

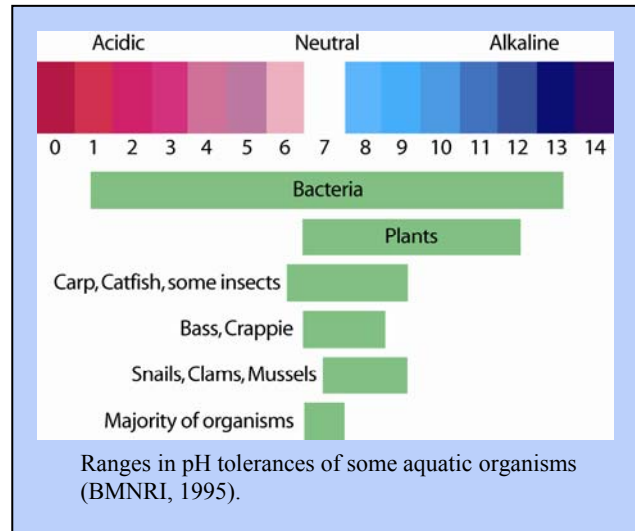
Water pollution spans a wide range of chemical, physical, and microbial factors, but over the years the balance of major pollutants has shifted markedly in most industrialized countries. One hundred years ago the main water contamination problems were fecal and organic pollution from untreated human waste. Through improved treatment and disposal, most industrialized countries have greatly reduced the effects of these pollutants. Unfortunately, a new suite of contaminants from intensive agriculture and development in watersheds have taken over.

Once pollutants enter an aquifer, the environmental damage can be severe and long-lasting, partly because of the very long time needed to flush pollutants out of the aquifer (UNEP, 1996). Below is a list of common groundwater contaminants and their impact on ecosystems (from Fraser et al., 1995).

- Excess organic matter: depletes oxygen from the water column as it decomposes, suffocating aquatic life.
- Toxic organic compounds (including oil, plastics, pesticides): various effects ranging from immunity suppression to reproductive failure to death.



Typical low-cost water quality monitoring kits test for dissolved oxygen, nitrates, phosphates, fecal coliform bacteria, pH, temperature, and turbidity. Photo by D. Ruez, 2005.



- Acidic runoff: acidic water injures/kills aquatic organisms and leaches heavy metals from rock and sediment into water.
- Dissolved salts: can lead to salt buildup in soils which kills/damages crops; renders freshwater supplies undrinkable.
- Excess nitrates and phosphorous: overstimulates algae growth, which leads to excess organic matter.
- Heavy metals: Accumulates in sediments and organic tissues; toxic to nearly every species.
- Microbial contaminants (such as bacteria): spreads infectious diseases, particularly among vertebrates.
- Suspended sediment: reduces water quality for drinking; interferes with aquatic organisms while spawning, feeding.
- Thermal pollution: decreases oxygen levels in water; accelerates algae growth.

References

- BMNRI (Blue Mountain Natural Resource Institute). 1995. Whole Ecosystems in Balance: A Natural Resources Curriculum. Blue Mountain Natural Resource Institute, La Grande, Oregon, 119 pp.
- Fraser, A. S., M. Meybeck, and E. D. Ongley. 1995. Water Quality of World River Basins. United Nations Environment Programme, Environment Library 14. UNEP, Nairobi, Kenya, 40 pp.
- UNEP (United Nations Environment Programme). 1996. Groundwater: A Threatened Resource. United Nations Environment Programme, Environment Library 15. UNEP, Nairobi, Kenya, 36 pp.

Sources of Contamination

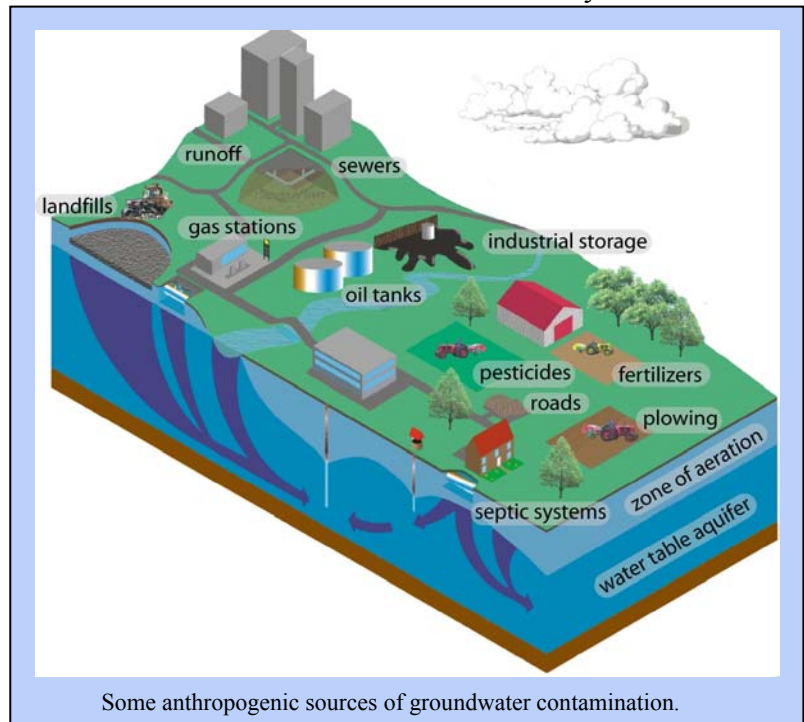
Contamination of groundwater is a serious problem because the pollutants often travel unnoticed until tested. This is especially problematic in karst aquifers because of the rapid movement of contaminants. Once contaminated, an aquifer is difficult to clean and the effects can linger for many years.

- Excess organic matter: farm animal wastes, leaky sewers and septic systems.
- Toxic organic compounds: landfills, gas stations, industrial sites, oil tanks, urban runoff.
- Acidic runoff: vehicle exhaust which forms acid rain.
- Dissolved salts: industrial sites, salt used to deice roads.
- Excess nitrates and phosphorous: fertilizers.
- Heavy metals: industrial sites and landfills.
- Microbial contaminants: animal and human wastes.
- Suspended sediment: plowing of fields, construction of roads and buildings, logging, urban runoff.
- Thermal pollution: industrial sites.
- Emerging contaminants: landfills, leaky sewers and septic systems. (Emerging contaminants are new pollutants, such as hormones and drugs, about which we do not yet understand the potential impacts.)
- Radioactive contaminants: wastewater discharge from factories, hospitals, and mines.

The most prevalent groundwater contaminant may be herbicides and pesticides. In a study of aquifers across the US, herbicides and pesticides were detected in about half (Barbash, 2001).

Contamination by Nature

Many of the items listed here as contaminants do occur naturally as well. Some are actually necessary to support healthy ecosystems. Organic matter, nitrates, and phosphorous all contribute to the diversity of life associated with groundwater. It is not the simple presence of these items that is problematic, but the excess amounts that pollutes groundwater resources for both human use and natural ecosystems.



Even when all precautions are taken, natural disturbances can impact groundwater quality. Storms can create large amounts of runoff that quickly carry pollutants into water supplies without being filtered. Fires can remove ground cover and cause increased sediment pollution. Landslides and earthquakes can break sewer lines and release contaminants from septic systems, landfills, and underground storage containers.

References

- Barbash, J. E., G. P. Thelin, D. W. Kolpin, and R. J. Gilliom. 2001. Major herbicides in ground water: results from the National Water-Quality Assessment. *Journal of Environmental Quality* 30:831-845.