Definition: groundwater from Philip's Encyclopedia

Water that lies beneath the surface of the Earth. It comes chiefly from rain, although some is of volcanic or sedimentary origin. It moves through porous rocks and soil and can be collected in wells. Groundwater can dissolve minerals and leave deposits, creating structures such as caves, stalagmites, and stalactites. See also water table.

Summary Article: Groundwater from Green Politics: An A-to-Z Guide

Image from: The hydrologic cycle. (Adapted from... in Encyclopedia of Soils in the Environment)

Groundwater reaches the surface through springs like this one in the Westcave Preserve in Texas. Groundwater is the biggest source of freshwater for human consumption.

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Water exists in many forms including water vapor, liquid, and ice, all of which are found on Earth including...
atmospheric moisture, precipitation, soil moisture, groundwater, ice, snow, oceans, and seas; within plants and animals; in lakes, streams, and rivers; and in man-made reservoirs. Water cycles between these forms both visibly, as when atmospheric moisture falls as rain, and invisibly, as when precipitation seeps into the soil to become groundwater. Water makes up 70 percent of the Earth's surface. Most of the water is contained in the oceans, with only a small percentage available as freshwater, most of which is frozen in glaciers.

Freshwater constitutes approximately 2.5 percent of all terrestrial water sources, with only 0.75 percent being groundwater. This amount of water sounds minuscule, but a comparison between available surface and groundwater resources reveals quite a difference. At any given time, the Earth contains roughly 30,300 cubic miles of surface water resources contained in lakes and streams compared with millions cubic miles of groundwater available within a half-mile of the land surface. With that comparison in mind, it comes as no surprise that groundwater is the largest single supply of freshwater available for human consumption. Groundwater resides below the surface of the Earth in porous layers of rock and sand called aquifers. Soil and rock strata differ in porosity, in the amount of water that can be held in the soil, and in permeability—the rate at which water flows through the soil. An aquifer that holds groundwater between layers of relatively impermeable rock or soil (e.g., clay or shale) is called a confined aquifer. Some confined aquifers are under pressure, such that when a natural opening, such as an artesian spring, or a man-made opening, such as a well, taps into the confined aquifer, water emerges from the surface under pressure. Unconfined aquifers are characterized by relative permeability between the ground surface and the water table below the surface where groundwater is stored.

Groundwater can be found almost everywhere on Earth at varying depths, some very near the surface, as in the case of wetlands, or at some depth below the surface, as in some dry areas in the western United States. Groundwater close to the surface may be just a few hours old, whereas groundwater located far beneath the surface of the Earth might be thousands of years old. Often, the older the groundwater, the more difficult it is to replenish by natural means.

Recharging Groundwater

Groundwater is most often recharged through percolation from rainfall and snowmelt or from nearby surface water. Surface water under the influence of groundwater describes locations where groundwater and surface water are interconnected. In these cases, either water from lakes, rivers, and streams can flow into the groundwater, in essence recharging the aquifer, or groundwater can flow into the surface water, diminishing the aquifer. Rivers and streams can receive as much as half of their flow from groundwater. Groundwater also plays a large role in the health of wetlands.

Water percolates through the Earth's surface at varying rates and flows down by gravity until the soil or rock is no longer permeable. The groundwater then flows laterally until it finally reaches the surface again and is discharged from the aquifer in springs, lakes, rivers, or the ocean. A few special cases exist in which groundwater movement is restricted. One such case is when the aquifer is perched above an impermeable layer of rock or sediment and above the water table. Another exception is ancient, or fossil, groundwater usually found in deserts. Fossil aquifers are essentially nonrenewable. Groundwater is predominantly used for drinking water supply and irrigation. Worldwide, approximately one and a half billion people depend on groundwater for their drinking water supply. In the United States, the U.S. Geological Survey estimates total groundwater withdrawals for 2000 were 80 billion gallons per day.

https://search.credoreference.com/content/topic/groundwater
This amount is more than twice the amount of groundwater withdrawn daily in the United States in 1950. The majority of groundwater withdrawals in the United States are used for irrigation, such as the 174,000 square-mile Ogallala Aquifer in the High Plains region; however, a third of the population relies on groundwater for drinking water.

**Groundwater Issues**

Groundwater is susceptible to two categories of issues: quality impairment and unsustainable use. Quality impairments can be natural or man-made. Because groundwater is held beneath the Earth's surface in aquifers, it is exposed to naturally occurring chemicals and minerals that dissolve or dissociate into the water by natural chemical processes. One such naturally occurring contaminant is arsenic. A famous example of the effects of this naturally occurring contaminant is the widespread arsenic poisoning that occurred in Bangladesh after the public water supply was changed from surface water to groundwater. The switch was made to improve the water supply because surface water supplies were contaminated with pathogens and other waterborne disease vectors. Unfortunately, once the population switched to consuming groundwater, it became evident that the aquifer was contaminated with arsenic, causing another public health issue. Groundwater can also be affected by anthropogenic contaminants. Anthropogenic contaminants are transported into the groundwater from agricultural runoff, urban runoff, municipal and industrial discharges, and seepage of directly injected wastes. Once contaminated, groundwater is notoriously difficult and expensive to treat and often must be abandoned altogether. The United States has moved to enact policies to reduce the likelihood of anthropogenic contamination of groundwater. One such policy is the 1974 Safe Drinking Water Act and its controls on underground injection of wastes.

Groundwater mining is the second serious issue facing groundwater resources. When groundwater is withdrawn at a rate that exceeds the rate of natural replenishment, the result is depletion of the aquifer—termed groundwater mining. In addition resulting in an unsustainable use of the resource, groundwater mining can cause significant effects on surface waters and on land overlying the aquifer, causing subsidence. Excessive pumping can rob nearby surface waters of their flow because, as the water table in the aquifer lowers, surface waters flow into the groundwater by gravity. Eventually, the surface water can cease to flow altogether, such as the drying of the Santa Cruz River near Tucson, Arizona. Groundwater mining is a serious concern in rapidly growing areas of the southwestern United States, including Arizona. Recent efforts to reduce the Arizonans' reliance on groundwater resources and to recharge the aquifers have focused on the creation of Groundwater Management Areas to restrict groundwater withdrawals. These efforts have resulted in some aquifer recovery. Over time, officials in Arizona hope to achieve sustainable groundwater use such that they meet the needs of the present without compromising future generations' use of the resource.

**See Also:**

Brundtland Commission, Innovation, Environmental, Urban Planning, Water Politics

**Further Readings**

- Gilliom, R. J. “Pesticides in U.S. Streams and Groundwater.” Environmental Science & Technology
(May 15, 2007).


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