Environmental Management & Pollution

WHAT IS POLLUTION?

1.1 Overview

Water is a unique substance, because it can naturally renew and cleanse itself, by allowing pollutants to settle out (through the process of sedimentation) or break down, or by diluting the pollutants to a point where they are not in harmful concentrations. However, this natural process takes time, and is difficult when excessive quantities of harmful contaminants are added to the water and humans are using more and more materials that are polluting the water sources that we drink from. In nine of the last ten years, large blue-green algae blooms have appeared on the northern part of Lake Winnipeg. These are caused by excess phosphorus in the water. Fertilizer use is 15 times higher today than it was in 1945. Beach closures are becoming increasingly common. The list of pollutants is long and the signs of water pollution surround us, but the point is this: we are dumping contaminants into the small portion of water on the planet that is fit for drinking.

1.2 What Is Pollution?

Pollution is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants. Pollution is often classed as point source or nonpoint source pollution.

Pollution can be defined in several ways. Water pollution occurs when energy and other materials are released, degrading the quality of the water for other users. Water pollution includes all of the waste materials that cannot be naturally broken down by water. In other words, anything that is added to the water, above and beyond its capacity to break it down, is pollution. Pollution, in certain circumstances, can be caused by nature itself, such as when water flows through soils with high acidities. Human actions are responsible for the pollutants that enter the water.

Pollution became a popular issue after World War II, due to radioactive fallout from atomic warfare and testing. Then a non-nuclear event, The Great Smog of 1952 in London, killed at least 4000 people.[7] This prompted some of the first major modern environmental legislation, The Clean Air Act of 1956.

Pollution began to draw major public attention in the United States between the mid-1950s and early 1970s, when Congress passed the Noise Control Act, the Clean Air Act, the Clean Water Act and the National Environmental Policy Act.

Severe incidents of pollution helped increase consciousness. PCB dumping in the Hudson River resulted in a ban by the EPA on consumption of its fish in 1974. Long-term dioxin contamination at Love Canal starting in 1947 became a national news story in 1978 and led to the Superfund legislation of 1980. Legal proceedings in the 1990s helped bring to light hexavalent chromium releases in California—the champions of whose victims became famous. The pollution of industrial land gave rise to the name brownfield, a term now common in city planning.

The development of nuclear science introduced radioactive contamination, which can remain lethally radioactive for hundreds of thousands of years. Lake Karachay, named by the Worldwatch Institute as the "most polluted spot" on earth, served as a disposal site for the Soviet Union throughout the 1950s and 1960s. Second place may go to the area of Chelyabinsk U.S.S.R. (see reference below) as the "Most polluted place on the planet".

Nuclear weapons continued to be tested in the Cold War, sometimes near inhabited areas, especially in the earlier stages of their development. The toll on the worst-affected populations and the growth since then in understanding about the critical threat to human health posed by radioactivity has also been a prohibitive complication associated with nuclear power. Though extreme care is practiced in that industry, the potential for disaster suggested by incidents such as those at Three Mile Island and Chernobyl pose a lingering specter of public mistrust. One legacy of nuclear testing before most forms were banned has been significantly raised levels of background radiation.

International catastrophes such as the wreck of the Amoco Cadiz oil tanker off the coast of Brittany in 1978 and the Bhopal disaster in 1984 have demonstrated the universality of such events and the scale on which efforts to address them needed

to engage. The borderless nature of atmosphere and oceans inevitably resulted in the implication of pollution on a planetary level with the issue of global warming. Most recently the term persistent organic pollutant (POP) has come to describe a group of chemicals such as PBDEs and PFCs among others. Though their effects remain somewhat less well understood owing to a lack of experimental data, they have been detected in various ecological habitats far removed from industrial activity such as the Arctic, demonstrating diffusion and bioaccumulation after only a relatively brief period of widespread use.

A much more recently discovered problem is the Great Pacific Garbage Patch, a huge concentration of plastics, chemical sludge and other debris which has been collected into a large area of the Pacific Ocean by the North Pacific Gyre. This is a less well known pollution problem than the others described above, but nonetheless has multiple and serious consequences such as increasing wildlife mortality, the spread of invasive species and human ingestion of toxic chemicals. Organizations such as 5 Gyres have researched the pollution and, along with artists like Marina DeBris, are working toward publicizing the issue.

Growing evidence of local and global pollution and an increasingly informed public over time have given rise to environmentalism and the environmental movement, which generally seek to limit human impact on the environment.

1.3 Where DOES Pollution Come From?

There are two main sources of water pollution; point sources and non-point sources. Point sources include factories, wastewater treatment facilities, septic systems, and other sources that are clearly discharging pollutants into water sources. Non-point sources are more difficult to identify, because they cannot be traced back to a particular location. Non-point sources include runoff including sediment, fertilizer, chemicals and animal wastes from farms, fields, construction sites and mines. Landfills can also be a non-point source of pollution, if substances leach from the landfill into water supplies. The United States Environmental Protection Agency (EPA) divides water pollution into the following six categories:

1. ***Biodegradable waste*** consists mainly of human and animal waste. When biodegradable waste enters a water supply, the waste provides an energy source (organic carbon) for bacteria. Organic carbon is converted to carbon dioxide and water, which can cause atmospheric pollution and acid rain;

this form of pollution is far more widespread and problematic than other forms of pollutants, such as radioactive waste. If there is a large supply of organic matter in the water, oxygen-consuming (aerobic) bacteria multiply quickly, consume all available oxygen, and kill all aquatic life.

2. ***Plant nutrients,*** such as phosphates and nitrates, enter the water through sewage, and livestock and fertilizer runoff. Phosphates and nitrates are also found in industrial wastes. Though these chemicals are natural, 80 percent of nitrates and 75 percent of phosphates in water are human-added. When there is too much nitrogen or phosphorus in a water supply (0.3 parts per million for nitrogen and 0.01 parts per million for phosphorus), algae begin to develop.

    - When algae blooms, the water can turn green and cloudy, feel slimy, and smell bad. Weeds start to grow and bacteria spread. Decomposing plants use up the oxygen in the water, disrupting the aquatic life, reducing biodiversity, and even killing aquatic life. This process, called eutrophication, is a natural process, but generally occurs over thousands of years. Eutrophication allows a lake to age and become more nutrient-rich; without nutrient pollution, this may take 10,000 years, but pollution can make the process occur 100 to 1,000 times faster.

3. ***Heat can be a source of pollution in water.*** As the water temperature increases, the amount of dissolved oxygen decreases. Thermal pollution can be natural, in the case of hot springs and shallow ponds in the summertime, or human-made, through the discharge of water that has been used to cool power plants or other industrial equipment. Fish and plants require certain temperatures and oxygen levels to survive, so thermal pollution often reduces the aquatic life diversity in the water.

4. ***Sediment is one of the most common sources of water pollution.*** Sediment consists of mineral or organic solid matter that is washed or blown from land into water sources. Sediment pollution is difficult to identify, because it comes from non-point sources, such as construction, agricultural and livestock operations, logging, flooding, and city runoff. Each year, water sources in the United States are polluted by over one billion tonnes of

sediment! Sediment can cause large problems, as it can clog municipal water systems, smother aquatic life, and cause water to become increasingly turbid. And, turbid water can cause thermal pollution, because cloudy water absorbs more solar radiation.

5. ***Hazardous and toxic chemicals*** are usually human-made materials that are not used or disposed of properly. Point sources of chemical pollution include industrial discharges and oil spills. The ***Oil Pollution*** fact sheet includes more detailed information about oil spills, as well as other sources of oil pollution.

    - Non-point sources of chemical pollution include runoff from paved roads and pesticide runoff. Many people think industries produce the greatest amount of chemical pollution. But domestic and personal use of chemicals can significantly contribute to chemical pollution. Household cleaners, dyes, paints and solvents are also toxic, and can accumulate when poured down drains or flushed down the toilet. In fact, one drop of used motor oil can pollute 25 litres of water! And, people who use pesticides on their gardens and lawns tend to use ten times more pesticide per acre than a farmer would!

6. Radioactive pollutants include wastewater discharges from factories, hospitals and uranium mines. These pollutants can also come from natural isotopes, such as radon. Radioactive pollutants can be dangerous, and it takes many years until radioactive substances are no longer considered dangerous.

It would be wise to add a seventh category of water pollution; pharmaceuticals and personal care products (often abbreviated PPCPs), including medications, lotions and soap, are being found in increasing concentrations in lakes and rivers. Scientists have discovered that many PPCPs act as hormone disrupters, which means that the synthetic hormones in the products interfere with the natural hormones in animals, especially fish that live in the water. There has not been enough research to determine the effects that PPCPs can have on humans, but there is evidence to suggest that these chemicals may be partially responsible for an increase in cancer and birth defects. For more information about PPCPs and other emerging contaminants, see the fact sheet titled ***Emerging Contaminants***.

1.4 How Bad is Pollution?

It is difficult, or impossible, to estimate the amount of water pollution that originates in Canada, because many pollutants come from non-point sources. As well, because all of the water in the world is connected, it is sometimes impossible to tell where the pollutants originated. However, here are a few statistics about North America and Canada:

1) It is estimated that five million tonnes of road salt are used in Canada each year.
2) Fertilizer use is more than 15 times what it was in 1945.
3) In the United States, over 7.5 trillion litres of water are filtered each year to remove silt.
4) Canadians are the second highest consumers of water, second only to Americans.
5) Over 360 chemical compounds, including lead, DDT and mercury, have been identified in the Great Lakes.
6) Between 1950 and 1975, Lake Erie experienced the process of eutrophication, due to excess phosphorus and nitrogen. Without human pollution, the process that took 25 years would have taken 15,000 years!
7) Some 70,000 commercial and industrial compounds are currently in use in Canada, and there are estimated 1,000 chemicals that are introduced each year.
8) Just one drop of many household chemicals can render large amounts of water undrinkable; for example, one drop of 2,4-D (a common household herbicide) can make 10 million litres of unfit for drinking!
9) The Sierra Legal Defence Fund reports that 21 Canadian cities dump more than one trillion litres of untreated sewage are dumped into our waters every year.

1.5 Agricultural Pollution

What impact does domestic waste have on water pollution? The categories of water pollution that domestic waste fits into are biodegradable waste, hazardous and toxic chemical pollutants and PPCPs. Generally, wastewater treatment facilities are equipped to effectively remove harmful substances generated from biodegradable waste. The hazardous and toxic chemicals that individuals release into the environment are more dangerous (and more preventable). Chemicals,

such as cleaners, dyes, paints, pesticides and solvents, which are poured down drains, are a substantial and dangerous form of pollution. Wastewater treatment facilities are generally unequipped to remove PPCPs from wastewater; water pollution from PPCPs is a growing concern. For more information about dangerous pollutants that are found in domestic products, see the Emerging Contaminants fact sheet.

What impact does industrial activity have on water pollution? Industrial pollution comes in a variety of forms. There are many federal regulations regarding types and amounts of pollutants that can be emitted from industries, though in some countries, companies who are over their limit can buy "pollution credit" from companies who are under the targeted amount.

Heat pollution is commonly caused by industries, but many regions have passed legislation requiring that power plants and industries cool water before they release it. Construction, mining and logging operations can cause great amounts of sediment to pollute lakes and streams. While agricultural practices are responsible for the most sediment pollution, construction and mining can lose up to 70 tonnes of sediment per acre per year, which is 15 times higher than the normal cropland rate.

What impact does agriculture have on water pollution? The greatest agricultural contributions to water pollution are through nutrient and sediment pollution. Livestock waste and fertilizers contain nitrogen and phosphorus, which, if carried to lakes and streams through runoff, can cause significant problems resulting in excess algae growth. In the last ten years, the number of livestock in Manitoba has increased by about 65 percent, mostly in the form of pigs and cows.

The livestock produce a large amount of waste, which many farmers use as fertilizer on their fields. In the Winnipeg area, thousands of hectares of farmland have been designed for efficient runoff, which minimizes flooding. However, when the water runs off, it carries organic matter from the fertilizers straight into the creeks that feed Lake Winnipeg. Agricultural practices in Manitoba are estimated to be responsible for about 17 percent of the phosphorus problem in Lake Winnipeg. There are several best management practices that can reduce the amount of agricultural water pollution, such as collecting animal wastes in a lagoon, or spraying pesticides in small amounts and at minimal runoff times.

Agricultural practices are the leading cause of sediment pollution, because bare lands are susceptible to large amounts of erosion. Erosion causes problems both for the water source and the farmland, which loses significant amounts of topsoil each year.

1.6 How Can I Prevent Pollution?

When we throw something in the garbage, or flush the toilet, we tend to forget about it. Because individuals are responsible for many non-point sources of pollution, we do not always realize how much we are contributing to water pollution. It seems easier to point the finger at agricultural, industrial, and mining operations. However, here are a few tips:

1) Conserve water; the less water you use, the less will be running down the drains and into gutters, carrying pollutants with it. For more information about water consumption, as well as some tips on how to conserve water, see the Water Consumption fact sheet.
2) Keep pet litter and debris out of street gutters.
3) Use pesticides sparingly; in general, people tend to use 10 to 50 times more fertilizer on their lawns and gardens than is necessary for good plant health.
4) Use compost to fertilize your garden.
5) Keep your vehicles running properly. If you have an oil leak, fix it immediately, and if you change your own oil, dispose of the used oil properly.
6) Use natural cleaners, such as baking soda, vinegar and borax.
7) Use detergents with less phosphate; sewage plants can only remove about 30 percent of the phosphates from waste. It is estimated that, in the United States, between 90.7 million and 226.8 million kilograms of phosphates are added into waterways each year.

The Safe Drinking Water Foundation has educational programs that can supplement the information found in this fact sheet. Operation Water Drop looks at the chemical contaminants that are found in water; it is designed for a science class. Operation Water Flow looks at how water is used, where it comes from and how much it costs; it has lessons that are designed for Social Studies, Math, Biology, Chemistry and Science classes. Operation Water Spirit presents a First

Nations perspective of water and the surrounding issues; it is designed for Native Studies or Social Studies classes.

Operation Water Health looks at common health issues surrounding drinking water in Canada and around the world and is designed for a Health, Science and Social Studies collaboration. Operation Water Pollution focuses on how water pollution occurs and how it is cleaned up and has been designed for a Science and Social Studies collaboration. To access more information on these and other educational activities, as well as additional fact sheets, visit the Safe Drinking Water Foundation website at www.safewater.org.