Water pollution is the contamination of water bodies

Environment, Pollution

Water pollutionis the contamination of water bodies (e. g. lakes, rivers, oceans and groundwater). Waterpollutionaffects plants and organisms living in these bodies of water; and, in almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.

Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. Millions depend on the polluted Ganges river. Water pollution is a major problem in the global context. It has been suggested that it is the leading worldwide cause of deaths and diseases,[1][2] and that it accounts for the deaths of more than 14, 000 people daily. [2] An estimated 700 million Indians have no access to a proper toilet, and 1, 000 Indian children die of diarrheal sickness every day. 3] Some 90% of China's cities suffer from some degree of water pollution,[4] and nearly 500 million people lack access to safe drinking water. [5] In addition to the acute problems of water pollution in developing countries, industrialized countries continue to struggle with pollution problems as well.

In the most recent national report on water quality in the United States, 45 percent of assessed stream miles, 47 percent of assessed lake acres, and 32 percent of assessed bay and estuarine square miles were classified as polluted. 6] Water is typically referred to as polluted when it is impaired by anthropogenic contaminants and either does not support a human use, like serving as drinking water, and/or undergoes a marked shift in its ability to support its constituent biotic communities, such as fish. Natural phenomena

such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water. [edit]Water pollution categories Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated. 7] Sources of surface water pollution are generally grouped into two categories based on their origin. [edit] Point source pollution Point source pollution - Shipyard - Rio de Janeiro. Point source pollution refers to contaminants that enter a waterway through a discrete conveyance, such as a pipe or ditch.

Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain. The U. S. Clean Water Act (CWA) defines point source for regulatory enforcement purposes. 8] The CWA definition of point source was amended in 1987 to include municipal storm sewer systems, as well as industrial stormwater, such as from construction sites. [9] [edit] Non–point source pollution Non–point source (NPS) pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often the cumulative effect of small amounts of contaminants gathered from a large area.

The leaching out of nitrogen compounds from agricultural land which has been fertilized is a typical example. Nutrient runoff in stormwater from " sheet flow" over an agricultural field or a forest are also cited as examples of NPS pollution. Contaminated storm water washed off of parking lots, roads and highways, called urban runoff, is sometimes included under the category of NPS pollution. However, this runoff is typically channeled into storm drain systems and discharged through pipes to local surface waters, and is a point

source. However where such water is not channeled and drains directly to ground it is a non-point source. [edit] Groundwater pollution See also: Hydrogeology Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, sometimes referred to as groundwater contamination, is not as easily classified as surface water pollution.

[7] By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies, and the distinction of point vs. non-point source may be irrelevant. A spill or ongoing releases of chemical or radionuclide contaminants into soil (located away from a surface water body) may not create point source or non-point source pollution, but can contaminate the aquifer below, defined as a toxin plume. The movement of the plume, a plume front, can be part of a Hydrological transport model or Groundwater model. Analysis of groundwater contamination may focus on the soil characteristics and site geology, hydrogeology, hydrology, and the nature of the contaminants. [edit] Causes of water pollution The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens, and physical or sensory changes such as elevated temperature and discoloration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, ron, manganese, etc.

) the concentration is often the key in determining what is a natural component of water, and what is a contaminant. Oxygen-depleting substances may be natural materials, such as plant matter (e. g. leaves and

grass) as well as man-made chemicals. Other natural and anthropogenic substances may cause turbidity (cloudiness) which blocks light and disrupts plant growth, and clogs the gills of some fish species. [10] Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts.

11] Alteration of water's physical chemistry includes acidity (change in pH), electrical conductivity, temperature, and eutrophication. Eutrophication is an increase in the concentration of chemical nutrients in an ecosystem to an extent that increases in the primary productivity of the ecosystem. Depending on the degree of eutrophication, subsequent negative environmental effects such as anoxia (oxygen depletion) and severe reductions in water quality may occur, affecting fish and other animal populations. [edit] Pathogens A manhole cover unable to contain a sanitary sewer overflow. Coliform bacteria are a commonly used bacterial indicator of water pollution, although not an actual cause of disease. Other microorganisms sometimes found in surface waters which have caused humanhealthproblems include: •Burkholderia pseudomallei •Cryptosporidium parvum •Giardia lamblia •Salmonella •Novovirus and other viruses •Parasitic worms (helminths). [12][13] High levels of pathogens may result from inadequately treated sewage discharges.

[14] This can be caused by a sewage plant designed with less than secondary treatment (more typical in less-developed countries). In developed countries, older cities with aging infrastructure may have leaky sewage collection systems (pipes, pumps, valves), which can cause sanitary

sewer overflows. Some cities also have combined sewers, which may discharge untreated sewage during rain storms. [15] Pathogen discharges may also be caused by poorly managed livestock operations. [edit] Chemical and other contaminants Muddy river polluted by sediment. Photocourtesy of United States Geological Survey. Contaminants may include organic and inorganic substances.

Organic water pollutants include: •Detergents •Disinfection by-products found in chemically disinfected drinking water, such as chloroform •Foodprocessing waste, which can include oxygen-demanding substances, fats and grease •Insecticides and herbicides, a huge range of organohalides and other chemical compounds •Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from stormwater runoff[16] •Tree and bush debris from logging operations Volatile organic compounds (VOCs), such as industrial solvents, from improper storage. Chlorinated solvents, which are dense non-aqueous phase liquids (DNAPLs), may fall to the bottom of reservoirs, since they don't mix well with water and are denser. •Various chemical compounds found in personal hygiene and cosmetic products Inorganic water pollutants include:•Acidity caused by industrial discharges (especially sulfur dioxide from power plants) •Ammonia from food processing waste •Chemical waste as industrial by-products Fertilizers containing nutrients--nitrates and phosphates--which are found in stormwater runoff from agriculture, as well as commercial and residential use[16] •Heavy metals from motor vehicles (via urban stormwater runoff)[16][17] and acid

mine drainage •Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land clearing sites Macroscopic pollution—large visible items polluting the water—may be termed " floatables" in an urban stormwater context, or marine debris when found on the open seas, and can include such items as: •Trash (e. . paper, plastic, or food waste) discarded by people on the ground, and that are washed by rainfall into storm drains and eventually discharged into surface waters •Nurdles, small ubiquitous waterborne plastic pellets •Shipwrecks, large derelict ships Potrero Generating Station discharges heated water into San Francisco Bay. [18] [edit] Thermal pollution Main article: Thermal pollution Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers.

Elevated water temperatures decreases oxygen levels (which can kill fish) and affects ecosystem composition, such as invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters. Thermal pollution can also be caused by the release of very cold water from the base of reservoirs into warmer rivers. [edit] Transport and chemical reactions of water pollutants See also: Marine pollution Most water pollutants are eventually carried by rivers into the oceans. In some areas of the world the influence can be traced hundred miles from the mouth by studies using hydrology transport models. Advanced computer models such as SWMM or the DSSAM Model have been used in many locations worldwide to examine the fate of pollutants in aquatic systems. Indicator filter feeding species such

as copepods have also been used to study pollutant fates in the New York Bight, for example.

The highest toxin loads are not directly at the mouth of the Hudson River, but 100 kilometers south, since several days are required for incorporation into planktonic tissue. The Hudson discharge flows south along the coast due to coriolis force. Further south then are areas of oxygen depletion, caused by chemicals using up oxygen and by algae blooms, caused by excess nutrients from algal cell death and decomposition. Fish and shellfish kills have been reported, because toxins climb the food chain after small fish consume copepods, then large fish eat smaller fish, etc. Each successive step up the food chain causes a stepwise concentration of pollutants such as heavy metals (e. g. mercury) and persistent organic pollutants such as DDT.

This is known as biomagnification, which is occasionally used interchangeably with bioaccumulation. A polluted river draining an abandoned copper mine on Anglesey Large gyres (vortexes) in the oceans trap floating plastic debris. The North Pacific Gyre for example has collected the so-called " Great Pacific Garbage Patch" that is now estimated at 100 times the size of Texas. Many of these long-lasting pieces wind up in the stomachs of marine birds and animals. This results in obstruction of digestive pathways which leads to reduced appetite or even starvation. Many chemicals undergo reactive decay or chemically change especially over long periods of time in groundwater reservoirs. A noteworthy class of such chemicals is the chlorinated hydrocarbons such as trichloroethylene (used in industrial metal degreasing and electronics manufacturing) and

tetrachloroethylene used in the dry cleaning industry (note latest advances in liquid carbon dioxide in dry cleaning that avoids all use of chemicals).

Both of these chemicals, which are carcinogens themselves, undergo partial decomposition reactions, leading to new hazardous chemicals (including dichloroethylene and vinyl chloride). Groundwater pollution is much more difficult to abate than surface pollution because groundwater can move great distances through unseen aquifers. Non-porous aquifers such as clays partially purify water of bacteria by simple filtration (adsorption and absorption), dilution, and, in some cases, chemical reactions and biological activity: however, in some cases, the pollutants merely transform to soil contaminants. Groundwater that moves through cracks and caverns is not filtered and can be transported as easily as surface water. In fact, this can be aggravated by the human tendency to use natural sinkholes as dumps in areas of Karst topography. There are a variety of secondary effects stemming not from the original pollutant, but a derivative condition. An example is silt-bearing surface runoff, which can inhibit the penetration of sunlight through the water column, hampering photosynthesis in aquatic plants.

[edit] Measurement of water pollution Environmental Scientists preparing water autosamplers. Water pollution may be analyzed through several broad categories of methods: physical, chemical and biological. Most involve collection of samples, followed by specialized analytical tests. Some methods may be conducted in situ, without sampling, such as temperature. Government agencies and research organizations have published

standardized, validated analytical test methods to facilitate the comparability of results from disparate testing events. [19] [edit] Sampling Sampling of water for physical or chemical testing can be done by several methods, depending on the accuracy needed and the characteristics of the contaminant. Many contamination events are sharply restricted in time, most commonly in association with rain events.

For this reason " grab" samples are often inadequate for fully quantifying contaminant levels. Scientists gathering this type of data often employ auto-sampler devices that pump increments of water at either time or discharge intervals. Sampling for biological testing involves collection of plants and/or animals from the surface water body. Depending on the type of assessment, the organisms may be identified for biosurveys (population counts) and returned to the water body, or they may be dissected for bioassays to determine toxicity. [edit] Physical testingCommon physical tests of water include temperature, solids concentration like total suspended solids (TSS) and turbidity. [edit] Chemical testing See also: water chemistry analysis and environmental chemistry Water samples may be examined using the principles of analytical chemistry. Many published test methods are available for both organic and inorganic compounds.

Frequently used methods include pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients (nitrate and phosphorus compounds), metals (including copper, zinc, cadmium, lead and mercury), oil and grease, total petroleum hydrocarbons (TPH), and pesticide