

Restoration, Creation and Recovery of Wetlands Effects of Hurricane Andrew (1992) on Wetlands in Southern Florida and Louisiana

By John K. Lovelace¹ and Benjamin F. McPherson¹

Hurricane Andrew was a small but powerful storm that caused massive destruction along a path through southern Florida and south-central Louisiana in late August 1992 (fig. 57). Rainfall associated with Andrew was light for a hurricane because of the small size and rapid forward movement of the storm. However, rainfall totals of more than 7 inches were recorded for the storm period in southeastern Florida and Louisiana; a high of 11.9 inches was recorded in Hammond, La. (Rappaport, 1992). Maximum sustained windspeeds of 141 mph (miles per hour), with gusts of 169 mph, were recorded on August 24, just before landfall in Florida (Rappaport, 1992). A storm surge of about 17 feet above sea level was recorded at Biscayne Bay, Fla. (fig. 58) and about 9 feet near Terrebonne Bay in south-central Louisiana (fig. 59).

Hurricane Andrew originated in the North Atlantic Ocean, moved westward over the Bahamas, and

made landfall near the southern tip of Florida on the morning of August 24. After passing over the Florida Everglades, the storm proceeded in a northwesterly direction across the Gulf of Mexico and made landfall in south-central Louisiana at Point Chevreuil on the morning of August 26. Andrew deteriorated rapidly after landfall in Louisiana and was downgraded to a tropical depression on August 27. The remnants of Andrew proceeded on a northeasterly path, producing severe weather throughout the Southeastern States (Rappaport, 1992).

Hurricane Andrew moved across southern Florida at an average forward speed of 18 mph (National Oceanic and Atmospheric Administration, 1992). As it crossed southern Florida, Andrew left a path of destruction 25 miles wide and 60 miles long (Gore, 1993).

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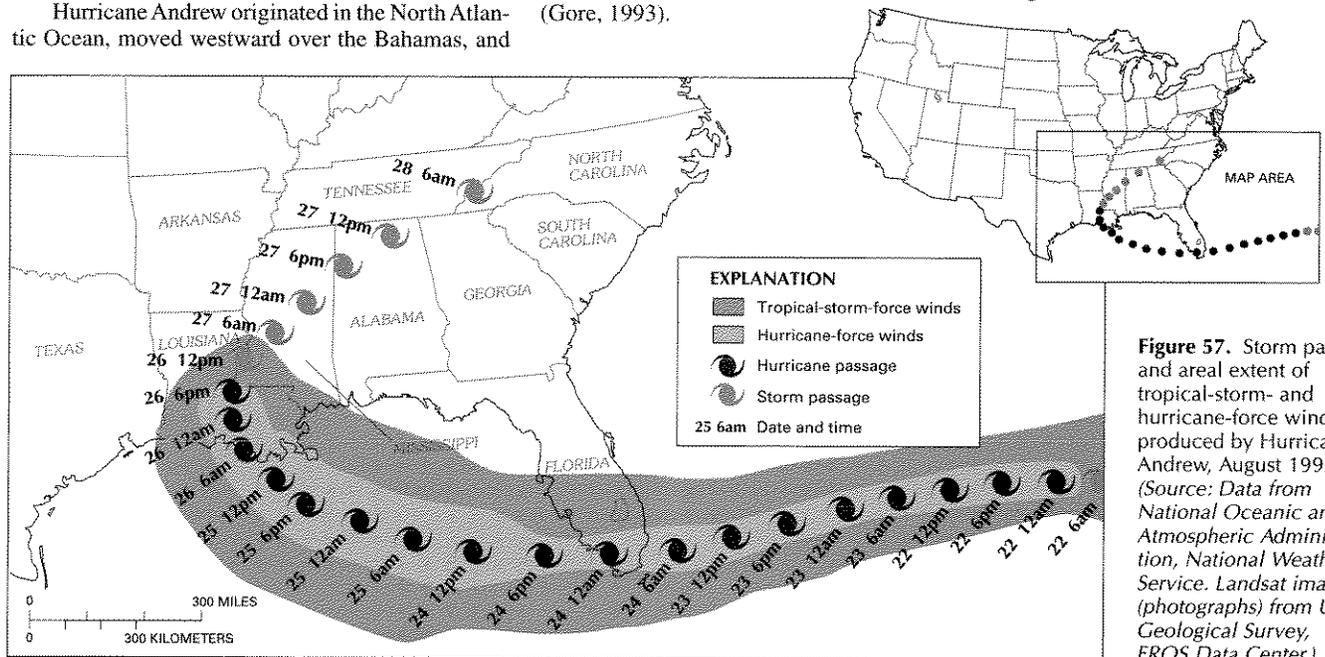
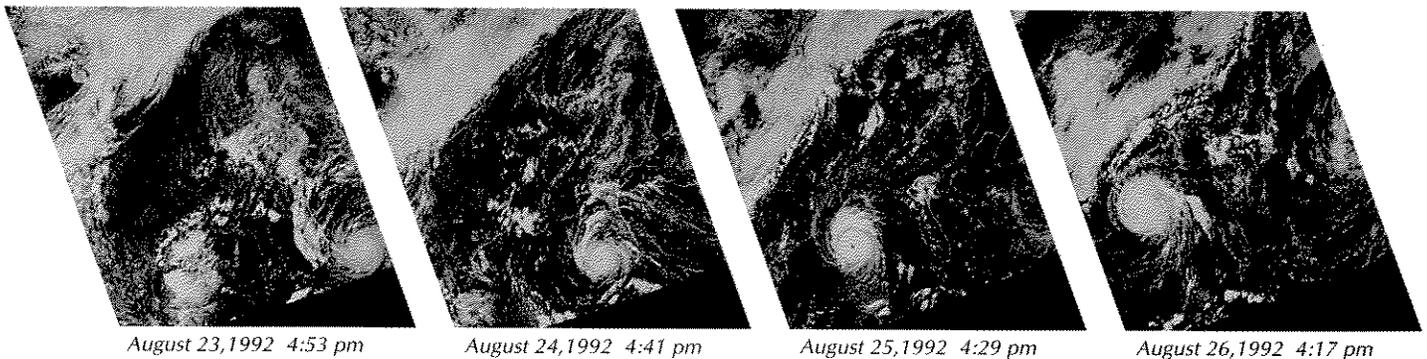


Figure 57. Storm path and areal extent of tropical-storm- and hurricane-force winds produced by Hurricane Andrew, August 1992. (Source: Data from National Oceanic and Atmospheric Administration, National Weather Service. Landsat images (photographs) from U.S. Geological Survey, EROS Data Center.)



¹ U.S. Geological Survey.

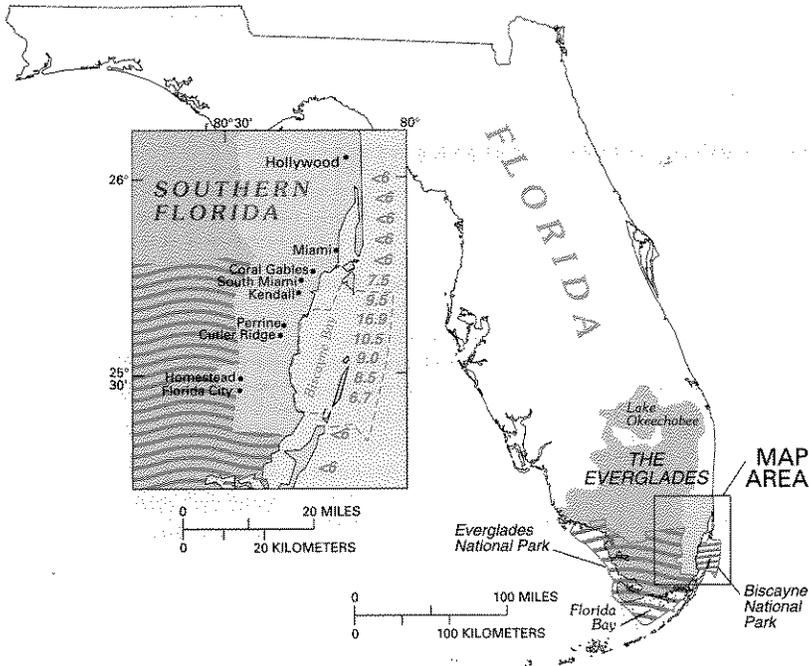


Figure 58. Storm-surge elevations, in feet above sea level, at selected points along the coast of Florida; < indicates less than. (Source: Data from U.S. Geological Survey files.)

Hurricane Andrew passed through the heart of the largest wetlands in the United States, the Florida Everglades. (See article "Florida Wetland Resources" in the State Summaries part of this volume.) Perhaps the most dramatic effect of the storm's passage through these wetlands was the major structural damage to trees caused by the strong winds. The storm passed directly over Biscayne National Park and Everglades National Park, knocking down or severely damaging mangrove trees on about 70,000 acres of wetlands in the two parks. Within the storm's path, virtually all large trees located in hammock areas (islands of dense, tropical undergrowth), typically hardwoods, were defoliated and about 25 percent of the trees were windthrown or badly broken. About one-fourth of the royal palms and one-third of the pine trees in Everglades National Park were broken or damaged by the winds (fig. 60). Damage to woody vegetation was most severe near the eye of the storm where winds were the strongest (Davis and others, 1994). However, within 20 days surviving trees and shrubs had sprouted new growth (Alper, 1992).

The storm appeared to have only minor effects on the interior freshwater wetlands of The Everglades, which are composed mainly of sawgrass. Nearly all post-storm (August 28 to September 17, 1992) water-quality properties sampled by the South Florida Water Management District were within the range of pre-storm values. These properties included

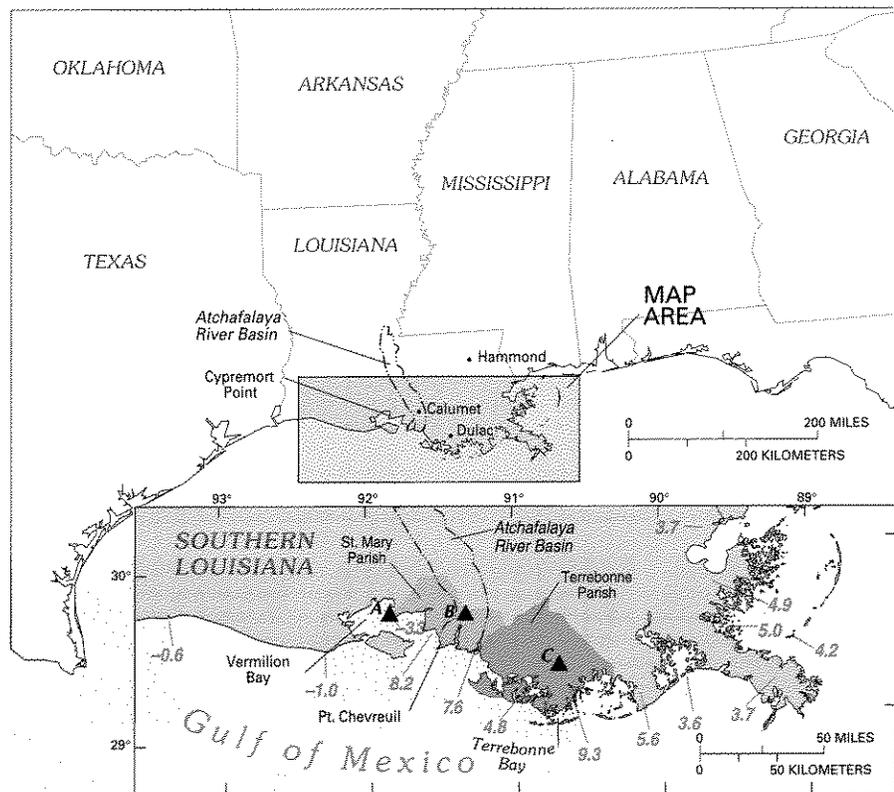
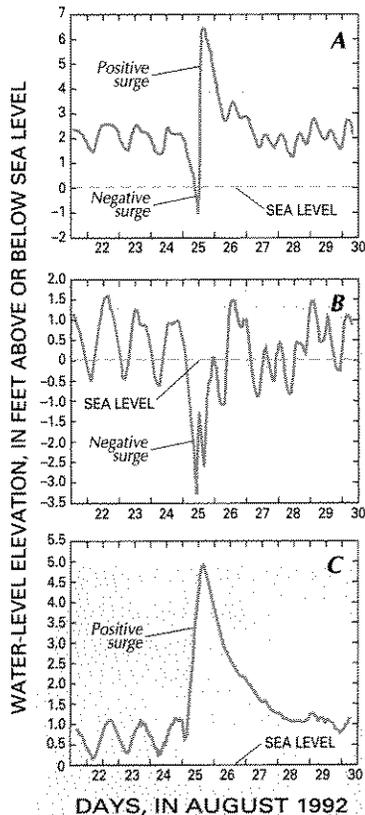


Figure 59. Storm-surge elevations, in feet above or below sea level, at selected points along the coast of Louisiana. Graphs indicate water levels at sites **A**, Vermilion Bay, near Cypremont Point; **B**, Wax Lake outlet, at Coleman; **C**, Houma Navigation Canal, at Dulac. (Source: Data from U.S. Geological Survey files.)

turbidity, color, ammonia, and dissolved phosphate. Wind-heaped, vegetative marsh debris was evident along the edges of some forested islands, and the characteristic periphyton mat (group of stalkless micro-organisms that live attached to surfaces projecting from the bottom of freshwater bodies) was absent or altered in structure. However, much of The Everglades' marsh appeared undamaged by the storm. A significant effect of the wind in the freshwater wetlands was the destruction of, or damage to, about 80 percent of the hydrologic and meteorologic monitoring stations located along the storm's path (Davis and others, 1994).

The hurricane had little effect on wildlife in The Everglades. Thirty-two deer wearing radio collars for a National Park Service study survived the hurricane, and the releafing of vegetation provided them with food and cover. Adult alligators appeared unaffected, but nests and young may have been adversely affected. Most wading birds survived; estimates of pre- and post-storm populations were similar, and about normal for the late-summer wet season (Davis and others, 1994).

In the marine environment, the major effects of the hurricane were changes in nearshore water quality, patches of intense bottom scouring, and beach overwash. Dramatically increased turbidity persisted in some areas for at least 30 days, particularly in western Biscayne Bay where mangrove peat soils continued to break down and enter the water. In northeastern Florida Bay, at the southern edge of the affected area, concentrations of ammonia, dissolved phosphate, and dissolved organic carbon increased dramatically. Phytoplankton (microscopic drifting aquatic plants) blooms added to the increased turbidity and, combined with low dissolved-oxygen concentrations, could have had severe effects on fish and invertebrate populations. In addition, fuel from hundreds of damaged boats and marina fuel tanks in Biscayne Bay continued to discharge into the water for at least 27 days after the hurricane had passed (Davis and others, 1994).

In Louisiana, the storm surge produced significant flooding in a few populated areas in the southern part of the State. However, there was no major flooding of inland rivers. The greatest surge was east of the point of landfall, where the counterclockwise rotation of winds, combined with forward motion of the hurricane, pushed water northward (fig. 59). Andrew also produced a negative surge of as much as 3 feet below sea level along the coast from about 10 miles west of landfall to the Texas State line, as the counterclockwise winds west of the hurricane's eye pushed water away from the shore. Because the hurricane was moving in a northwesterly direction at the time of landfall, areas near landfall experienced a negative surge as the hurricane was to the southeast, then a positive surge as the hurricane moved past and was to the west.

After making landfall in Louisiana, Hurricane Andrew curved back towards the northeast, passing over the Atchafalaya River Basin, which contains the largest hardwood swamp (1.5 million acres) in the United States, and Louisiana's largest palustrine wetland. (See article "Louisiana Wetland Resources" in this volume.) In parts of the basin, the storm severely



Figure 60. Hammock (top) and pine forest (bottom) in Everglades National Park, Fla., after Hurricane Andrew, September 1992. (Photographs by Benjamin F. McPherson, U.S. Geological Survey.)

damaged trees, primarily willows and some cypress. Near the coast, about 80 percent of the trees were knocked down; about 20 miles inland, the estimates were about 30 percent. With the loss of trees, an estimated 50 to 75 percent of the young squirrels in the area, those produced during the second litter of the year, died. The storm had little effect on deer (David Morrison, Louisiana Department of Wildlife and Fisheries, oral commun., 1993).

In the Atchafalaya River Basin, an estimated 182 million freshwater fish perished because of the resuspension of anaerobic bottom materials in the water column (fig. 61). Most of the fish probably died during the first 24 hours after the storm as toxic hydrogen sulfide was released from bottom sediments, and decaying organic matter consumed dissolved oxygen, causing fish to asphyxiate (Gary Tilyou, Louisiana Department of Wildlife and Fisheries, oral commun., 1993). After the storm, U.S. Geological Survey personnel measured dissolved-oxygen concentrations of less than 1 mg/L throughout most of the basin, in an area extending northward more than 60 miles from the coast (Charles Demas, U.S. Geological Survey, oral commun., 1993). Dissolved-oxygen concentrations in the upper water column of larger water bodies in the Atchafalaya River Basin generally range from 3 to 6 mg/L during summer months (Dennis K. Demecheck, U.S. Geological Survey, oral commun., 1994). During the 2 weeks follow-

Hurricane Andrew passed through the heart of the largest wetlands in the United States.



Figure 61. Dead fish in the Atchafalaya River Basin, La., September 2, 1992. (Photograph by Charles R. Demas, U.S. Geological Survey.)

ing the hurricane, fishkills were caused primarily by the movement of water containing low concentrations of dissolved oxygen into previously unaffected water (Gary Tilyou, Louisiana Department of Wildlife and Fisheries, oral commun., 1993). The value of freshwater fish killed was about \$160 million, most of which was attributed to the estimated 29,000 paddlefish that died. (The paddlefish is an endangered species and its valuation is based on the \$2,500 per-fish fine for killing paddlefish.) Estimates of the number of other species killed (in millions) include shad, 100; bream, 23; crappie, 7; largemouth bass, 5; fresh-water drum, 11; buffalo, 12; catfish, 11; and carp, 1 (Harry Blanchet, Louisiana Department of Wildlife and Fisheries, oral commun., 1993).

In the coastal waters, an estimated 9.4 million saltwater fish valued at \$7.8 million were killed by the storm. The exact causes of death are uncertain, but popular theories include suffocation, caused by clogging of gills by sediment, and gas-bubble disease, caused by the formation of nitrogen bubbles in the fish's bloodstream due to increased pressure. Most of the fish were found along a band of coastline about 5 miles long, just southeast of the point of landfall. Species killed (in millions) include menhaden, 5.7; mullet, 0.9; croaker, 0.9; spotted sea trout, 0.2; sea catfish, 0.4; black drum, 0.03; and red drum, 0.02 (Harry Blanchet, Louisiana Department of Wildlife and Fisheries, oral commun., 1993).

Large segments of Louisiana's coastal marsh, primarily in Terrebonne and St. Mary Parishes, were damaged. About 40 percent of the Nation's tidal wetlands are located on Louisiana's gulf coast (S.J. Williams, 1993). A substantial part of these wetlands is composed of fresh and intermediate marsh (Chabreck and Linscombe, 1978). Much of this marsh is "floatant" (a floating type of marsh). The marsh is said to float because partially decomposed organic matter and intertwining plant roots form a dense mat that rises and falls with the water level. The roots of the plants that make up the mat are unattached, or only partly attached, to the bottom (Lee Foot, U.S. Fish and Wildlife Service, oral commun., 1993).

The marsh suffered substantial damage caused by wind, tide, and wave action. Three specific kinds of damage were identified:

- Compressed marsh, where a net decrease in surface area results from the marsh being pushed together, somewhat like an accordion closing
- Marsh balls, which are created by the marsh being piled, rolled, or otherwise deformed to create large mounds (resulting in decreased surface area)

- Sediment deposition in thicknesses of as much as 10 inches, but averaging less than 1 inch, which killed vegetation and sank part of the floating marsh

Other damage was attributed to vegetative scour, which resulted from large areas of attached plants having their roots torn from the bottom, and salt burn, which occurred when saline (salty) water from the Gulf of Mexico was pushed into freshwater areas, killing and damaging salt-sensitive plants (Lee Foot, U.S. Fish and Wildlife Service, oral commun., 1993).

About 25 square miles of coastal wetlands in Louisiana are being lost every year due to coastal erosion and wetland deterioration. Hurricane Andrew probably caused substantial immediate loss of coastal wetlands and possibly has hastened the erosion and deterioration processes already at work (Dunbar and others, 1992).

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An estimated 9.4 million saltwater fish valued at \$7.8 million were killed by the storm.

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Restoration, Creation, and Recovery of Wetlands

Effects of the Great Midwest Flood of 1993 on Wetlands

By James R. Kolva¹

The Great Midwest Flood of 1993 was the "most devastating flood in modern United States history" with economic damages near \$20 billion. More than 50,000 homes were damaged or destroyed. The areal extent, intensity, and long duration of the flooding makes this event unique in the 20th century (National Oceanic and Atmospheric Administration, 1994). At least 38 people lost their lives as a result of this extreme flood (Interagency Floodplain Management Task Force, 1994).

Significant flooding in the Upper Mississippi River Basin began in mid-June and persisted into early August 1993. The areal extent of this flooding included southern Minnesota, southwestern Wisconsin, Iowa, western Illinois, northern Missouri, southern North Dakota, and eastern parts of South Dakota, Nebraska, and Kansas (fig. 62).

Record flood-peak discharge was recorded at 39 streamflow-gaging stations in the Upper Mississippi River Basin. Fifteen other gaging stations recorded peak discharges exceeding previous maximum known regulated discharges (Parrett and others, 1993). The recurrence interval of the peak discharge at 40 stations exceeded the 100-year flood (one-percent chance of occurring in any given year).

Near-record and record precipitation in June and July, falling on soil already saturated by as much as twice normal early spring rains, caused these record floods. Precipitation for the period January–July 1993 totaled more than 20 inches in most of the flooded area and more than 40 inches in parts of northeastern Kansas and east-central Iowa (Wahl, Vining, and Wiche, 1993). Many areas received more precipitation in those 7 months than is normally received during the entire year.

The Great Midwest Flood of 1993 was unique not only because of the record high water levels and flows and the wide areal extent, but also because of the long duration of flooding. Many rivers were above flood stage for several months. The long period of inundation had significant effects on agricultural land and wetlands.

The flood effects on wetlands varied in both the short term and long term. In the Upper Mississippi National Wildlife Refuge, the flooding lasted 14 weeks—from April through mid-August. "This prolonged inundation of bottom-land hardwood forest and backwater wetlands caused many tree tip-overs, scoured out ground cover and tree regeneration sites, eroded islands, destroyed emergent/submergent vegetation beds, impacted project dikes, and thus destroyed most of the moist soil plants at three sites," according to James Lennartson of the U.S. Fish and Wildlife Service. The effects on wildlife populations also were severe. Many birds, including green-backed herons and red-shouldered hawks, fledged few young

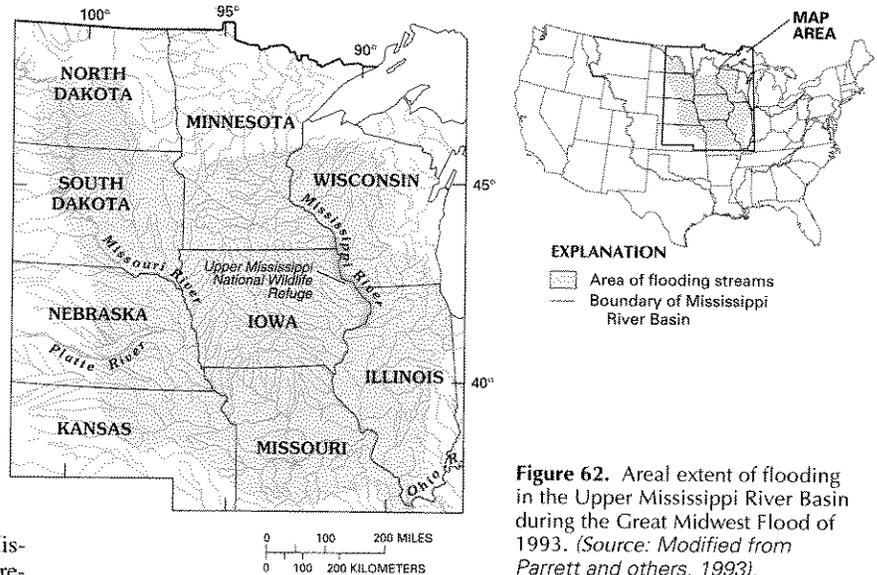


Figure 62. Areal extent of flooding in the Upper Mississippi River Basin during the Great Midwest Flood of 1993. (Source: Modified from Parrett and others, 1993).

due to flooded foraging areas. Substrate disturbance and massive sedimentation affected freshwater mussel populations. Mussels were found buried by 1 to 2 feet of sand. Mammals were displaced from the flood plain and suffered higher than normal mortality rates on adjacent roads and railroad tracks (James Lennartson, U.S. Fish and Wildlife Service, written commun., 1994). Fishes that rely on sight to find their food were handicapped because of the increased turbidity.

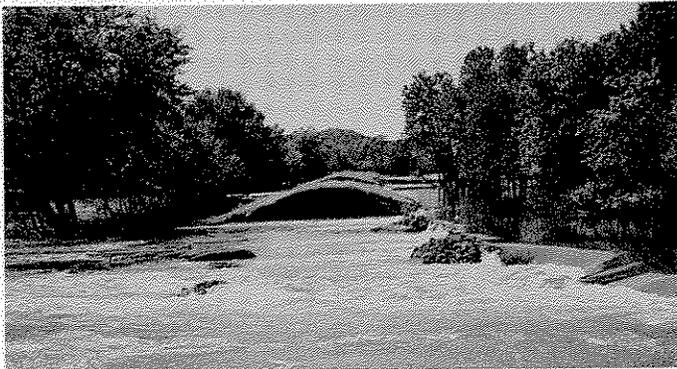
The flooding, however, had some short-term benefits. Many fish feed and spawn on inundated flood plains. "Ideal conditions for spring spawning fishes occur during years in which flood and temperature rise are coupled" (Scientific Assessment and Strategy Team, 1994). The evidence, particularly in the lower Missouri River flood plain, "****indicates that the magnitude and timing of the 1993 flood provided appropriate temperature and discharge cues for spawning river-floodplain fishes" (Scientific Assessment and Strategy Team, 1994).

The long-term effects of the floods are still being evaluated. Fish habitat may have been improved by creation of deep scour holes and massive underwater debris piles which provide more cover (James Lennartson, oral commun., 1994). Greater-than-normal sedimentation on flood plains and in wetland ponds may have introduced contaminants and excess nutrients into those areas. Exotic plants such as purple loosestrife have colonized disturbed areas and displaced native vegetation (Susan Hassletine, U.S. Fish and Wildlife Service, oral commun., 1994). Purple loosestrife colonies also have been observed at higher elevations than normal, probably because seeds were carried by the extremely high floodwaters to these

...the "most devastating flood in modern United States history"...

...a historically unprecedented hydrometeorological event...

¹ U.S. Geological Survey.



This perimeter levee surrounding the Clarence Cannon National Wildlife Refuge, Mo., damaged during the 1993 flooding, allowed excessive water to enter the refuge. (Photograph courtesy of U.S. Fish and Wildlife Service.)

locations (James Lennartson, oral commun., 1994). Flood debris on flood plains has caused access problems for people at some places, but provides good wildlife cover. Open wetland aquatic vegetation appeared to be back to normal condition during the summer of 1994 (Susan Hassletine, oral commun., 1994).

Wetlands commonly mitigate the effects of floods. Wetland areas can be filled with and temporarily store floodwaters so that flood effects on agricultural and residential areas are lessened. However, wetlands have been steadily disappearing or converted to other uses throughout the

flood-affected area for the last two centuries (see "History of Wetlands in the Conterminous United States" in this volume). These wetlands include the river flood plains and the upland prairie potholes.

Many upland prairie pothole wetlands are closed flow systems, which fill with rain and melting snow and then slowly evaporate or drain through the ground-water system. Thus, they are ideal retention basins during and after intense rains because they "do not normally contribute to stream flow by runoff, except during storms large enough to make the depressions fill and spill" (Scientific Assessment and Strategy Team, 1994). This seems to have been the case in the flood of 1993. All available storage capacity of the wetlands was exceeded, and usually noncontributing areas did contribute to runoff (Interagency Floodplain Management Task Force, 1994). In modeling done by the Scientific Assessment and Strategy Team (1994), upland wetlands simulated decreased flooding in a 1-year

event by 9–23 percent, but only by 5–10 percent in a 100-year event. Flood-plain wetlands decreased flooding 5–6 percent for 1-year floods and only 2–3 percent for the 100-year storms.

The Executive Summary of the Report of the Interagency Floodplain Management Review Committee to the Administrative Floodplain Management Task Force (1994) states the effect that wetlands had on the Great Midwest Flood of 1993:

The loss of wetlands and upland cover and the modification of the landscape throughout the basin over the last century and a half significantly increased runoff. *** Although upland watershed treatment and restoration of upland and bottom-land wetlands can reduce flood stages in more frequent floods (25 years and less), it is questionable whether they would have significantly altered the 1993 conditions (Interagency Floodplain Management Task Force, 1994).

In conclusion, the Great Midwest Flood of 1993 was a historically unprecedented hydrometeorological event in area affected, severity of the effects, and duration of the effects. Wetlands were affected beneficially and detrimentally in the short and long term. The historical loss of wetlands from the basin increased the severity of the flood, but even if all presettlement wetlands had still existed, the flood would probably still have set records and caused billions of dollars in damages.

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These prairie grasses (foreground) and trees (background) were killed by the excessive water resulting from the long-term flooding of the Mississippi River in the summer of 1993. (Photograph courtesy of U.S. Fish and Wildlife Service.)

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Glossary

- Absorption**—the process by which substances in gaseous, liquid, or solid form are assimilated or taken up by other substances.
- Acid**—pH of water less than 5.5; pH modifier used in the U.S. Fish and Wildlife Service wetland classification system.
- Acidic**—has a pH of less than 7.
- Acidic deposition**—the transfer of acidic or acidifying substances from the atmosphere to the surface of the Earth or to objects on its surface. Transfer can be either by wet-deposition processes (rain, snow, dew, fog, frost, hail) or by dry deposition (gases, aerosols, or fine to coarse particles).
- Acre-foot (acre-ft)**—the volume of water needed to cover an acre of land to a depth of one foot; equivalent to 43,560 cubic feet or 325,851 gallons.
- Adsorption**—the adherence of gas molecules, ions, or molecules in solution to the surface of solids.
- Aerate**—to supply air to water, soil, or other media.
- Aerobic**—pertaining to or caused by the presence of oxygen.
- Algal bloom**—the rapid proliferation of passively floating, simple plant life, such as blue-green algae, in and on a body of water.
- Alkaline**—has a pH greater than 7; pH modifier in the U.S. Fish and Wildlife Service wetland classification system; in common usage, a pH of water greater than 7.4.
- Alluvium**—general term for sediments of gravel, sand, silt, clay, or other particulate rock material deposited by flowing water, usually in the beds of rivers and streams, on a flood plain, on a delta, or at the base of a mountain.
- Alpine snow glade**—a marshy clearing between slopes above the timberline in mountains.
- Anadromous fish**—migratory species that are born in freshwater, live mostly in estuaries and ocean water, and return to freshwater to spawn.
- Anaerobic**—pertaining to or caused by the absence of oxygen.
- Anthropogenic**—having to do with or caused by humans.
- Anticline**—a fold in the Earth's crust, convex upward, whose core contains stratigraphically older rocks.
- Aquatic**—living or growing in or on water.
- Aquaculture**—the science of farming organisms that live in water, such as fish, shellfish, and algae.
- Aquifer**—a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to springs and wells.
- Arroyo**—a small, deep, flat-floored channel or gully of an ephemeral or intermittent stream, usually with nearly vertical banks cut into unconsolidated material—term commonly used in the arid and semiarid regions of the Southwestern United States.
- Atmospheric pressure**—the pressure exerted by the atmosphere on any surface beneath or within it; equal to 14.7 pounds per square inch at sea level.
- Backwater**—a body of water in which the flow is slowed or turned back by an obstruction such as a bridge or dam, an opposing current, or the movement of the tide.
- Bacteria**—single-celled microscopic organisms.
- Bank storage**—the change in the amount of water stored in an aquifer resulting from a change in stage of an adjacent surface-water body.
- Barrier bar**—an elongate offshore ridge submerged at least at high tide, built up by the action of waves or currents.
- Barrier beach**—a narrow, elongate sandy ridge rising slightly above the high-tide level and extending generally parallel with the mainland shore, but separated from it by a lagoon.
- Base flow**—the sustained low flow of a stream, usually ground-water inflow to the stream channel.
- Basic**—the opposite of acidic; has a pH of greater than 7.
- Bed material**—sediment composing the streambed.
- Bedrock**—a general term used for solid rock that underlies soils or other unconsolidated material.
- Benthic organism**—a form of aquatic life that lives on the bottom or near the bottom of streams, lakes, or oceans.
- Bind**—to exert a strong chemical attraction.
- Biochemical-oxygen demand (BOD)**—the amount of oxygen, in milligrams per liter, that is removed from aquatic environments by the life processes of micro-organisms.
- Biochemical process**—a process characterized by, produced by, or involving chemical reactions in living organisms.
- Biomass**—the amount of living matter, in the form of organisms, present in a particular habitat, usually expressed as weight-per-unit area.
- Biota**—all living organisms of an area.
- Blowout**—a small saucer or trough-shaped hollow or depression formed by wind erosion on a pre-existing dune or other sand deposit.
- Bog**—a nutrient-poor, acidic wetland dominated by a waterlogged spongy mat of sphagnum moss that ultimately forms a thick layer of acidic peat; generally has no inflow or outflow; fed primarily by rain water.
- Bolson**—an extensive, flat, saucer-shaped, alluvium-floored basin or depression, almost or completely surrounded by mountains and from which drainage has no surface outlet; a term used in the desert regions of the Southwestern United States.
- Boreal**—a climatic zone having a definite winter with snow and a short summer that is generally hot, and which is characterized by a large annual range of temperature.
- Bosque**—a dense growth of trees and underbrush.
- Bottom land**—See flood plain.
- Bottom-land forest**—low-lying forested wetland found along streams and rivers, usually on alluvial flood plains.
- Brackish water**—water with a salinity intermediate between seawater and freshwater (containing from 1,000 to 10,000 milligrams per liter of dissolved solids).

- Braided river**—a river that divides into or follows an interlacing or tangled network of several small branching and reuniting shallow channels.
- Brine**—water that contains more than 35,000 milligrams per liter of dissolved solids.
- Calcareous**—formed of calcium carbonate or magnesium carbonate by biological deposition or inorganic precipitation in sufficient quantities to effervesce when treated with cold hydrochloric acid.
- Caldera**—a large, more or less circular, basin-shaped volcanic depression whose diameter is many times greater than the volcanic vent.
- Channel scour**—erosion by flowing water and sediment on a stream channel; results in removal of mud, silt, and sand on the outside curve of a stream bend and the bed material of a stream channel.
- Channelization**—the straightening and deepening of a stream channel to permit the water to move faster or to drain a wet area for farming.
- Cienaga**—a marshy area where the ground is wet due to the presence of seepage or springs.
- Circumneutral**—pH of water between 5.5 and 7.4; pH modifier used in the U.S. Fish and Wildlife Service wetland classification system.
- Cirque**—a deep, steep-walled half-bowl-like recess or hollow situated high on the side of a mountain and commonly at the head of a glacial valley and produced by the erosive activity of mountain glaciers.
- Concentration**—the ratio of the quantity of any substance present in a sample of a given volume or a given weight compared to the volume or weight of the sample.
- Confining layer**—a body of impermeable or distinctly less permeable material stratigraphically adjacent to one or more aquifers that restricts the movement of water into and out of the aquifers.
- Conglomerate**—a coarse-grained sedimentary rock composed of fragments larger than 2 millimeters in diameter.
- Contact recreation**—recreational activities where there is prolonged or intimate contact with water and in which there is a likelihood of ingesting water.
- Contributing area**—the area in a drainage basin that contributes water to streamflow or recharge to an aquifer.
- Coral reef**—a ridge of limestone, composed chiefly of coral, coral sands, and solid limestone resulting from organic secretion of calcium carbonate; occur along continents and islands where the temperature is generally above 18° C.
- Core sample**—a sample of rock, soil, or other material obtained by driving a hollow tube into the undisturbed medium and withdrawing it with its contained sample.
- Cypress dome**—small, isolated, circular, depression-al, forested wetlands, in which cypress predominates, that have convex silhouettes when viewed from a distance.
- Deciduous**—shedding foliage at the end of the growing season.
- Deepwater habitat**—permanently flooded lands lying below the deepwater boundary of wetlands.
- Degraded**—condition of the quality of water that has been made unfit for some specified purpose.
- Delta**—the low, nearly flat tract of land at or near the mouth of a river, resulting from the accumulation of sediment supplied by the river in such quantities that it is not removed by tides, waves, or currents. Commonly a triangular or fan-shaped plain.
- Direct runoff**—the runoff entering stream channels promptly after rainfall or snowmelt.
- Discharge**—the volume of fluid passing a point per unit of time, commonly expressed in cubic feet per second, million gallons per day, gallons per minute, or seconds per minute per day.
- Discharge area (ground water)**—area where subsurface water is discharged to the land surface, to surface water, or to the atmosphere.
- Dissolved oxygen**—oxygen dissolved in water; one of the most important indicators of the condition of a water body. Dissolved oxygen is necessary for the life of fish and most other aquatic organisms.
- Dissolved solids**—minerals and organic matter dissolved in water.
- Dolomite**—a sedimentary rock consisting chiefly of magnesium carbonate.
- Dominant plant**—the plant species controlling the environment.
- Drainage basin**—the land area drained by a river or stream.
- Drought**—a prolonged period of less-than-normal precipitation such that the lack of water causes a serious hydrologic imbalance.
- Ecosystem**—a community of organisms considered together with the nonliving factors of its environment.
- Emergent plants**—erect, rooted, herbaceous plants that may be temporarily to permanently flooded at the base but do not tolerate prolonged inundation of the entire plant.
- Endangered species**—a species that is in imminent danger of becoming extinct.
- Environment**—the sum of all conditions and influences affecting the life of organisms.
- Ephemeral stream**—a stream or part of a stream that flows only in direct response to precipitation; it receives little or no water from springs, melting snow, or other sources; its channel is at all times above the water table.
- Erosion**—the process whereby materials of the Earth's crust are loosened, dissolved, or worn away and simultaneously moved from one place to another.
- Estuarine wetlands**—tidal wetlands in low-wave-energy environments where the salinity of the water is greater than 0.5 part per thousand and is variable owing to evaporation and the mixing of seawater and freshwater; tidal wetlands of coastal rivers and embayments, salty tidal marshes, mangrove swamps, and tidal flats.
- Estuary**—area where the current of a stream meets the ocean and where tidal effects are evident; an arm of the ocean at the lower end of a river.
- Eutrophication**—the process by which water be-

- comes enriched with plant nutrients, most commonly phosphorus and nitrogen.
- Evaporation—the process by which water is changed to gas or vapor; occurs directly from water surfaces and from the soil.
- Evaporites—a class of sedimentary rocks composed primarily of minerals precipitated from a saline solution as a result of extensive or total evaporation of water.
- Evapotranspiration—a term that includes water discharged to the atmosphere as a result of evaporation from the soil and surface-water bodies and by plant transpiration.
- Exotic species—plants or animals not native to the area.
- Fall line—imaginary line marking the boundary between the ancient, resistant crystalline rocks of the Piedmont province of the Appalachian Mountains, and the younger, softer sediments of the Atlantic Coastal Plain province in the Eastern United States. Along rivers, this line commonly is reflected by waterfalls.
- Fallow—cropland, tilled or untilled, allowed to lie idle during the whole or greater part of the growing season.
- Fen—peat-accumulating wetland that generally receives water from surface runoff and (or) seepage from mineral soils in addition to direct precipitation; generally alkaline; or slightly acid.
- Filtrate—liquid that has been passed through a filter.
- Flood—any relatively high streamflow that overflows the natural or artificial banks of a stream.
- Flood attenuation—a weakening or reduction in the force or intensity of a flood.
- Flood plain—a strip of relatively flat land bordering a stream channel that is overflowed at times of high water.
- Fluvial—pertaining to a river or stream.
- Flyway—a specific air route taken by birds during migration.
- Freshwater—water with less than 1,000 milligrams per liter of dissolved solids.
- Friable—descriptive of a rock or mineral that crumbles naturally or is easily broken, pulverized, or reduced to powder.
- Geomorphic—pertaining to the form of the Earth or of its surface features.
- Geomorphology—the science that treats the general configuration of the Earth's surface; the description of landforms.
- Glacial—of or relating to the presence and activities of ice or glaciers.
- Glacial drift—a general term for rock material transported by glaciers or icebergs and deposited directly on land or in the sea.
- Glacial lake—a lake that derives its water, or much of its water, from the melting of glacial ice; also a lake that occupies a basin produced by glacial erosion.
- Glacial outwash—stratified detritus (chiefly sand and gravel) “washed out” from a glacier by meltwater streams and deposited in front of or beyond the end moraine or the margin of an active glacier.
- Ground water—in the broadest sense, all subsurface water; more commonly that part of the subsurface water in the saturated zone.
- Ground-water flow system—the underground pathway by which ground water moves from areas of recharge to areas of discharge.
- Growing season—the frost-free period of the year.
- Habitat—the part of the physical environment in which a plant or animal lives.
- Hardpan—a relatively hard, impervious, and usually clayey layer of soil lying at or just below land surface—produced as a result of cementation by precipitation of insoluble minerals.
- Herbaceous—with characteristics of an herb; a plant with no persistent woody stem above ground.
- Herbicide—a type of pesticide designed to kill plants.
- Hydraulic head—the height of the free surface of a body of water above a given point beneath the surface.
- Hydraulic gradient—the change of hydraulic head per unit of distance in a given direction.
- Hydric soil—soil that is wet long enough to periodically produce anaerobic conditions, thereby influencing the growth of plants.
- Hydrologic cycle—the circulation of water from the sea, through the atmosphere, to the land, and thence back to the sea by overland and subterranean routes.
- Hydrology—the science that deals with water as it occurs in the atmosphere, on the surface of the ground, and underground.
- Hydrophyte—any plant growing in water or on a substrate that is at least periodically deficient in oxygen as a result of excessive water content.
- Hydrostatic pressure—the pressure exerted by the water at any given point in a body of water at rest.
- Hydrologic regime—the characteristic behavior and total quantity of water involved in a drainage basin.
- Igneous rocks—rocks that have solidified from molten or partly molten material.
- Immobilize—to hold by a strong chemical attraction.
- Impaired—condition of the quality of water that has been adversely affected for a specific use by contamination or pollution.
- Indurated—cemented, hardened, or a rocklike condition.
- Infiltration—the downward movement of water from the atmosphere into soil or porous rock.
- Inorganic—containing no carbon; matter other than plant or animal.
- Inorganic soil—soil with less than 20 percent organic matter in the upper 16 inches.
- Integrated drainage—drainage developed during maturity in an arid region, characterized by coalescence of drainage basins as a result of headward erosion in the lower basins or spilling over from the upper basins.
- Interface—in hydrology, the contact zone between two fluids of different chemical or physical makeup.
- Intermittent stream—a stream that flows only when it receives water from rainfall runoff or springs,

- or from some surface source such as melting snow.
- Intermontane**—situated between or surrounded by mountains, mountain ranges, or mountainous regions.
- Internal drainage**—surface drainage whereby the water does not reach the ocean, such as drainage toward the lowermost or central part of an interior basin.
- Intertidal**—alternately flooded and exposed by tides.
- Ion**—a positively or negatively charged atom or group of atoms.
- Irrigation**—controlled application of water to arable land to supply requirements of crops not satisfied by rainfall.
- Karst**—a type of topography that results from dissolution and collapse of carbonate rocks such as limestone, dolomite, and gypsum, and that is characterized by closed depressions or sinkholes, caves, and underground drainage.
- Kettle**—a steep-sided hole or depression, commonly without surface drainage, formed by the melting of a large detached block of stagnant ice that had been buried in the glacial drift.
- Kettle lake**—a body of water occupying a kettle, as in a pitted outwash plain or in a kettle moraine.
- Lacustrine**—pertaining to, produced by, or formed in a lake.
- Lacustrine wetlands**—wetlands within a lake or reservoir greater than 20 acres or within a lake or reservoir less than 20 acres if the water is greater than 2 meters deep in the deepest part of the basin; ocean-derived salinity is less than 0.5 part per thousand.
- Lagoon**—a shallow stretch of seawater (or lakewater) near or communicating with the sea (or lake) and partly or completely separated from it by a low, narrow, elongate strip of land.
- Latent heat**—the amount of heat given up or absorbed when a substance changes from one state to another, such as from a liquid to a solid.
- Lateral moraine**—a low ridgelike moraine carried on, or deposited near, the side margin of a mountain glacier.
- Leachate**—a liquid that has percolated through soil containing soluble substances and that contains certain amounts of these substances in solution.
- Life zone**—major area of plant and animal life; region characterized by particular plants and animals and distinguished by temperature differences.
- Limestone**—a sedimentary rock consisting chiefly of calcium carbonate, primarily in the form of the mineral calcite.
- Limnetic**—the deepwater zone (greater than 2 meters deep); a subsystem of the Lacustrine System of the U.S. Fish and Wildlife Service wetland classification system.
- Littoral**—the shallow-water zone (less than 2 meters deep); a subsystem of the Lacustrine System of the U.S. Fish and Wildlife Service wetland classification system.
- Load**—material that is moved or carried by streams, reported as weight of material transported during a specified time period, such as tons per year.
- Loess**—a widespread, homogeneous, commonly nonstratified, porous, friable, slightly coherent, fine-grained blanket deposit of wind-blown and wind-deposited silt and fine sand.
- Main stem**—the principal trunk of a river or a stream.
- Marine wetland**—wetlands that are exposed to waves and currents of the open ocean and to water having a salinity greater than 30 parts per thousand; present along the coastlines of the open ocean.
- Marsh**—a water-saturated, poorly drained area, intermittently or permanently water covered, having aquatic and grasslike vegetation.
- Maturity**—a stage in the evolutionary erosion of land areas where the flat uplands have been widely dissected by deep river valleys.
- Maturity (stream)**—the stage in the development of a stream at which it has reached its maximum efficiency, when velocity is just sufficient to carry the sediment delivered to it by tributaries; characterized by a broad, open, flat-floored valley having a moderate gradient and gentle slope.
- Mean low tide**—the average altitude of all low tides recorded at a given place over a 19-year period.
- Mean high tide**—the average altitude of all high tides recorded at a given place over a 19-year period.
- Mesophyte**—any plant growing where moisture and aeration conditions lie between the extremes of “wet” and “dry.”
- Metamorphic rocks**—rocks derived from preexisting rocks by mineralogical, chemical, or structural changes (essentially in a solid state) in response to marked changes in temperature, pressure, shearing stress, and chemical environment at depth in the Earth's crust.
- Mineral soil**—soil composed predominantly of mineral rather than organic materials; less than 20 percent organic material.
- Mitigation**—actions taken to avoid, reduce, or compensate for the effects of human-induced environmental damage.
- Montane**—of, pertaining to, or inhabiting cool upland slopes below the timber line; characterized by the dominance of evergreen trees.
- Moraine**—a mound, ridge, or other distinct accumulation of unsorted, unstratified glacial drift, predominantly till, deposited chiefly by direct action of glacier ice.
- Muck**—dark, finely divided, well-decomposed, organic matter forming a surface deposit in some poorly drained areas.
- Muskeg**—large expanses of peatlands or bogs that occur in subarctic zones.
- National Geodetic Vertical Datum of 1929**—geodetic datum derived from a general adjustment of first-order level nets of the United States and Canada—formerly called “Sea Level Datum of 1929.”
- Natural levee**—a long, broad, low ridge built by a stream on its flood plain along one or both banks of its channel in time of flood.
- Navigable water**—in the context of the Clean Water Act, all surface water.
- Noncontact water recreation**—recreational activities, such as fishing or boating, that do not include di-

- rect contact with the water.
- Nonpersistent emergent plants**—emergent plants whose leaves and stems break down at the end of the growing season from decay or by the physical forces of waves and ice; at certain seasons, there are no visible traces of the plants above the surface of the water.
- Nonpoint source**—a source (of any water-carried material) from a broad area, rather than from discrete points.
- Nuisance species**—undesirable plants and animals, commonly exotic species.
- Nutrient**—any inorganic or organic compound needed to sustain plant life.
- Organic**—containing carbon, but possibly also containing hydrogen, oxygen, chlorine, nitrogen, and other elements.
- Organic soil**—soil that contains more than 20 percent organic matter in the upper 16 inches.
- Orographic**—pertaining to mountains, in regard to their location and distribution; said of the precipitation caused by the lifting of moisture-laden air over mountains.
- Overland flow**—the flow of rainwater or snowmelt over the land surface toward stream channels.
- Oxbow**—a bow-shaped lake formed in an abandoned meander of a river.
- Palustrine wetlands**—freshwater wetlands including open water bodies of less than 20 acres in which water is less than 2 meters deep; includes marshes, wet meadows, fens, playas, potholes, pocosins, bogs, swamps, and shallow ponds; most wetlands are in the Palustrine system.
- Pathogen**—any living organism that causes disease.
- Peat**—a highly organic soil, composed of partially decomposed vegetable matter.
- Perched ground water**—unconfined ground water separated from an underlying main body of ground water by an unsaturated zone.
- Percolation**—the movement, under hydrostatic pressure, of water through interstices of a rock or soil (except the movement through large openings such as caves).
- Periphyton**—micro-organisms that coat rocks, plants, and other surfaces on lake bottoms.
- Perennial stream**—a stream that normally has water in its channel at all times.
- Permafrost**—any frozen soil, subsoil, surficial deposit, or bedrock in arctic or subarctic regions where below-freezing temperatures have existed continuously from two to tens of thousands of years.
- Permeability**—the capacity of a rock for transmitting a fluid; a measure of the relative ease with which a porous medium can transmit a liquid.
- Pesticide**—any substance used to kill plant or animal pests; major categories of pesticides include herbicides and insecticides.
- pH**—a measure of the acidity (less than 7) or alkalinity (greater than 7) of a solution; a pH of 7 is considered neutral.
- Photosynthesis**—the synthesis of compounds with the aid of light.
- Physiographic province**—a region in which the land forms differ significantly from those of adjacent regions.
- Physiography**—a description of the surface features of the Earth, with an emphasis on the mode or origin.
- Pioneer plant**—herbaceous annual and perennial seedling plants that colonize bare areas as a first stage in secondary succession.
- Piping**—erosion by percolating water in a layer of subsoil, resulting in caving and in the formation of narrow conduits, tunnels, or “pipes” through which soluble or granular soil material is removed.
- Placer**—a surficial mineral deposit formed by mechanical concentration of mineral particles from weathered debris.
- Playa**—a dry, flat area at the lowest part of an undrained desert basin in which water accumulates and is quickly evaporated; underlain by stratified clay, silt, or sand and commonly by soluble salts; term used in Southwestern United States.
- Playa lake**—a shallow, temporary lake in an arid or semiarid region, covering or occupying a playa in the wet season but drying up in summer; temporary lake that upon evaporation leaves or forms a playa.
- Pocosin**—a local term along the Atlantic coastal plain, from Virginia south, for a shrub-scrub wetland located on a relatively flat terrain, often between streams.
- Point source**—originating at any discrete source.
- Population**—a collection of individuals of one species or mixed species making up the residents of a prescribed area.
- Porosity**—the ratio of the volume of voids in a rock or soil to the total volume.
- Potential evapotranspiration**—the amount of moisture which, if available, would be removed from a given land area by evapotranspiration, expressed in units of water depth.
- Prairie pothole**—a shallow depression, generally containing wetlands, occurring in an outwash plain, a recessional moraine, or a till plain; usually the result of melted blocks of covered glacial ice; occur most commonly in the North-Central United States and in States west of the Great Lakes from Wisconsin to eastern Montana.
- Precipitation**—any or all forms of water particles that fall from the atmosphere, such as rain, snow, hail, and sleet. The act or process of producing a solid phase within a liquid medium.
- Pristine**—the earliest condition of the quality of a water body; unaffected by human activities.
- Rain shadow**—a dry region on the lee side of a topographic obstacle, usually a mountain range, where rainfall is noticeably less than on the windward side.
- Reach**—a continuous part of a stream between two specified points.
- Reaeration**—the replenishment of oxygen in water from which oxygen has been removed.
- Recessional moraine**—an end moraine built during a temporary but significant pause in the final re-

treat of a glacier.
 Recharge (ground water)—the process involved in the absorption and addition of water to the zone of saturation; also, the amount of water added.
 Recharge area (ground water)—an area in which water infiltrates the ground and reaches the zone of saturation.
 Recurrence interval—the average interval of time within which the magnitude of a given event, such as a storm or flood, will be equaled or exceeded once.
 Regolith—the layer or mantle of fragmented and unconsolidated rock material, residual or transported, that nearly everywhere forms the surface of the land and overlies or covers the bedrock.
 Regulation (of a stream)—artificial manipulation of the flow of a stream.
 Return flow—that part of irrigation water that is not consumed by evapotranspiration and that returns to its source or another body of water.
 Riparian—pertaining to or situated on the bank of a natural body of flowing water.
 Riverine wetlands—wetlands within river and stream channels; ocean-derived salinity is less than 0.5 part per thousand.
 Runoff—that part of precipitation or snowmelt that appears in streams or surface-water bodies.
 Salina—an area where deposits of crystalline salt are formed, such as a salt flat; a body of saline water, such as a saline playa or salt marsh.
 Saline water—water that is considered generally unsuitable for human consumption or for irrigation because of its high content of dissolved solids; generally expressed as milligrams per liter (mg/L) of dissolved solids; seawater is generally considered to contain more than 35,000 mg/L of dissolved solids. A general salinity scale is—

<i>Description</i>	<i>Dissolved solids, in milligrams per liter</i>
Slightly	1,000–3,000
Moderately	3,000–10,000
Very	10,000–35,000
Brine	More than 35,000

In the U.S. Fish and Wildlife Service wetland classification system, a general term for waters containing various dissolved salts; applied specifically to inland waters where the ratio of salts often vary; the term haline is applied to coastal waters where the salts are roughly in the same proportion as found in sea water.
 Salinity—the concentration of dissolved salts in a body of water; commonly expressed as parts per thousand.
 Salt flat—the level, salt-encrusted bottom of a dried up lake or pond.
 Salt meadow—a meadow subject to overflow by salt water.
 Saltwater—water with a high concentration of salt; sometimes used synonymously with seawater or saline water.
 Sandstone—a medium-grained sedimentary rock

composed of abundant fragments of sand that are more or less firmly united by a cementing material.
 Saturated zone—generally the zone within sediment and rock formations where all voids are filled with water under pressure greater than atmospheric.
 Savanna—a plain characterized by coarse grasses and scattered tree growth.
 Scrub-shrub wetland—wetlands dominated by woody vegetation less than 6 meters tall.
 Sea level—the long-term average position of the sea surface; in this volume, it refers to the National Geodetic Vertical Datum of 1929.
 Secondary succession—an association of plants that develops after the destruction of all or part of the original plant community.
 Sediment—particles derived from rocks or biological materials that have been transported by, suspended in, or deposited by air, water, or ice or that are accumulated by other natural agents, such as chemical precipitation from solution or secretion by organisms.
 Sedimentary rocks—rocks resulting from the consolidation of loose sediment that has accumulated in layers.
 Sedimentation—the act or process of forming or accumulating sediment in layers; the process of deposition of sediment.
 Seep—a small area where water percolates slowly to the land surface.
 Seiche—a sudden oscillation of the water in a moderate-size body of water, caused by wind.
 Shale—a fine-grained sedimentary rock formed by the consolidation of clay, silt, or mud.
 Shallows—a term applied to a shallow place or area in a body of water; a shoal.
 Shoal—a relatively shallow place in a stream, lake, or sea.
 Shrubland—land covered predominantly with shrubs.
 Siltation—the deposition or accumulation of silt (or small-grained material) in a body of water.
 Siltstone—an indurated silt having the texture and composition of shale but lacking its fine lamination.
 Silviculture—the cultivation of forest trees.
 Sinkhole—a depression in an area underlain by limestone. Its drainage is subterranean.
 Slough—a small marshy tract lying in a swale or other local shallow undrained depression; a sluggish creek or channel in a wetland.
 Soil horizon—a layer of soil that is distinguishable from adjacent layers by characteristic physical and chemical properties.
 Soil moisture—water occurring in the pore spaces between the soil particles in the unsaturated zone from which water is discharged by the transpiration of plants or by evaporation from the soil.
 Spit—a small point or low tongue or narrow embankment of land having one end attached to the mainland and the other terminating in open water.
 Specific conductance—a measure of the ability of a substance to conduct an electrical current.
 Spoil—overburden or other waste material removed

- in mining, quarrying, dredging, or excavating.
- Spring—area where there is a concentrated discharge of ground water that flows at the ground surface.
- Stage—height of the water surface above an established datum plane, such as in a river above a predetermined point that may (or may not) be near the channel floor.
- Storm surge—an abnormal and sudden rise of the sea along a shore as a result of the winds of a storm.
- Streamflow—the discharge of water in a natural channel.
- Submersed plant—a plant which lies entirely beneath the water surface, except for flowering parts in some species.
- Subsidence—the gradual downward settling or sinking of the Earth's surface with little or no horizontal motion.
- Substrate—the surface beneath a wetland in which organisms grow or to which organisms are attached.
- Subtidal—continuously submerged; an area affected by ocean tides.
- Surface runoff—runoff which travels over the land surface to the nearest stream channel.
- Surface water—an open body of water such as a lake, river, or stream.
- Suspended sediment—sediment that is transported in suspension by a stream.
- Swale—a slight depression, sometimes filled with water, in the midst of generally level land.
- Swamp—an area intermittently or permanently covered with water, and having trees and shrubs.
- Tarn—a relatively small and deep, steep-sided lake or pool occupying an ice-gouged basin amid glaciated mountains.
- Tectonic activity—movement of the Earth's crust resulting in the formation of ocean basins, continents, plateaus, and mountain ranges.
- Terrestrial—pertaining to, consisting of, or representing the Earth.
- Terminal moraine—the end moraine extending across a glacial plain or valley as an arcuate or crescent ridge that marks the farthest advance or maximum extent of a glacier.
- Terrain—physical features of a tract of land.
- Terrane—area or surface over which a particular rock type or group of rock types is prevalent.
- Thermokarst—an irregular land surface formed in a permafrost region by melting ground ice and a subsequent settling of the ground.
- Tidal flat—an extensive, nearly horizontal, tract of land that is alternately covered and uncovered by the tide and consists of unconsolidated sediment.
- Tide—the rhythmic, alternate rise and fall of the surface (or water level) of the ocean, and connected bodies of water, occurring twice a day over most of the Earth, resulting from the gravitational attraction of the Moon, and to a lesser degree, the Sun.
- Till—predominantly unsorted and unstratified drift, deposited directly by and underneath a glacier without subsequent reworking by meltwater, and consisting of a heterogeneous mixture of clay, silt, sand, gravel, and boulders.
- Tinaja—a pocket of water developed below a waterfall; a term used in the Southwestern United States; used loosely to mean a temporary pool.
- Topography—the general configuration of a land surface or any part of the Earth's surface, including its relief and the position of its natural and man-made features.
- Trace element—a chemical element that occurs in minute quantities in a substance.
- Trade winds—a system of easterly winds that dominate most of the tropics. A major component of the general circulation of the atmosphere.
- Transpiration—the process by which water passes through living organisms, primarily plants, into the atmosphere.
- Tundra—a vast, nearly level, treeless plain of the arctic and subarctic regions. It usually has a marshy surface which supports mosses, lichens, and low shrubs, underlain by mucky soils and permafrost.
- Turbidity—the state, condition, or quality of opaqueness or reduced clarity of a fluid due to the presence of suspended matter.
- Unconfined aquifer—an aquifer whose upper surface is a water table free to fluctuate under atmospheric pressure.
- Understory—a foliage layer lying beneath and shaded by the main canopy of a forest.
- Unsaturated zone—a subsurface zone above the water table where the pore spaces may contain a combination of air and water.
- Upland—a general term for nonwetland; elevated land above low areas along streams or between hills; any elevated region from which rivers gather drainage.
- Vascular plant—a plant composed of or provided with vessels or ducts that convey water or sap. A fern is an example of this type of plant.
- Vernal pool—a small lake or pond that is filled with water for only a short time during the spring.
- Water budget—an accounting of the inflow to, outflow from, and storage changes of water in a hydrologic unit.
- Water column—an imaginary column extending through a water body from its floor to its surface.
- Water gap—a deep, narrow pass in a mountain ridge, through which a stream flows.
- Watershed—same as drainage basin.
- Water table—the top water surface of an unconfined aquifer at atmospheric pressure.
- Weathering—process whereby earthy or rocky materials are changed in color, texture, composition, or form (with little or no transportation) by exposure to atmospheric agents.
- Wetland function—a process or series of processes that take place within a wetland that are beneficial to the wetland itself, the surrounding ecosystems, and people.
- Willow carr—a pool, or wetland dominated by willow trees or shrubs.
- Xerophyte—a plant adapted for growth under dry conditions.