Chapter 22

Contamination

Water naturally contains a variety of dissolved components and although this helps classify the type of water, it does not necessarily mean the water quality is poor. In fact, many of the dissolved components in water are useful and beneficial to humans.

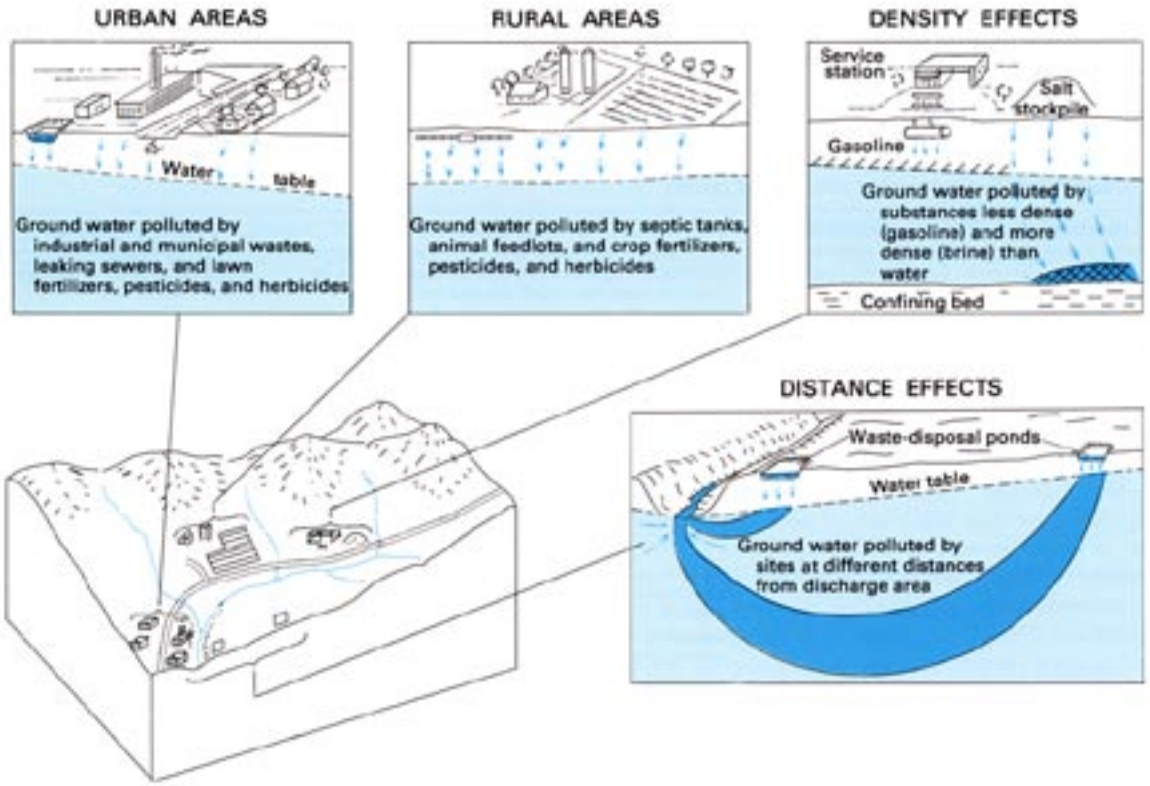
Contaminated water, however, is a different story. Contaminated or polluted water occurs when human activity changes the natural water quality making it no longer fit for use as previously intended and utilized. Just like with the discussion of water quality, the key part of the definition concerns quantity or how contaminated is the water. It is extremely rare that any precipitation, surface water, and shallow ground water have no level of human contamination. In fact, snow samples from the surface of Antarctica and Greenland show trace levels of industrial aerosols and tritium (radioactive hydrogen from bomb tests beginning in the 1950s). Rain and snow in the U.S. typically contains trace amounts of industrial and agricultural chemicals. Does this mean the rain and snow are contaminated? Not necessarily. The precipitation contains contaminants, but usually the levels are low enough to not change how people would use the water.

Contamination of water is related to criteria established by the USEPA. Different standards are applied based on water use, such that water quality for fish habitat will have a different set of criteria than that for human drinking water. These standards are based on the potential effects (toxicity) posed by exposure to certain chemicals. Some chemicals at very low levels can be toxic to humans. Also, some chemicals have adverse effects in small doses or exposures (acute exposure) compared to others which require long-term exposure (chronic exposure), often over many months or years.

Based on the risk of known chemicals, the USEPA has developed drinking water standards as part of the Safe Drinking Water Act. Under this act, many known chemicals have been classified and human exposure quantified by MCLs. MCLs provide maximum amounts of exposure to any certain chemical above which there are potential human health risks. These standards are based on the best science available, but we need to keep in mind that many chemicals are relatively new to the environment (and to humans) and their long-term health effects may need more research and real-world data collection to better understand how these chemicals actually affect people.

Contamination of water can be from various sources. In most of rural Nevada, potential sources include chemicals in precipitation, agricultural chemicals, urban and domestic contamination, mining practices, and various spills. Chemicals in precipitation can be industrial and agricultural chemicals carried as dust and particles in clouds that get deposited with rain and snow. Winds can pick up dirt that has chemicals with it and carry these contaminants to the atmosphere. Industrial and urban (cars) exhaust goes into the atmosphere and can be carried for long distances by the winds before being deposited. An example of this is acid and mercury found in lakes in relatively pristine parts of the Appalachian Mountains that were carried by the wind and deposited in rain and snow. What happens downwind from a location, even hundreds of miles downwind, can ultimately affect the water quality at this location.

Many studies have shown that agricultural chemicals (pesticides, herbicides, and fertilizers) are showing up in surface water and ground water across the country. Often, these chemicals are found in direct association to where they are applied (such as in shallow ground water beneath a farm field). However, rain and snow also carry some levels of agricultural chemicals. One thing scientists are now researching is not only the occurrence of these chemicals in water, but also how these chemicals change in the environment.



GROUND-WATER POLLUTION OCCURS IN BOTH URBAN AND RURAL AREAS AND IS AFFECTED BY DIFFERENCES IN CHEMICAL COMPOSITION, BIOLOGICAL AND CHEMICAL REACTIONS, DENSITY, AND DISTANCE FROM DISCHARGE AREAS

Source: Heath, 1989

Agricultural chemicals are designed to breakdown in the environment. However, these chemicals breakdown into different chemicals. Most of these "breakdown products" typically are harmless, but some are now being studied because of potential health risks.

Urban and domestic contamination can be a wide variety of substances. One of the most prevalent in Nevada is nitrate from septic systems. High nitrate levels can be dangerous for all humans, but especially for babies. Other sources of contamination include, but are not limited to, leaky underground storage tanks at gas stations, storm runoff from streets into drains, lawn care products, automotive exhaust, landfills, road salt, cemeteries, car washes, and other potential releases of chemicals. One of the sources of contamination under recent study is what we call emerging contaminants, specifically pharmaceuticals and personal care products. Such things like antibiotics and other medicines are getting into the environment from human and animal waste discharge and from people dumping extra medicines into sinks and toilets. These products can produce resistive bacteria in the environment. Personal care products, such as skin and hair products, soaps, detergents, and even caffeine from beverages, are being detected in the environment.

Mining practices can be an important source of potential contamination in Nevada because of the large number of mines (present and abandoned). Contaminants, such as arsenic, are associated with mines because of ore processing and exposure of rock debris to weathering. Acid-mine drainage from sites has been shown to affect water quality in runoff and ground water near mines. Mercury has been widely used in Nevada to extract metals such as gold and silver from ores. The mercury can get into the environment and have potential human and aquatic health effects. For example, mercury from mining has contaminated sediments in the Carson River. Mining also uses cyanide for leaching gold and silver from ores. Spills and leaks of cyanide can cause contamination and has been associated with fish kills in some mining areas of the country.

Spills are a common occurrence for surface-water and ground-water contamination. Most people are familiar with the Exxon Valdez oil spill. Spills can happen wherever potential environmental contaminants are stored or transported. Trains and fuel trucks can become damaged (usually through collision or human error) and leak large quantities of contaminants into streams or into the ground. People often think about these large spills when talking about contamination, but many spills can be smaller and still quite harmful. Some folks dump old paints and fuels from their homes and farms into drains or into the backyard. These contaminants get into the water supply and cause damage. Some people drain their engines directly onto the ground when doing oil changes. This too can get into drinking water supplies. Often normal human activities can be the cause of many spills and degradation of the water supply for a community.

As one can see, water can become contaminated in a number of ways. Some things can not be controlled locally (such as pollution that gets into the air and carried by the wind). These require State or Federal regulations to control. Other things can be controlled, such as what is put into the ground, down drains, or on yards. The most important thing to keep in mind when considering contamination is that everyone lives downstream (in some form or another, even if talking about air contamination) from someone else. What one does to one's yard, one's land, and one's city can affect many surrounding people and those downgradient.

Potential source of surface-water contamination. Photograph from the USGS Toxic Substances Hydrology Program, Midcontinent Herbicide Reconnaissance study <http://toxics.usgs.gov/photo_gallery/ag_chemicals.html>.

Fish samples collected as part of the USGS National Water-Quality Assessment Program. Photograph by M.R. Rosen, USGS.