated by applying the data and observing forecast errors with respect to known (sample) values;
- [5] **Forecasting** – Based upon the ability of the model to accurately “fit” or predict historical values, the model is used to forecast beyond the last data point as prescribed by scenarios under analysis.

Also see *Econometrics, Regression Analysis, Stochastic Process, and Deterministic Process*.

Econometrics — (Statistics) The application of statistical and mathematical methods to the analysis of economic data, with a purpose of giving empirical content to economic theories and verifying them or refuting them. Also see *Econometric Model Building, Regression Analysis, Stochastic Process, and Deterministic Process*.

Ecoregion — A continuous geographic area over which the macroclimate is sufficiently uniform to permit development of similar ecosystems on sites with similar geophysical properties. Ecoregions contain multiple landscapes with different spatial patterns of ecosystems.

Ecosphere — The mantle of earth and troposphere inhabited by living organisms; the “bio-bubble” that contains life on earth, in surface waters, and in the air. Also see *Biosphere*.

Ecosystem — (1) A community of animals, plants, and bacteria, and its interrelated physical and chemical environment. An ecosystem can be as small as a rotting log or a puddle of water, but current management efforts typically focus on larger landscape units, such as a mountain range, a river basin, or a watershed. (2) A complex of interacting plants and animals with their physical surroundings. Ecosystems are isolated from each other by boundaries which confine and restrict the movement of energy and matter, for example, an ecosystem could be recognized at a watershed scale by designating an area of common drainage (i.e., topography determines movement of water). Also see *Biodiversity*.

Ecosystem Functions — (1) The processes through which the constituent living and nonliving elements of ecosystems change and interact. The term *Ecological Function* is often used in reference to the role or specific contribution of an entity to system behavior. (2) Processes that are necessary for the self-maintenance of an *Ecosystem* such as primary production, nutrient cycling, decomposition, etc. The term is used primarily as a distinction from values.

Ecosystem Management — (1) A concept of natural resources management wherein human activities are considered within the context of economic, ecological, and social interactions within a defined area or region over both the short and long term. Its purpose is to meet human needs while maintaining the health, diversity, and productivity of ecosystems. (2) An approach to managing the nation’s lands and natural resources which recognizes that plant and animal communities are interdependent and interact with their physical environment (i.e., soil, water, and air) to form distinct ecological units called *Ecosystems*. The fact that these ecosystems span jurisdictional and political boundaries necessitates a more comprehensive and unified approach to managing them. Implementing the initial stage of a government-wide approach to ecosystem management typically requires clarifying the policy goals and undertaking certain practical steps to apply the principles being considered to include:

- [1] Delineating the ecosystem;
- [2] Understanding the system(s) ecologies;
- [3] Making management choices;
- [4] Unifying disparate data and information needs and sources; and
- [5] Adapting management on the basis of new information.

Ecosystem Restoration — Actions taken to modify an ecosystem for the purpose of re-establishing and maintaining desired ecological structures and processes.

Ecosystem Structure — (1) The physical elements and spatial arrangement of the living and nonliving elements within an *Ecosystem*. (2) Attributes related to instantaneous physical state of an ecosystem; examples include species population density, species richness or evenness, and standing crop *Biomass*.

Ecosystem Sustainability — The capacity of an *Ecosystem* for long-term maintenance of ecological processes and functions, biological diversity, and productivity. Also called *Ecological Sustainability*.

Ecotone — (1) A habitat created by the juxtaposition of distinctly different habitats; an edge habitat; or an ecological

zone or boundary where two or more ecosystems meet. (2) A transition line or strip of vegetation between two communities, having characteristics of both kinds of neighboring vegetation as well as characteristics of its own.

Ecotype — A locally adopted population of a species which has a distinctive limit of tolerance to environmental factors.

Edaphic — (Ecology) (1) Pertaining to the chemical and physical characteristics of the soil, without reference to climate. (2) Soil characteristics, such as water content, pH, texture, and nutrient availability, that influence the type and quantity of vegetation in an area.

Eddy — A current, as of water or air, moving contrary to the direction of the main current, especially in a circular motion.

Eddy Current — A circular water movement that develops when the main flow becomes separated from the bank. The eddy current may then be set up between the main flow and the bank.

Edema, also Oedema — (Botany) Extended swelling in plant organs caused primarily by an excessive accumulation of water.

Edwards Decree [Nevada] — The Edwards Decree was issued on October 8, 1935 and represented a modification of adjudicated water rights for the Humboldt River based on the October 20, 1931 *Bartlett Decree*. Due to subsequent protests to the issuance of the Bartlett Decree, on December 16, 1931, the first of a number of rulings for the modification, correction and amendment of the Bartlett Decree was made by Judge H.W. Edwards. This was followed by additional changes and amendments entered on April 27, 1933, February 8, 1934, June 8, 1934, October 1, 1934, November 19, 1934, February 11, 1935, and finally on March 11, 1935. Collectively, this compilation of modifications and changes to the 1931 Bartlett Decree became known as the Edwards Decree. One particular change of some importance removed the Bartlett Decree's language pertaining to the formal division of the Humboldt River system into a District No. 1 below Palisade and a District No. 2 above Palisade. In its place, the Edwards Decree merely established specific irrigation seasons and reaffirmed the three classes of land for specific water rights, the water duty for each land class, and the period over which water was to be received by these lands. As most of the corrected water-rights contained within the Edwards Decree applied to lands above Palisade (i.e., the upper Humboldt River Basin), the Edwards Decree was applied to and used for distribution of the Humboldt River system's waters above Palisade, while the Bartlett Decree continued to apply to and be used in the distribution of water below Palisade. In general, the Edwards Decree provided for a flow of 1.23 cfs per 100 acres of decreed land or at proportional rates. Three land classes were established (the same as for the Bartlett Decree) with different dates of use and number of days of allowed irrigation. Each sub-basin within the overall Humboldt River Basin had its unique amount of decreed land and decreed water within the three land classes (A, B and C). Diverted water for irrigation purposes was to be measured where the main ditch enters or becomes adjacent to the land to be irrigated. With respect to adjudication of the Humboldt River, also see *Carville Decree*.

Effective Porosity — The amount of interconnected pore space through which fluids can pass, expressed as a percentage of the total volume occupied by the interconnecting interstices. Porosity may be primary, formed during deposition or cementation of the material, or secondary, formed after deposition or cementation, such as fractures. Part of the total porosity will be occupied by static fluid being held to the mineral surface by surface tension, so effective porosity will be less than total porosity.

Effective Precipitation (or Rainfall) — That portion of precipitation which remains on the foliage or in the soil that is available for *Evapotranspiration*, and reduces the withdrawal of soil water by a like amount. As described by the U.S. Bureau of Reclamation, that part of the precipitation falling on an irrigated area that is effective in meeting the *Crop Consumptive Use* requirements.

Efficiency (Irrigation) — (1) A measure of a distribution system's ability to transport and apply water to a desired effect with a minimum of effort, expense, or waste. (2) With reference to an irrigation water delivery system, the proportion of the amount of water delivered for irrigation use compared to the total amount of water released to meet that delivery (i.e., the amount of delivery divided by the amount of release). With respect to irrigation project efficiency, the following terms generally apply:

- [1] **Canal Efficiency** – The volume of water diverted into a canal system versus total water available for farm headgate deliveries;
- [2] **Irrigation Efficiency** – The percentage of water applied that can be accounted for in soil moisture increase; and
- [3] **Farm Efficiency** – The amount of water actually required for growing a crop compared to the amount of irrigation water that is diverted at the farm headgate.

Efficient Water Management Practices (EWMP)–Agricultural Water Use — The agricultural water use equivalent of *Best Management Practices (BMP)* as applied to urban water use, efficient water management practices cover

the spectrum of methods to improve both the efficiency and conservation of agricultural water use by (1) enhancing irrigation management services, measurement, and accounting; (2) improving the physical system of irrigation delivery, distribution, and drainage; and (3) promoting the modification of and adjustments to the institutional system of water use by agricultural interests to include information and educational programs. See Appendix C–2, Efficient Water Management Practices, for a more complete itemization of irrigation management, physical improvement, and institutional adjustment practices.

Effloresce — (Chemistry) To become a powder by losing water of crystallization, as when a hydrated crystal is exposed to air.

Efflorescence — (1) (Chemistry) The deposit that results from the process of *Efflorescing*, called bloom. (2) A growth of salt crystals on a surface caused by evaporation of salt-laden water.

Effluent — (1) Something that flows out or forth, especially a stream flowing out of a body of water. (2) (Water Quality) Discharged wastewater such as the treated wastes from municipal sewage plants, brine wastewater from desalting operations, and coolant waters from a nuclear power plant.

Effluent Guidelines — Technical *U.S. Environmental Protection Agency (EPA)* documents which set effluent limitations for given industries and pollutants.

Effluent Limitation — An amount or concentration of a water pollutant that can be legally discharged into a water body by a *Point Source (PS)*, expressed as the maximum daily discharge, the maximum discharge per amount of product, and/or the concentration limit in the wastewater stream, as a 24-hour or 30-day average. The applicable technology-based standard is set by the *U.S. Environmental Protection Agency (EPA)* by *Standard Industrial Classification (SIC) Code*, but differs between new and existing sources and by broad types of water pollutants: conventional pollutants, toxic pollutants, nonconventional, nontoxic pollutants; dredge and fill wastes; and heat discharges.

Effluent Seepage — Diffuse discharge of ground water to the ground surface.

Effluent Standard — The maximum amounts of specific pollutants allowable in wastewater discharged by an industrial facility or wastewater treatment plant. The standards are set for individual pollutants and apply across all industrial categories. This term can be contrasted with *Effluent Limitations*, which are set for individual pollutants by *Standard Industrial Classification (SIC) Code*.

Effluent Streams — Effluent streams are those leaving a lake. Also referred to as *Gaining Stream*. Also see *Stream*.

Ejector — (1) A device using a jet of water to withdraw a fluid from a space. (2) A device used to disperse a chemical solution into water being treated.

Ekman Dredge — A dredge that has opposable jaws operated by a messenger traveling down a cable to release a spring catch and that is used in ecology for sampling the bottom of a body of water.

Electric Power Water (Public Utility) — Water withdrawn by public utilities for hydroelectric power generation and condenser cooling.

Electrical Conductivity — A measure of the salt content of water.

Electrical Log — A record of electrical-resistivity tests made at various depths in a well.

Electrodialysis — A treatment process that uses electrical current and an arrangement of permeable membranes to separate soluble minerals from water. Often used to desalinate salt or brackish water. In the electrodialysis process, 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. Also see *Reverse Osmosis*.

Electrodialysis Reversal (EDR) — A treatment process in which minerals and other constituents in water are separated by an electrical charge. The resulting ions are transferred through membranes from a less concentrated to a more concentrated solution. By varying the amount of the electrical charge input to the system, it is possible to remove the dissolved solids in water to the extent desired. The EDR process can also be used in desalinating sea water.

Electrolysis — The passage of an electric current through an *Electrolyte*, causing the migration of the positively charged ions to the negative electrode (cathode) and the negatively charged ions to the positive electrode (anode).

Electrolyte — (1) (Chemistry) Any compound that dissociates into ions when dissolved in water. The solution that results will conduct an electric current. For example, table salt (NaCl) is an electrolyte. (2) (Physiology) Any of various ions, such as sodium, potassium, or chloride, required by cells to regulate the electric charge and flow of water molecules across the cell membrane.

Electrophoresis — The migration of charged colloidal particles (*Colloids*) or *Molecules* through a solution under the influence of an applied electric field usually provided by immersed electrodes. Also call *Cataphoresis*.

Element — (1) (Chemistry) Any substance that cannot be separated into different substances by ordinary chemical

methods. (2) (Historical) Any of four substances (earth, air, fire, and water) formerly regarded as a fundamental constituent of the universe. (3) (Meteorology) Weather conditions, especially violent or severe weather.

Elevated Ditch — Earth-filled, constructed to specifications similar to those for earthfill dams, to provide normal grade as a substitute for flumes or siphons. Also referred to as *Raised Ditches*.

Elevation — (1) The variation in the height of the earth's surface as measured by the vertical distance from a known datum plane, typically *Mean Sea Level (MSL)*. (2) In retrofitting, the process of raising a house or other building so that it is above the height of a given flood.

Elevation Datum Plane — Arbitrary surface that serves as a common reference for the elevations of points above or below it. Elevations are expressed in terms of feet, meters, or other units of measure and are identified as negative or positive depending on whether they are above or below the datum plane.

Elevation Head — The potential energy in a hydraulic system, represented by the vertical distance between the hydraulic system (pipe, channel, etc.) and a reference level, and expressed in length units. The sum of the elevation head and the *Pressure Head* is equal to the *Hydraulic Head*. Also referred to as the *Total Head*.

Eligible Costs — The construction costs for waste-water treatment plants upon which *U.S. Environmental Protection Agency (EPA)* grants are based.

Eligible Land — An irrigation project land which has a valid right and which is classified as irrigable or has a paid-out water right.

Elimination — The act, process, or an instance of eliminating or discharging, as the removal from a molecule of the constituents of a simpler molecule for example, ethylene is formed by the elimination of water from ethanol.

El Niño — (Oceanography and Meteorology) [From the child (i.e., the Christ child)] The name of a southward-flowing ocean current off the coast of Peru causing an irregularly occurring flow of unusually warm surface water along the western coast of South America that is accompanied by abnormally high rainfall in usually arid areas and that prevents upwelling of nutrient-rich cold deep water causing a decline in the regional fish population. It typically results in a warm inshore current flowing along the coast of Ecuador and about every seven to ten years it extends southward down the coast of Peru with frequently devastating effects on weather, crops, and fishing (due to adverse effects on plankton). El Niño's warm and nutrient-poor waters cause great damage to the fishing industry and also to the birds feeding there, which are an important source of guano. The climatic effects of large-scale El Niño disturbances also cause flooding and drought conditions over a wide area, sometimes extending as far as the southern Pacific Ocean, Europe, Africa, and Asia. Such disturbances have taken place in 1953, 1957-58, 1972-73, 1976, 1982-83, and 1992. It is also believed that this condition (*El Niño Effect*) has more far-reaching effects on climatological patterns in the Western Hemisphere and also influences storm patterns in the western Atlantic Ocean region (Caribbean and Gulf of Mexico). It has generally been found that the presence of El Niño tends to reduce hurricane activity while the presence of *La Niña*, or cool eastern Pacific waters, tends to increase hurricane activity. Also see *Hurricane Forecasting*.

El Niño/Southern Oscillation (ENSO) — (Oceanography and Meteorology) The expansion of warm waters in the Pacific Warm Pool east across the International Date Line, sometimes all the way to the coast of Peru, at which time it is called an *El Niño* event. The Pacific Warm Pool, located north and east of New Guinea, is approximately the size of the United States and gets its name from the fact that surface temperatures never go below 86°F (30°C). When this body of water expands, as it did in the early 1980s, the consequences of a warming trend on the coast of South America are dire. Typically, the fishing industry collapses in Peru as the plankton die off and fish head for cooler waters and torrential rainfalls bring devastating floods.

Elutriate — To purify, separate, or remove by washing, decanting, and settling.

Elutriation — Separation of solid waste into heavy and light fractions by washing.

Eluviation — (1) The removal of soil material in suspension (or in solution) from a layer or layers of a soil. (2) The transportation of dissolved or suspended material within the soil by the movement of water when rainfall exceeds evaporation.

Embankment — An artificial deposit of material that is raised above the natural surface of the land and used to contain, divert, or store water, support roads or railways, or for other similar purposes.

Embankment Dam — A dam structure constructed of fill material, usually earth or rock, placed with sloping sides and usually with a length greater than its height. Types of embankment dams include:

- [1] **Earthfill or Earth Dam** — An embankment dam in which more than 50 percent of the total volume is formed of compacted fine-grained material obtained from a borrow area (i.e., excavation pit);
- [2] **Fill Dam** — Any dam constructed of excavated natural materials or of industrial waste materials;
- [3] **Homogeneous Earthfill Dam** — An embankment dam constructed of similar earth material throughout, except for the possible inclusion of internal drains or drainage blankets; distinguished from a *Zoned*

Earthfill Dam;

- [4] **Hydraulic Fill Dam** – An embankment dam constructed of materials, often dredged, that are conveyed and placed by suspension in flowing water;
- [5] **Rockfill Dam** – An embankment dam in which more than 50 percent of the total volume is comprised of compacted or dumped pervious natural or crushed rock;
- [6] **Rolled Fill Dam** – An embankment dam of earth or rock in which the material is placed in layers and compacted by using rollers or rolling equipment; and
- [7] **Zoned Embankment Dam** – An embankment dam which is composed of zones of selected materials having different degrees of porosity, permeability, and density.

Emergency Action Plan (Dam) — A predetermined plan of action to be taken to reduce the potential for property damage and loss of lives in a downstream area affected by a dam break or excessive spillway discharges.

Emergency Program (FEMA) — The phase of the *National Flood Insurance Program (NFIP)* which a community enters prior to the completion of an individual community flood insurance study. It is intended to provide a first layer amount of insurance at federally-subsidized rates on all existing structures and new construction begun prior to the effective date of a *Flood Insurance Rate Map (FIRM)*, in return for the community's adoption of general floodplain management regulations.

Emergency Spillway — A dam spillway built to carry runoff in excess of that carried by the principal spillway; a secondary spillway designed to operate only during exceptionally large floods. Also referred to as *Auxiliary Spillway*. Also see *Spillway*.

Emergent — Rising above a surrounding medium, especially a fluid. Having part of a plant aerial and the rest submerged; with parts extending out of the water.

Emergent Hydrophytes — Erect, rooted, herbaceous *Angiosperms* that may be temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire stem or plant. Familiar examples are cattails, bulrushes, and saltmarsh cordgrass.

Emergent Mosses — Mosses occurring in wetlands, but generally not covered by water.

Emergent Plant — A plant that grows in shallow water with the root system submerged under the water and the upper vegetation rising above the water surface. Also see *Emergent Hydrophytes*.

Emergent Wetland — Typically, a wetland classification characterized by erect, rooted, herbaceous, hydrophytes, excluding mosses and lichens, and which is present for most of the growing season.

Emersed — (Botany) Rising above the surface of water as emersed aquatic plants.

Eminent Domain — (Legal) (1) The right of a government to appropriate private property for public use, usually with fair compensation to the owner. (2) The authority of the federal or state government, or an agency or party authorized by the federal government, to condemn all interest in land for public purposes, after payment of just compensation.

Empedocles — Fifth century B.C. Greek philosopher who believed that all matter is composed of elemental particles of fire, water, earth, and air and that all change is caused by motion.

Empirical — (Statistics) Based on experience or observations, as opposed to theory or conjecture.

Emulsion — A suspension of small *Globules* of one liquid in a second liquid with which the first will not mix.

Encroachment — (1) Any physical object placed in the floodplain that hinders the passage of water or otherwise affects flood flows, such as fill, excavation, storage of equipment and materials, or buildings. (2) The advance or infringement of uses, plant growth, fill, excavation, buildings, permanent structures or development into a floodplain which may impede or alter the flow capacity of a floodplain.

Endamoeba Histolytica — A waterborne disease organism causing amoebic dysentery.

Endangered Species — Any plant or animal species threatened with extinction by man-made or natural changes throughout all or a significant area of its range; identified by the Secretary of the Interior as “endangered”, in accordance with the 1973 *Endangered Species Act (ESA)*, below. [See Appendix D–1, Nevada's Endangered and Threatened Species.]

Endangered Species Act (ESA) — An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of “aesthetic, ecological, educational, historical, recreational and scientific value.” It may also protect the listed species’ “critical habitat”, the geographic area occupied by, or essential to, the protected species. The *U.S. Fish and Wildlife Service (USFWS)* and the *National Marine Fisheries Service (NMFS)* share authority to list endangered species, determine critical habitat and develop recovery plans for listed species. Currently, approximately 830 animals and 270 plants are listed as endangered or threatened nationwide at Title 50, Part 17, sections 11 and 12 of the Code of Federal Regulations. Further, under a settlement with environmental groups, USFWS has agreed to propose listing another 400 species over the next few years. The 1973 Endangered

Species Act superseded and strengthened the *Endangered Species Preservation Act* of 1966 and the *Endangered Species Conservation Act* of 1969. The 1973 provisions required that the act be re-authorized by Congress every five years. Major provisions of the 1973 ESA included:

- [1] Emphasis on the conservation of ecosystems upon which species depend;
- [2] Consolidated existing U.S. and foreign lists;
- [3] Established and defined categories of “endangered” and “threatened”;
- [4] Lowered the listing threshold to “in danger of extinction in a significant portion of range”;
- [5] Made eligible all classes of vertebrates, invertebrates, and plants;
- [6] Defined and prohibited “take” of endangered vertebrates and invertebrates;
- [7] Established prohibitions on take of threatened species available by special regulation;
- [8] Restricted import and export;
- [9] Required federal agencies to undertake conservation programs;
- [10] Prohibited federal agencies from authorizing, funding, or carrying out actions that may jeopardize the continued existence of listed species;
- [11] Authorized the establishment of National Wildlife Refuges to protect habitat;
- [12] Established a state grant program; and
- [13] Appropriated funding for programs through 1978 (5-year cycle).

1978 amendments included:

- [1] Established cabinet level exception from jeopardy standard;
- [2] Critical habitat defined and designation required for listing;
- [3] Economic impacts considered when designating critical habitat;
- [4] Distinct population of vertebrates could be listed;
- [5] Required recovered plans for species listed as endangered; and
- [6] Appropriated funding for programs through 1982.

1982 amendments included:

- [1] Listing based solely on best biological information available;
- [2] Critical habitat designation concurrent with listing only to maximum extent prudent and determinable;
- [3] Established time requirements for listing process;
- [4] Established recovery priority system;
- [5] Designation of experimental populations;
- [6] Limited prohibition on take of endangered plants;
- [7] Incidental take permits for development of private land;
- [8] Incidental take provision incorporated within Biological Opinions; and
- [9] Appropriated funds for programs through 1988.

1988 amendments included:

- [1] Prohibited recovery preference based on *Taxonomy*;
- [2] Required monitoring of recovered and candidate species;
- [3] Established recovery plan content requirements;
- [4] Required public review and comment on recovery plans;
- [5] Required reporting of recovery expenditures and species status;
- [6] Strengthened take prohibitions for endangered plants; and
- [7] Appropriated funds for programs through 1992.

Also see *National Oceanic and Atmospheric Administration (NOAA)*.

Endangered Species Conservation Act — Passed in 1969, this act superseded the *Endangered Species Preservation Act* of 1966 and would eventually be replaced by the *Endangered Species Act (ESA)* of 1973. Major provisions of this act included:

- [1] Identified vertebrates and invertebrates in danger of worldwide extinction;
- [2] Prohibited interstate commerce of illegally taken species;
- [3] Prohibited import or subsequent sale within U.S. with only few exceptions; and
- [4] Required an international agreement on trade in endangered species.

Endangered Species Preservation Act — Passed in 1966, this represented the first legislated effort towards identification and protection of animal species in the United States threatened by extinction. It represented the forerunner of the *Endangered Species Act (ESA)* of 1973, but would first be replaced by the *Endangered Species Conservation Act* of 1969. Major provisions of this act included:

- [1] Identification of native vertebrates in danger of extinction;

[2] Directed federal agencies to preserve habitat when “practicable and consistent”;

[3] Authorized establishment of *National Wildlife Refuges* to protect habitat; and

[4] Provided no protection except on refuges.

Endangerment Assessment — A study to determine the nature and extent of contamination at a site on the *National Priorities List* and the risks posed to public health or to the environment. The *U.S. Environmental Protection Agency (EPA)* or the state would conduct the study when a legal action is to be taken to direct potentially responsible parties to clean up a site or pay for it. An endangerment assessment supplements a *Remedial Investigation (RI)*.

Endemic — (Ecology) Confined to, or *Indigenous* in, a certain area or region, as an endemic plant or animal.

Endogenous — (Geology) Derived from within; geologic processes originating from internal causes within the earth or magma.

Endogenous Variable — (Statistics) Variables which are determined solely within the series of equations of the model. Also referred to as dependent variables as their values are assumed to be dependent upon the behavior of other pre-determined or explanatory variables, referred to as *Exogenous Variables*. An exception to this is a *Lagged Endogenous Variable*, which may also be an explanatory variable but whose value is determined within the system of equations by past values of the explanatory variables. For example, in the equation below, for any time period t (where $t=1, 2, \dots, n$),

$$Y_t = \hat{a} + \hat{a} X_t + \hat{a} Y_{t-1} + \hat{a}_t$$

where Y_t represents the endogenous variable, X_t represents the exogenous variable, and Y_{t-1} represents the lagged endogenous variable. Also referred to as the *Dependent Variable* or the variable to be explained (*Explained Variable*).

Endoreic — A term used to describe areas with terminal lakes and an interior drainage basin. Approximately 27 percent of the earth’s total land surface is endoreic; only about 5 percent of the North American continent is endoreic.

Endosmosis, also Endosmotic — The inward flow of a fluid through a permeable membrane toward a fluid of greater concentration. Contrast with *Exosmosis (Exosmotic)*.

Endrin — A pesticide toxic to freshwater and marine aquatic life that produces adverse health effects in domestic water supplies.

Energy — The capacity to perform work, or the potential for power and activity; energy may be captured or held in living matter (e.g., food is stored energy). Various forms of energy include kinetic, potential, thermal, nuclear, rotational, and electromagnetic. *Hydroelectric* power, a form of potential energy, is derived from flowing water, typically by allowing water to be raised to, or maintained at, an elevated height and then release energy as it flows to a lower level.

Energy Dissipator — (1) A structure for slowing the fast moving spillway flows of a dam in order to prevent erosion of the stream channel below the dam. (2) An apron of rocks, logs, concrete baffles, or other materials that slows down water flowing through a culvert or ditch, or over a dam, and thereby reduces its erosive force.

Energy Gradient — The change in energy per unit length in the direction of flow or motion.

(National) Energy Policy Act (EPAct) — A federal act passed in 1992 that established maximum water-use standards for newly manufactured plumbing fixtures. According to the act, any tank-type toilet for household use manufactured after January 1, 1994, must use a maximum of 1.6 gallons per flush. The same requirement is mandatory for all tank-type toilets for commercial use manufactured beginning in 1997. The EPAct also sets water-use standards for all newly manufactured urinals (a maximum of one gallon per flush), kitchen and bath faucets, and showerheads. [See Appendix C–3, Conservation from Efficient Water Fixtures.]

Enforceable Requirements — Conditions or limitations in permits issued under the *Clean Water Act (CWA)*, Section 202 or 404, that, if violated, could result in the issuance of a compliance order or initiation of a civil or criminal action under federal or applicable state laws.

Enforce (Water Right) — Generally refers to the allocation of water resources in strict accordance with various terms and conditions specified by a water right, i.e., priority dates, amounts, etc.

Englacial — Located or occurring within a glacier.

Enhanced Oil Recovery — Techniques for the removal of the remaining thick, heavy oil from reservoirs after primary recovery and secondary recovery techniques have been used. Typically, steam is injected into the reservoir to reduce the viscosity and provide pressure to force the oil into collection wells.

Enhanced Surface Water Treatment Rule (ESWTR) — A proposed rule promulgated by the *U.S. Environmental Protection Agency (EPA)* to take effect in the year 2000 intended to reduce the number of *Crypto Oocysts*

(*Cryptosporidium parvum*) found in raw water supplies used for drinking water.

Enhancement — Emphasis on improving the value of particular aspects of water and related land resources.

Enjoin — To prohibit or forbid, especially by legal action.

Enlibra (Initiative) — A set of environmental policy principles prepared by the Western Governors' Association (WGA) that symbolizes balance and stewardship as a means for reconciling economic development with sustaining natural resources. The doctrine speaks to greater participation and collaboration by citizens in resources decision making and promotes the use of market forces as tools to achieve resource conservation goals. A goal of Enlibra is to encourage people on all sides of resources issues to respect different values and to give affected parties a role in designing and implementing solutions. Principles and characteristics of the doctrine include:

- [1] Greater participation and collaboration in decision making by citizens who believe natural resources can be protected while still using them;
- [2] Focusing on results and not on programs;
- [3] Using tools other than regulations to protect and improve resources management and environmental quality;
- [4] Allowing local solutions for meeting national standards;
- [5] Replacing confrontation with collaboration;
- [6] Using science instead of subjectivity for policy making;
- [7] Using cost-effective means for achieving benefits;
- [8] Managing resources according to natural boundaries, not political or administrative ones.

[Source Information: Western Governors' Association, February 24, 1998, Policy Resolution 98-001] Also see for comparisons and contrasts, *Basin Management, Ecosystem Management, Integrated Resource Planning (IRP), Holistic, Watershed Management and Watershed Planning*.

Enrichment — The addition of nutrients, such as nitrogen and phosphorus and carbon compounds, into a lake or waterway to the point that the *Trophic Level* is greatly increased because of the stimulation of the growth of algae and other aquatic plants.

Ensarine (Euhaline) — Salinity approximating seawater (33 parts per million).

Enteric Fever — An acute, highly infectious disease caused by a bacillus (*Salmonella typhi*) transmitted chiefly by contaminated food or water and characterized by high fever, headache, coughing, intestinal hemorrhaging, and rose-colored spots on the skin. More commonly referred to as *Typhoid Fever*.

Enteric Viruses — A category of viruses related to human excreta found in waterways.

Enterococcus Bacteria — Bacteria commonly found in the feces of humans and other warm-blooded animals. Their presence in water is considered to verify fecal pollution. They are characterized as gram-positive, cocci bacteria that are capable of growth in brain-heart infusion broth. In the laboratory, they are defined as all the organisms that produce red or pink colonies within 48 hours at 35 degrees centigrade plus or minus 1 degree centigrade on KF-streptococcus medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100mL of sample.

Entitlement — (1) The right to receive, demand or do something, as a water entitlement. (2) The annual maximum amount of water which can be delivered to a parcel of land, a product of eligible acres and water duty (expressed in acre-feet per year).

Entrain — To trap bubbles in water either mechanically through turbulence or chemically through a reaction.

Entrainment — (Streams) (1) To be moved by water motion involuntarily. (2) The incidental trapping of fish and other aquatic organisms in the water, for example, used for cooling electrical power plants or in waters being diverted for irrigation or similar purposes.

Entrance Head — The *Head* required to cause flow into a conduit or other structure, including both entrance loss and *Velocity Head*.

Entrapment Zone — An area of an estuary or other watercourse where seaward-flowing fresh water overlays more dense, saline ocean water resulting in a two-layer mixing zone characterized by *Flocculation*, aggregation, and accumulation of suspended materials from upstream.

Environment — All of the external factors, conditions, and influences which affect the growth, development, and survival of organisms or a community. The components of an environment include climate, physical, chemical, and biological factors, nutrients, and social and cultural conditions. These influences affect the form and survival of individuals and communities.

Environmental Analysis — (1) An analysis of alternative actions and their predictable short and long-term environmental effects, which may include physical, biological, economic, social and environmental design factors and their interaction. (2) (NEPA) Systematic process for considering environmental factors in resource management actions.

Environmental Assessment (EA) — An environmental analysis prepared pursuant to the *National Environmental Policy Act (NEPA)* that presents the first thorough examination of alternative plans to positively demonstrate that the environmental and social consequences of an applicable project or action were considered. If it is determined that proposed actions would not have a significant impact on the environment, then a *Finding of No Significant Impact (FONSI)* would be issued. If it is shown that such activities do, in fact, significantly impact the environment or are otherwise deemed controversial, then an *Environmental Impact Statement (EIS)* will normally be required.

Environmental Audit — (1) An internal investigation of company compliance with environmental regulations. (2) A study of a site prior to a real estate transaction to uncover potential environmental liability associated with the property, such as the prior improper disposal of hazardous wastes into the ground. (3) An independent assessment of the current status of a party's compliance with applicable environmental requirements or of a party's environmental compliance policies, practices, and controls.

Environmental Defense Fund (EDF) — A national, non-profit environmental and conservation organization active in legal, economic, and scientific aspects of environmental issues. The EDF employs scientists, attorneys, economists, computer modelers, and other environmental professionals whose purpose is to propose practical and economically feasible solutions to major environmental problems. The EDF has been responsible for a number of important environmental law cases coming to the attention of the courts in the United States. The EDF is headquartered in New York City and has six other offices across the United States. The EDF was founded in the early 1970s when scientists documented the effects of the pesticide DDT on humans, wildlife, and the environment. The EDF subsequently joined with scientists and attorneys and successfully campaigned to have DDT banned nationwide in 1972. Currently, major EDF projects include: (1) limiting the greenhouse effect and climate change; (2) improving air quality; (3) tracing and blocking the sources of ocean pollution; (4) enforcing and extending the *Endangered Species Act (ESA)*; (5) limiting chemical pollution and its effects on human health and the environment; (6) promoting water and energy conservation; (7) encouraging recycling and the reduction of solid waste; and (8) protecting endangered land areas such as Antarctica and the rain forests in Brazil, West Africa, and Indonesia.

Environmental Evaluation — That part of the planning process by governmental agencies that inventories and estimates the potential effects on the human environment of alternative solutions to resource problems, determines the need for an *Environmental Assessment (EA)* or an *Environmental Impact Statement (EIS)*, and aids in the consideration of alternatives and the identification of available resources.

Environmental Impact Statement (EIS) — A report required by Section 102(2)(c) of Public Law 91-190, *National Environmental Policy Act (NEPA)*, for all major projects which significantly impact on the quality of the human environment or are environmentally controversial. The EIS is a detailed and formal evaluation of the favorable and adverse environmental and social impacts of a proposed project and its alternatives. A tool for decision making, the EIS describes the positive and negative effects of an undertaking and cites possible, less environmentally disruptive alternative actions. Also see *Environmental Assessment (EA)*.

Environmental Indicator — A measurement, statistic or value that provides a proximate gauge or evidence of the effects of environmental management programs or of the state or condition of the environment.

Environmentalism — Advocacy for or work toward protecting the natural environment from destruction or pollution.

Environmental Manipulation — Actions taken directly or indirectly by man to alter the natural characteristics and evolving patterns of an *Ecosystem* through alterations to plant or animal life, or habitat conditions.

(United States) Environmental Protection Agency (EPA) — The U.S. Environmental Protection Agency (EPA) is responsible for implementing the federal laws designed to protect the environment. EPA endeavors to accomplish its mission systematically by proper integration of a variety of research, monitoring, standard-setting, and enforcement activities. As a complement to its other activities, EPA coordinates and supports research and anti-pollution activities of state and local governments, private and public groups, individuals, and educational institutions. EPA also monitors the operations of other Federal agencies with respect to their impact on the environment. EPA was created through Reorganization Plan #3 of 1970, which was devised to consolidate the federal government's environmental regulatory activities into a single agency. The plan was sent by the President to Congress on July 9, 1970, and the agency began operation on December 2, 1970. EPA was formed by bringing together 15 components from 5 executive departments and independent agencies. Air pollution control, solid waste management, radiation control, and the drinking water program were transferred from the Department of Health, Education, and Welfare (now the Department of Health and Human Services). The federal water pollution control program was taken from the Department of the Interior, as was part of a pesticide research program. From the Department of Agriculture, EPA acquired authority to register pesticides and to regulate their use, and from the Food and Drug Administration, EPA inherited the responsibility to set tolerance levels of pesticides in food. EPA

was assigned some responsibility from the Atomic Energy Commission, and absorbed the duties of the Federal Radiation Council. The enactment of major new environmental laws and important amendments to older laws in the 1970s and 1980s greatly expanded EPA's responsibilities. The agency now administers ten comprehensive environmental protection laws:

- [1] Clean Air Act (CAA)
- [2] Clean Water Act (CWA)
- [3] Safe Drinking Water Act (SDWA)
- [4] Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or "Superfund")
- [5] Resource Conservation and Recovery Act (RCRA)
- [6] Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
- [7] Toxic Substances Control Act (TSCA)
- [8] Marine Protection, Research, and Sanctuaries Act (MPRSA)
- [9] Uranium Mill Tailings Radiation Control Act (UMTRCA)
- [10] Pollution Prevention Act

The primary mandates for the water-related programs administered through the EPA Water Management Division are the *Federal Water Pollution Control Act (Public Law 92-500)*, as amended, commonly referred to as the *Clean Water Act (CWA)*, and the *Safe Drinking Water Act (SDWA — Public Law 93-523)*. The CWA addresses the discharge of pollutants from point and nonpoint sources into waters of the United States (as defined). The goal of the SDWA is to protect public health over lifetime exposure to drinking water by ensuring that the source water as well as the system storage distribution and service lines are free and protected from contamination. EPA water-related programs establish national and regional objectives, promote delegation of programs to states (primacy), and support that delegation in a manner that ensures achievement of required objectives. Also see *Science Advisory Board (SAB)*. [See Appendix E-1 for a more complete description of the organizational structure of the U.S. Environmental Protection Agency.]

Environmental Water — The water for wetlands, the instream flow for a major river (based on the largest fish flow specified in an entire reach of that river) or, for wild and scenic rivers, the amount of water based on unimpaired natural flow. Also referred to as *Dedicated Natural Flows*.

Enzyme — Any of numerous proteins or conjugated proteins produced by living organisms and functioning as biochemical catalysts. Specifically, an organic catalyst that accelerates (catalyzes) specific transformations of material in plants and animals. Enzymes are elaborated by cells, but their action is independent of life processes and they are not consumed in the course of their action. They occur in all tissues, particularly in digestive secretions, and are of greatest importance for the cellular processes or the digestion and utilization of food.

Eolian — Pertaining to the wind; especially said of rocks, soils, and deposits (such as loess, dune sand, sand from volcanic tuffs) whose constituents were transported (blown) and laid down by atmospheric currents, or of landforms produced or eroded by the wind, or of sedimentary structures (such as ripple marks) made by the wind, or of geologic processes (such as erosion and deposition) accomplished by the wind.

Eolian Soil Material — Soil material accumulated through wind action.

EPA — See (*United States*) *Environmental Protection Agency (EPA)*.

Ephemeral (Stream) — A stream that flows only in direct response to precipitation, and thus discontinues its flow during dry seasons. Such flow is usually of short duration. Most of the dry washes of more arid regions may be classified as ephemeral streams. Also see *Stream*.

Epidemiology — The study of the incidence, transmission, distribution, and control of infectious disease (including waterborne disease) in large populations.

Epilimnion — The warm upper layer of a body of water with thermal stratification, which extends down from the surface to the *Thermocline*, which forms the boundary between the warmer upper layers of the epilimnion and the colder waters of the lower depths, or *Hypolimnion*. The epilimnion is less dense than the lower waters and is wind-circulated and essentially homothermous. Also see *Thermal Stratification*, *Fall Overturn*, and *Spring Overturn*.

Epiphyte — A plant that grows on another plant but is not a parasite and produces its own food by photosynthesis, as certain orchids, mosses, and lichens; an air plant.

Epithermal — A *Hydrothermal* mineral deposit formed within approximately one kilometer (0.6 mile) of the earth's surface and in the temperature range of 50°C (122°F) to 200°C (392°F).

Equal Discharge Increment (EDI) — A method used in measuring suspended sediment in a stream wherein samples are obtained at the centroids of equal discharge increments. This method requires knowledge of the flow distribution in the stream cross section, but can save time over the *Equal Transit Rate (ETR)* method because fewer verticals are required.

Equal Footing Doctrine (U.S. Constitution) — A provision of the U.S. Constitution which provides to each state the title to tidelands and the beds of *Navigable* lakes and streams within its borders. In conjunction with the *Public Trust Doctrine*, which is generally recognized in some form by most states, these provisions embody the principle that the state holds title to such properties within the state in trust for the beneficial use of all its citizens and that public rights of access to and for the use of tidelands and navigable waters are inalienable. Traditional public trust rights include navigation, commerce, and fishing, and in some cases have been extended to include protection of fish and wildlife, preserving trust lands in their natural condition for scientific study and scenic enjoyment, and related open-space uses.

Equal Transit Rate (ETR) — A method used in measuring *Suspended Sediment* in a stream wherein the sample volume taken is proportional to the streamflow at each of several equally spaced verticals. This technique results in a gross sample proportional to the total streamflow.

Equilibrium Condition — As used in the chemical sense, a state in which there are no changes in the relative concentrations of the chemical species present in a system. The specific relationship is given by the equilibrium constant for the reaction of interest. Used in reference to a groundwater system it describes a condition in which all inputs (of water) equal all outputs. The *Groundwater Table* is neither rising nor falling under equilibrium conditions.

Equilibrium Constant — A value which describes the relationship between chemical species in a system at equilibrium. The value of the constant is dependent upon temperature.

Equilibrium Drawdown — The ultimate constant drawdown for a steady rate of pumped discharge.

Equilibrium Surface Discharge — The steady rate of surface discharge which results from a steady rate of net rainfall over a long period, with the discharge rate equal to the net rainfall rate.

Equilibrium Time — The point in time when flow conditions become substantially equal to those corresponding to *Equilibrium Surface Discharge* or *Equilibrium Drawdown*.

Equinoctial — A violent storm of wind and rain occurring at or near the time of the equinox.

Equipotential Line — A line in a field of flow such that the total head is the same for all points on the line; therefore, the direction of flow is perpendicular to the line at all points.

Equipotential Surface — A surface (or line) in a three-dimensional ground-water flow field such that the total hydraulic head is the same everywhere on the surface.

Erodible — Susceptible to *Erosion*.

Erosion — (1) Detachment of soil particles under the influence of water and/or wind. (2) The wearing away and removal of materials of the earth's crust by natural means. (3) The process by which flood waters lower the ground surface in an area by removing upper layers of soil. As usually employed, the term includes weathering, solution, corrosion, and transportation. The agents that accomplish the transportation and cause most of the wear are running water, waves, moving ice, and wind currents. Most writers include under the term all the mechanical and chemical agents of weathering that loosen rock fragments before they are acted on by the transportation agents; a few authorities prefer to include only the destructive effects of the transporting agents. Various types of water erosion include:

- [1] **Accelerated** – Erosion much more rapid than normal, natural, or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of other animals or natural catastrophes that expose bare surfaces, for example, forest fires;
- [2] **Geological** – The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing away of mountains, the building up of floodplains, coastal plains, etc., and also referred to as natural erosion;
- [3] **Gross** – A measure of the potential for soil to be dislodged and moved from its place of origin, not necessarily the amount of soil that actually reaches a stream or lake, but the amount of soil that can be calculated from water and wind equations;
- [4] **Gully** – The erosion process whereby water accumulates in narrow channels and, over short periods of time, removes soil from this narrow area to considerable depths, ranging from 1–2 feet (0.3–0.6 meters) to as much as 75–100 feet (23–31 meters);
- [5] **Natural** – The wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man, and also referred to as geological erosion;
- [6] **Normal** – The gradual erosion of land used by man that does not greatly exceed natural erosion;
- [7] **Overfall** – Erosion caused by water flowing over an overfall;
- [8] **Rill** – An erosion process in which numerous small channels only several inches deep are formed; occurs

mainly on recently cultivated soils and/or recent cuts and fills;

- [9] **Sheet** – The removal of a thin, fairly uniform layer of soil from the land surface by runoff waters;
- [10] **Shore** – Removal of soil, sand, or rock from the land adjacent to a body of water due to wave action;
- [11] **Splash** – The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff;
- [12] **Streambank** – Scouring of material and the cutting of channel banks by running water;
- [13] **Streambed** – Scouring of material and cutting of channel beds by running water;
- [14] **Undercutting** – Removal of material at the base of a steep slope, overfall, or cliff by falling water, a stream, wind erosion, or wave action; the removal steepens the slope or produces an overhanging cliff.

Erosion Ballon — A metaphorical term for commonly obovately shaped, eroded sideslope areas that normally empty into an incised drainageway and are surrounded by non-eroded sideslopes.

Erosion, Bank — Destruction of land areas bordering rivers or water bodies by the cutting or wearing action of waves or flowing water.

Erosion, Beach — The retrogression of the shore line of large lakes and coastal waters caused by wave action, shore currents, or natural causes other than *Subsidence*.

Erosion Control — Materials, structures, and actions utilized and taken to reduce or prevent erosion.

Erosion, Gross — The total of all sheet, gully, and channel erosion in a drainage basin, usually expressed in units of mass.

Erosion, Gully — The widening, deepening, and headcutting of small channels and waterways due to erosion.

Erosion Hazard — A predictive rating of the erosion potential for a specific soil or location.

Erosion Potential — A ranking of a soil's potential to erode.

Erosion, Rill — Removal of soil by running water with formation of shallow channels that can be smoothed out completely by normal cultivation (tillage).

Erosion, Sheet — The removal of a fairly uniform layer of soil or materials from the land surface by the action of rainfall and runoff water.

Erosion Control — The application of necessary measures including artificial structures, vegetative manipulation, water control, or physical soil changes to minimize soil erosion.

Erosion Flood Plain — A flood plain that has been created by the lateral erosion and the gradual retreat of the valley walls.

Erosive — The action of wind or water having sufficient velocity to cause *Erosion*. Not to be confused with *Erodible* as a quality of soil.

ESA (Endangered Species Act) — An act passed by Congress in 1973 intended to protect species and subspecies of plants and animals that are of “aesthetic, ecological, educational, historical, recreational and scientific value.” It may also protect the listed species’ “critical habitat”, the geographic area occupied by or essential to the species. The *U.S. Fish and Wildlife Service (USFWS)* and the *National Marine Fisheries Service (NMFS)* share authority to list endangered species, determine critical habitat and develop recovery plans for listed species. As of July, 1993, nationwide, some 728 plants and animals were on the federal threatened or endangered list. Further, under a settlement with environmental groups, USFWS has agreed to propose listing another 400 species over the next few years.

Escarpment — A steep slope or long cliff that results from erosion or faulting and separates two relatively level areas of differing elevations; the topographic expression of a fault.

Escherichia Coli (*E. Coli*) — A bacterial species which inhabits the intestinal tract of man and other warm-blooded animals. Although it poses no threat to human health, its presence in drinking water does indicate the presence of other, more dangerous bacteria. Specifically, *E. coli* are a member species of the fecal coliform group of indicator bacteria. In the laboratory, they are defined as those bacteria that produce yellow or yellow-brown colonies on a filter pad saturated with urea substrate broth after primary culturing for 22 to 24 hours at 44.5 degrees centigrade on mTEC medium. Their concentrations are expressed as number of colonies per 100 mL of sample.

Esker — A narrow ridge of gravelly or sandy glacial outwash material deposited by a stream in an ice tunnel within a glacier. Also referred to as *os3*.

Established — A plant firmly rooted and producing a good growth of leaves.

Estuarine — (1) Of, pertaining to, or formed in, an *Estuary*. (2) One of the classification systems under the *Wetlands and Deepwater Habitats* classification system. See *Wetlands*. [Also see Appendix D–2, *Wetlands and Deepwater Habitats*, for additional information on this classification system and specific characteristics of Estuarine Systems.]

Estuarine Waters — Deepwater tidal habitats and tidal wetlands that are usually enclosed by land but have access to the ocean and are at least occasionally diluted by freshwater runoff from the land (such as bays, mouths of rivers,

salt marshes, lagoons, etc.).

Estuarine Zone — The area near the coastline that consists of estuaries and coastal saltwater wetlands.

Estuary — (1) An area where fresh water meets salt water; for example, bays, mouths of rivers, salt marshes, and lagoons. (2) That portion of a coastal stream influenced by the tide of the body of water into which it flows, for example, a bay or mouth of a river, where the tide meets the river current; an area where fresh and marine waters mix. The *Coastal Zone Management Act* of 1972 defines an estuary as “that part of a river or stream or other body of water having unimpaired connection with the open sea, where the sea-water is measurably diluted with freshwater derived from land drainage.” These brackish water ecosystems shelter and feed marine life, birds, and wildlife.

Euphotic — Of, relating to, or being the uppermost layer of a body of water that receives sufficient light for *Photosynthesis* and the growth of green plants. Also see *Euphotic Zone*.

Euphotic Zone — An area, particularly in regard to lakes, where there is sufficient light for *Photosynthesis* to take place. Contrast with *Bathyal Zone* and *Abyssal Zone*. Also see *Zone of Net Metabolic Production*.

Eurybathic — Capable of living in a wide range of water depths. Use of an aquatic organism.

Euryhaline — Capable of tolerating a wide range of salt water concentrations. Use of an aquatic organism.

Eurythermic — Capable of tolerating a wide range in temperature.

Eutrophic (Water) — Pertaining to a lake or other body of water characterized by large nutrient concentrations such as nitrogen and phosphorus 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)*.

Eutrophication — (1) The degradation of water quality due to enrichment by nutrients, primarily nitrogen (N) and phosphorus (P), which results in excessive plant (principally algae) growth and decay. When levels of N:P are about 7:1, algae will thrive. Low dissolved oxygen (DO) in the water is a common consequence. (2) The process of enrichment of water bodies by nutrients. (3) Over-enrichment of a lake or other water body with nutrients, resulting in excessive growth of organisms and the depletion of oxygen. 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). Eutrophication of a lake normally contributes to its slow evolution into a *Bog* or *Marsh* and ultimately to dry land. Eutrophication may be accelerated by human activities and thereby speed up the aging process. Also see *Carlson's Trophic State Index (TSI)* and *(Mean) Trophic State Index (TSI)*.

Eutrophic Lakes — Lakes that are rich in nutrients and organic materials, therefore, highly productive for plant growth. These lakes are often shallow and seasonally deficient in oxygen in the *Hypolimnion*. Also see *Oligotrophic Lakes*.

Eutrophic Zone — An area, particularly with respect to lakes, where there exists sufficient light for photosynthesis to take place.

Evaporation — (1) The physical process by which a liquid (or a solid) is transformed to the gaseous state. (2) The process by which water is changed from a liquid to a vapor. In *Hydrology*, evaporation is vaporization that takes place at a temperature below the boiling point. Also see *Evapotranspiration*.

Evaporation, Land — Evaporation from land surfaces, in contrast to evaporation from free water surfaces.

Evaporation, Net Reservoir — The evaporative water loss from a reservoir after making allowance for precipitation on the reservoir and runoff that would have occurred from that precipitation from the land area covered by the reservoir. Net reservoir evaporation equals the total evaporation minus the precipitation on the reservoir plus the runoff from the land area covered by the reservoir.

Evaporation Opportunity (Relative Evaporation) — The ratio of the rate of evaporation from a land or water surface in contact with the atmosphere, to the Evaporativity under existing atmospheric conditions. It is the ratio of actual to potential rate of evaporation, generally expressed as a percentage. The opportunity for a given rate of evaporation to continue is determined by the available moisture supply.

Evaporation Pan — An open tank used to contain water for measuring the amount of evaporation. The U.S. Department of Commerce Weather Bureau Class A pan is 4 feet in diameter, 10 inches deep, set up on a timber grillage so that the top rim is about 16 inches from the ground. The water level in the pan during the course of observation is maintained between 2 and 3 inches below the rim.

- Evaporation Ponds** — (Water Quality) Shallow ponds in which sewage sludge is placed to dry and then be removed for further treatment and/or disposal. Also, shallow ponds used to extract through evaporation various chemicals in solution or suspension, e.g., salt evaporation ponds. Also see *Evaporites*.
- Evaporation Rate** — The quantity of water which evaporates from a given surface per unit of time, usually expressed in inches or depth per day, month, or year.
- Evaporation, Total** — The sum of water lost from a given land area during any specific period of time by transpiration from vegetation and the building of plant tissue; by evaporation from water surfaces, moist soil, and snow; and by interception. It has been variously termed *Evaporation*, *Evaporation from Land Areas*, *Evapotranspiration*, *Total Loss*, *Water Loss*, and *Fly Off*.
- Evaporative Cooling** — Cooling of a liquid, such as water, by allowing a portion to evaporate. The process is important in the operation of cooling towers used to cool heated effluents from power plants as well as in the cooling of the human body through the evaporation of perspiration. The process is more effective than convection cooling.
- Evaporativity (Potential Rate of Evaporation)** — The rate of evaporation under the existing atmospheric conditions from a surface of water that is chemically pure and has the temperature of the atmosphere.
- Evaporites** — Sediments deposited from an aqueous (water) solution as a result of extensive or local evaporation of a solvent, such as salts in the Great Salt Lake in the western United States.
- Evapotranspiration (ET)** — (1) The process by which plants take in water through their roots and then give it off through the leaves as a by-product of respiration; the loss of water to the atmosphere from the earth's surface by evaporation and by transpiration through plants. (2) The quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. (3) The sum of *Evaporation* and *Transpiration* from a unit land area. (4) The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. (5) The combined evaporative-type processes, including evaporation, interception, and transpiration, usually applied to biological systems. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (*Phreatophytes*) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.
- Evapotranspiration, Actual** — The evapotranspiration that actually occurs under given climatic and soil-moisture conditions.
- Evapotranspiration of Applied Water (ETAW)** — The portion of the total *Evapotranspiration* which is provided by irrigation and landscape watering.
- Evapotranspiration, Potential** — (1) The maximum quantity of water capable of being evaporated from the soil and transpired from the vegetation of a specified region in a given time interval under existing climatic conditions, expressed as depth of water. (2) The water loss that will occur if at not time there is a deficiency of water in the soil for use by vegetation.
- Evapotranspirometer** — An instrument designed to measure *Evapotranspiration* as related to a particular place, soil type, and vegetation. The device consists of a block of soil with some planted vegetation enclosed in a container. Evapotranspiration is determined by maintaining a *Water Budget* for the container, that is, accounting for the water applied, water drained off the bottom, and the change in the moisture content of the soil. If there is a provision for drainage of the soil water, the device is referred to as a *Lysimeter*.
- Everglade** — A tract of marshland, usually under water and covered in places with tall grass. Usually used in the plural.
- Everglades [Florida]** — The Everglades are extensive marshlands in southern Florida. They originally extended about 100 miles (160 kilometers) from Lake Okeechobee south to the Gulf of Mexico. More than 40 miles (64 kilometers) wide in some sections, they have an area of about 4,000 square miles (10,360 square kilometers). The northern part of the Everglades has been drained by a complex system of canals and dikes, and its rich soils are now used for farming. The southern part has been preserved as the 2,188 square mile (1,400,533-acre) Everglades National Park, which was established in 1947. The Everglades were formed in a flat, shallow basin with a limestone floor that slopes very gradually to the Gulf of Mexico. The area receives over 55 inches (140 centimeters) of rain annually. Water accumulates on the surface because the porous limestone floor has been sealed by peat deposits formed by decomposing vegetation. Evaporation and drainage to the Gulf of Mexico regulate the water level. The Everglades support a unique pattern of vegetation characterized by plains of saw grass and thick hummocks of pine, cypress, and mangrove trees. The mangrove may grow as high as 70–80 feet (21–24 meters). A unique ecological system, the Everglades are under threat from 100 years of dredging, draining, and land clearing. The flow of water across the area and into the Biscayne Aquifer has been drastically reduced; seawater

has intruded into the aquifer; and fertilizer runoff has encouraged the growth of algae and of non-indigenous flora. A major rescue effort has begun, involving primarily the restoration of natural water courses throughout the Everglades based on early channelization efforts of the U.S. Army Corps of Engineers (COE).

Evergreen (Plant) — (Botanical) Remaining verdant, as coniferous trees and many tropical plants. Contrasted with *Deciduous* whose leaves, fruit, or petals fall at the end of the growing period.

Evergreen Stand — A plant community where *Evergreen* trees or shrubs represent more than 50 percent of the total areal coverage of trees and shrubs. The canopy is never without foliage; however, individual trees or shrubs may shed their leaves.

EWMP — See *Efficient Water Management Practices (EWMP)*.

Exceedence — (Water Quality) The violation of the pollutant levels permitted by environmental protection standards.

Exceedence Interval — The average number of years between the occurrence of an event of a given magnitude and one that is more extreme.

Excessive Precipitation — Standard U.S. Weather Bureau term for “rainfall in which the rate of fall is greater than certain adopted limits, chosen with regard to the normal precipitation (excluding snow) of a given place or area.” Not the same as *Excess Rainfall*.

Excess Land (USBR) — Irrigable land, other than *Exempt Land*, owned by any landowner in excess of the maximum ownership entitlement under applicable provision of reclamation law.

Excess Rainfall — Effective rainfall in excess of infiltration capacity, resulting in runoff. Not the same as *Excessive Precipitation*.

Exempt Land (USBR) — Irrigation land in a district to which the acreage limitation and pricing provisions of reclamation law do not apply. Also see *Excess Land*.

Exempted Aquifer — Underground bodies of water defined in the *Underground Injection Control (UIC)* program as aquifers that are potential sources of drinking water though not being used as such, and thus exempted from regulations barring underground injection activities.

Exempted — (Water Quality) A state (with *Primacy*) may exempt a *Public Water System (PWS)* from a requirement involving a *Minimum Contaminant Level (MCL)*, treatment technique, or both, if the system cannot comply due to compelling economic or other factors, or because the system was in operation before the requirement or MCL was instituted, and the exemption will not create a public health risk.

Exhaust Trail — A condensation trail that is visible when water vapor in aircraft exhaust mixes with the air in the vehicle’s wake and saturates it. Also referred to as a *Contrail* or *Vapor Trail*.

Existing Construction (FEMA) — As used in reference to the *National Flood Insurance Program (NFIP)*, any structure already existing or on which construction or substantial improvement was started prior to the effective date of a community’s floodplain management regulations.

Exogenous — (Geology) Geologic processes originating at or near the surface of the earth or magma.

Exogenous Variable — (Statistics) A variable whose value is determined completely outside the model system and whose behavior is used to describe that of the *Endogenous Variable*. As such the terms independent or explanatory variable are frequently used. An exception to this is a *Lagged Endogenous Variable*, which may also be an explanatory variable but whose value is determined within the system of equations by past values of the explanatory variables. For example, in the equation below, for any time period t (where $t=1, 2, \dots, n$),

$$Y_t = \hat{a} + \hat{a} X_t + \hat{a} Y_{t-1} + \hat{a}_t$$

where Y_t represents the endogenous variable, X_t represents the exogenous variable, and Y_{t-1} represents the lagged endogenous variable. Also referred to as the *Independent Variable* or the *Explanatory Variable*.

Exosmosis, also Exosmotic — The passage of a fluid through a semipermeable membrane toward a solution of lower concentration, especially the passage of water through a cell membrane into the surrounding medium. Contrast with *Endosmosis (Endosmotic)*.

Exotic — (1) An organism or species that is not native to the area in which it is found. (2) A non-native or non-indigenous species, usually introduced as the result of human activities.

Exotic Species — A non-native species that is introduced into an area.

Exploratory Holes — An excavation drilled to obtain engineering or geological data for the purposes of defining water bearing formations for production wells.

Exponential Decay — (Statistics) A rate of decay (decline) characterized by a fixed percentage each time period, e.g., a 10 percent decline in each period of time. Represented by the equation:

$$N(t) = N_0 e^{-kt}$$

where $N(t)$ is the value of the variable at time period t , N_0 is the initial value, e is the base of the natural logarithm, k is a constant value, and t represents the various time period where $t = 1, 2, \dots, n$.

Exponential Growth — (Statistics) A rate of growth characterized by a fixed percentage each time period, e.g., a 10 percent growth each period of time. Represented by the equation:

$$N(t) = N_0e^{kt}$$

where $N(t)$ is the population level at time t , e is the base of the natural logarithm, k is a constant value, and t represents time period where $t = 1, 2, \dots, n$. Compare to *Arithmetic Growth* and *Sigmoid Growth*.

Exposure — The amount of pollution present in a given environment that represents a potential health threat to living organisms.

Exposure Assessment — Identifying the pathways by which toxicants may reach individuals, estimating how much of a chemical an individual is likely to be exposed to, and estimating the number likely to be exposed.

Exposure Indicator — A characteristic of the environment measured to provide evidence of the occurrence or magnitude of a response indicator's exposure to a chemical or biological stress.

Extended Aeration — (Water Quality) A modification of the activated sludge process which maintains a longer period of aeration, thus providing for sludge digestion within the aeration tank.

Externality — The unintended or unwanted byproduct of production or consumption which must be borne by society in general. A negative externality arises from the detrimental affects of use or production. For example, water pollution may represent a negative externality of motorcraft operation.

External Cost — The cost of production or consumption that must be borne by society and not specifically by the producer or consumer.

Extinction — (Biology) The complete disappearance of a species because of failure to adapt to environmental change. Compare to *Extirpation*.

Extinction Depth — The minimum depth from the surface to the groundwater table at which plant species that rely on groundwater can no longer survive.

Extirpated Species — A species rendered extinct in a given area.

Extirpation — (Biology) To destroy or remove completely, as a species from an particular area, region, or habitat. Compare to *Extinction*.

Extractable Organics — (Water Quality) Organic chemical compounds that can be removed from a water sample by the solvent methylene chloride under conditions of pH greater than 11 or less than 2. Organic compounds in water represent a class of pollutants that are potentially toxic materials.

Extrapolate/Extrapolation — (Statistics) The continuation, by means of simple estimation or sophisticated analysis, of a trend of time series data beyond its last observed value. The function of time series model building is to add some degree of certainty and confidence to this extrapolation process by analyzing the past behavior of the data and attempting to fit a model to its historical patterns which may then be used to forecast (extrapolate) its future values. Also see *Interpolate/Interpolation*.

Extreme High Water of Spring Tides — The highest tide occurring during a lunar month, usually near the new or full moon. This is equivalent to extreme higher high water of mixed semidiurnal tides.

Extreme Low Water of Spring Tides — The lowest tide occurring during a lunar month, usually near the new or full moon. This is equivalent to extreme lower low water of mixed semidiurnal tides.

Extreme Value Series — Hydrological series which includes the largest or smallest values, with each value selected from an equal time interval in the record.

Extrusive Bedrock — (Geology) Those *Igneous Rocks* derived from volcanic lavas that cooled on the surface of the earth. This lava cools rapidly and forms fine-textured rocks such as basalt and andesite.

Exude — (1) To ooze forth. (2) To discharge or emit a liquid gradually.