

Topic 6 - N.I.M.B.Y. There Is No Away In Throwing

The acronym N.I.M.B.Y stands for NOT IN MY BACKYARD. With humans producing more and more waste, the disposal of these wastes in our backyards is becoming a concern. How do they get there?

Blowing In The Wind

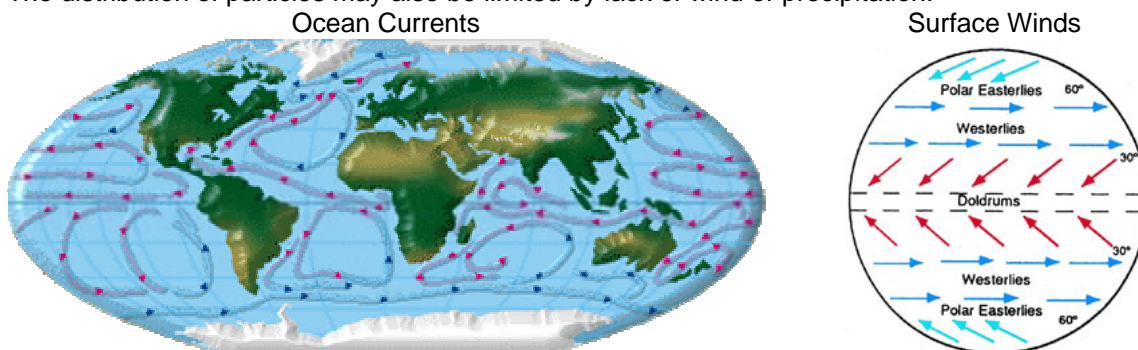
The source of a pollutant may be in one place, but it can show up in many other places around the world. There are three stages of transport of substances in the environment:

- Release of chemicals at the source
- Dispersion of the chemical into the atmosphere
- Deposition of the chemical in soil or water

The direction and distance that airborne chemicals travel are determined by various factors, including:

- The properties of the chemical pollutant
- The wind speed
- The direction of the prevailing winds

The distribution of particles may also be limited by lack of wind or precipitation.



The source of most airborne particles now is primarily human activities (industries, agriculture and manufacturing), whereas in the past natural sources (forest fires and volcanoes) were the main culprits.

Stratospheric Ozone and CFCs

Ozone at the Earth's surface is an irritating toxin. Atmospheric ozone is the chemical that occurs high in the atmosphere where it maintains a shield around the Earth protecting everyone from harmful UV radiation from the Sun. The ozone layer is a natural formation 15 to 50 kilometers above us. Since the late 1970's Scientists who have been monitoring this protective layer, have noticed that it is becoming thinner. They have also discovered 'holes' in the layer. This results in more UV radiation getting through to the surface of the Earth and increasing the likelihood of more organisms getting skin cancer and cataracts. It is also affecting the plankton population – which is an important food supply for many animals.

The thinning of the atmosphere is caused by our use of **chlorofluorocarbons** (CFC's). In the past these chemicals were used in: Styrofoam™, aerosol spray cans and coolants in refrigeration systems. These chemicals eventually get into the upper atmosphere where they are broken down into elements like chlorine – which destroys ozone. (1 chlorine atom can destroy 100, 000 ozone molecules. Many countries have signed agreements to reduce their use of these chemicals, which are stable and will persist in the atmosphere for many years to come.

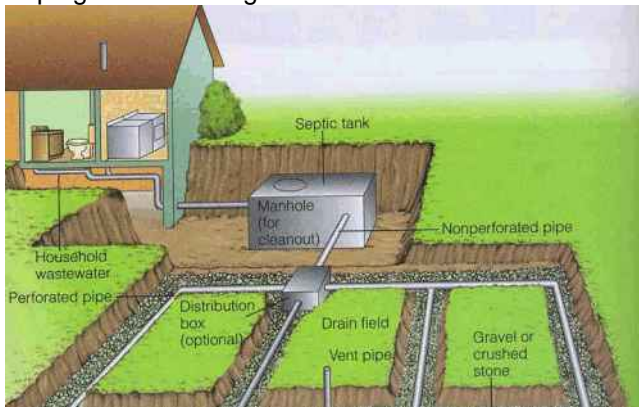
Controlling Water Pollution in Surface Waters <http://www3.gov.ab.ca/env/water/SWQ/index.cfm>

Hazardous chemicals can enter surface water from the air, the groundwater, runoff from agricultural fields and industrial sites and outflow from storm sewers and sewage treatment plants. A substance that dissolves in water easily may be carried by water a fair distance and dispersed over a wide area. Substances that do not dissolve easily may sink to the bottom and be concentrated close to the source, affecting organisms in the immediate area. Because humans use water for drinking and agricultural use, its quality is monitored regularly.

Most surface water pollution is a result of washing clothes or watering lawns. Nitrates and phosphates enter the water system through storm sewers, runoff or untreated wastewater. Treatment of wastewater and sewage is necessary to reduce its harmful effects when it reenters the water system from which it was taken. Sewage includes: dissolved and undissolved materials from your kitchen, bathroom and laundry. Treatment can occur in rural areas with septic systems and urban areas with waste treatment plants.

Septic tank (rural areas) –

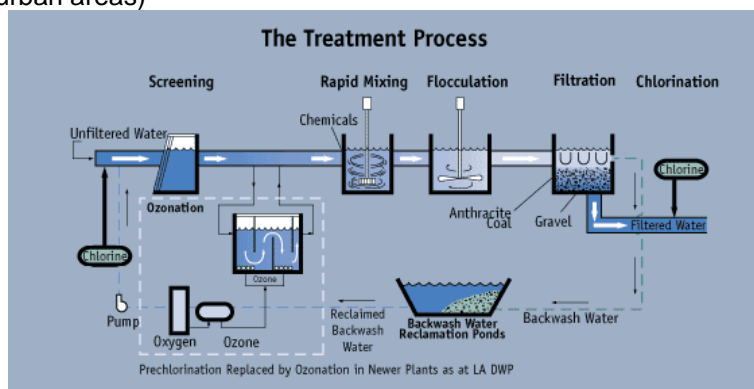
A septic tank is a large underground container that traps grease and large solids.



The remaining liquid waste is distributed through pipes with holes (perforated); the pipes lead into a drainage area containing gravel. Bacteria and other micro-organisms in the gravel and soil break down the organic waste and use it as a source of food energy. This system mimics the way in which decomposers normally recycle biodegradable wastes. The septic tank is periodically pumped out to prevent overflow.

Sewage Treatment Plant (urban areas) –

A waste facility treats sewage in three levels or steps.



Primary - *physical*

- filtering, sieving and settling
- waste water can be further treated with chlorine and returned to the environment as effluent. Waste material, called **sludge**, can be recycled as fertilizer or landfill.

Secondary - *biological*

- bacteria and micro-organisms decompose most of the remaining biodegradable waste.

Tertiary - *chemical*

- removes dissolved nitrates, phosphates and undissolved solids from the effluent

Controlling Water Pollution in Ground Water

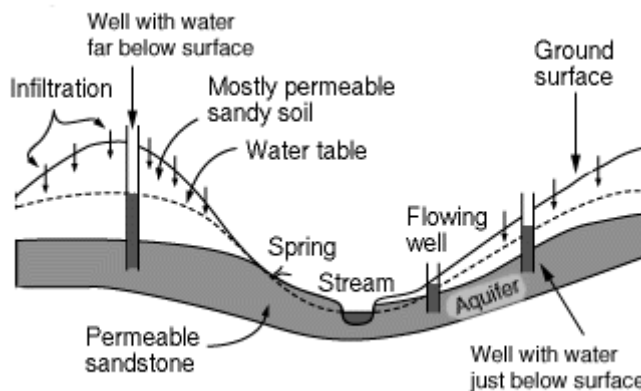
Water that soaks into the soil is collected in a zone called the **groundwater zone**. The top of the groundwater zone in the soil is called the **water table**. Groundwater moves sideways, up or down and can move very slowly (1 meter per year) or very quickly (1 meter per day).

Water in Alberta - <http://www3.gov.ab.ca/env/water/index.cfm> <http://www.groundwater.org/kc/kc.html>

Certain contaminants (http://www.cee.vt.edu/program_areas/environmental/teach/gwprimer/gw-types.html) can remain collected in the groundwater for long periods of time (because they are heavy metals), posing problems if the groundwater is used for drinking, agricultural purposes or industrial use.

A factor that affects the movement of contaminants in groundwater is the number and connection of pores (tiny spaces between soil grains) in the soil. When the pores are packed together very tightly and are not connected, the soil is considered **impermeable**. If the pores are connected the soil is **permeable** and water can move through easily.

Permeable ground can create **aquifers**, which collect naturally filtered amounts of water that providing a good source of drinking water, accessible when a well is drilled. Unfortunately they can also contain concentrated soluble substances as well. They are difficult to clean up and the solution is prevention.



Pollutants, which occur naturally or through human activities, can move more quickly through permeable soil.

Some Substances That Contaminate Groundwater

Substance	Source	Examples	Occurrence
Minerals	Rocks and Soil	Iron, Calcium, Selenium	Natural
Organic Substances	Soil	Pesticides, solvents	Natural & Human Activities
Leached Substances	Landfill sites, mines	Heavy metals, organics	Human Activities
Leaked substances	Underground storage tanks, pipelines	Gasoline, Natural gas, oil	Human Activities
Inorganic substances	Run-off	De-icing roadways, sewage, industrial processes	Human Activities
Micro-organisms	Septic tanks, sewage treatment ponds, runoff	Bacteria, viruses, Protozoans	Human Activities
Chemicals	Household	Nitrates, phosphates, detergents, cleaners	Human Activities

Biodegradability and the Environment

Biodegradation occurs in the environment because living things (earthworms, bacteria and fungi) are actively breaking down organic substances, including many pollutants. Micro-organisms are especially important in the biodegradation of pollutants. The existing organic molecules provide carbon atoms, which are used to build biological compounds, such as carbohydrates and proteins. This is a multi-step process in which the large organic molecules are broken down (hydrolyzed) either inside or outside bacteria.

Some bacteria grow and reproduce only when oxygen is present. They use the oxygen for the process of **aerobic biodegradation**. When oxygen is not present – in an **anaerobic environment** (like deep in landfill sites) - some bacteria remove chlorine from harmful chlorine-containing compounds, such as PCB's (polychlorinated biphenyls - human made oils used in electrical equipment), by replacing them with hydrogen atoms – which can then be used as food for the bacteria. During the winter, biodegradation is slow, because **temperature** is one factor that affects the rate of biodegradation. Other factors include **soil moisture, pH, oxygen supply and nutrient availability**.

Hazardous Wastes

A hazardous waste is any discarded material that contains substances that can be poisonous, toxic, corrosive, flammable, or explosive. Chemicals used in the home and garden can be classified as hazardous wastes.

HOUSEHOLD PRODUCTS DATABASE - <http://householdproducts.nlm.nih.gov/products.htm>

A Sample List of Products Used in the Home

http://www.checcnet.org/healthhouse/education/articles-detail.asp?Main_ID=650

Common Household Hazardous Waste

<http://www3.gov.ab.ca/env/waste/aow/hhw/common.html>

Improper storage, transport and disposal of these products can contribute to burns, heart problems, kidney failure, lung (respiratory) ailments, cancer and even death.

Regulations are designed to protect consumers and reduce the risk of hazardous chemicals. The regulations reflect current scientific research done on the products and how they might interact with other products.

Identifying of HHW

Look for these Signal Words:

- Toxic
- Warning
- Caution
- Flammable
- Corrosive
- Reactive
- Danger



Danger

Caution

Poison

Learn about Chemicals in your home <http://www.epa.gov/kidshometour/index.htm>




Workplace Hazardous Materials Information System

MSDS

Material Safety Data Sheets

MSDS information sheets give a detailed description of the product – its composition, physical appearance, and chemical characteristics. It also describes the precautions that should be taken when handling, transporting and disposing of the product, as well as health effects, first aid treatment and what to do in case of a spill.

Different labels are used for different purposes:

Transporting	Supplying	Used in the Workplace	Disposal
 <p>Figure 2 POISON Placard</p> <p>Transporting Hazardous Materials Test</p>	<p>Toilet Bowl Cleaner</p> <p>DANGER: Corrosive – produces chemical burns. Contains Hydrochloric Acid. Do not get in eyes, or on skin or clothing. May be harmful or fatal if swallowed. Do not breathe vapor or fumes. Keep out of reach of children. Fumes are corrosive to metal.</p> <p>STORAGE AND DISPOSAL: Store in original container out of reach of small children. Keep securely closed in a cool, well-ventilated area. Do not reuse empty containers. When empty, discard in trash or recycle.</p>	<p>If a controlled product is transferred at the workplace to other containers, the employer may need to apply a workplace label to the new container. Workplace labels provide the following information: product identification; information for safe handling and a statement indicating that the MSDS is available.</p>	<p>HAZARDOUS WASTE FEDERAL LAW PROHIBITS IMPROPER DISPOSAL</p> <p>Office of Environmental Health & Safety 220 Forsyth Building Boston, Massachusetts 02115 (617) 373-2300 http://www.doe.mass.gov/ehs/whs.htm</p> <p>Investigator: _____ Phone #: _____ Dept.: _____ Room #: / Bldg.: _____ Date Container Filled: _____ Container ID(s): _____ Principal Constituent(s) (Give % and full Chemical Name): _____</p> <p>Hazardous Waste Classification (Check at least one) <input type="checkbox"/> Ignitable (includes flammable liquids, solids and gases) <input type="checkbox"/> Corrosive (pH of 2 or less, or 12 or greater, and/or can corrode steel) <input type="checkbox"/> Reactive (is unstable, can detonate or react violently with water) <input type="checkbox"/> Toxic (Contains heavy metals or pesticides) <input type="checkbox"/> Listed (Appears on the F, U, P, or M List) Other (Specify): _____</p>

Eco-Label - Established in 1988, Canada's "Environmental Choice" Eco-Logo program helps consumers identify products and services that are less harmful to the environment.



http://www.environmentalchoice.com/index_main.cfm

New Product Regulations

When new products are produced, the supplier must apply for approval to make it available to the consumer. The information about the product must include:

- Intended use, physical and chemical properties, active ingredient(s)
- Instructions for use, safety precautions
- Health effects, environmental effects, toxicity to humans, and first aid instructions in case of poisoning

Storage of Hazardous Chemicals in the Home

- Leave original label on the product
- Keep out of reach of children (locked up)
- Containers should be in good condition and secure
- Store in a cool, dry, well-ventilated place
- Never store flammables or gas in glass containers
- Store different classifications of chemicals on separate shelves in separate locations
- Keep oxidizers away from flammables
- Keep upright
- Store chemical in proper place when not in use
- Discard old products
- Place rusted or leaking containers inside a second container – dispose of both

Waste Management – Back to the 4Rs

Solid waste includes the garbage collected from households, industries, commercial retailers, institutions and construction or demolition sites.

Some of this waste can be **reduced**, **recycled**, **recovered** or **reused**, but most of it is placed in landfill sites. The most preferred option is to **reduce** – in other words don't make as much waste and the problem of disposal will take care of itself.

Follow the **4Rs** to avoid waste products being placed in a sanitary landfill and eventually coming back to haunt us.



Hazardous Waste Collection Sites <http://www.landcentre.ca/foundation/hazardous/legab.cfm>

A small amount of waste is incinerated (burned). Materials that cannot be recycled are packaged into larger containers and are then transported to **incinerators** like the one in Swan Hills.

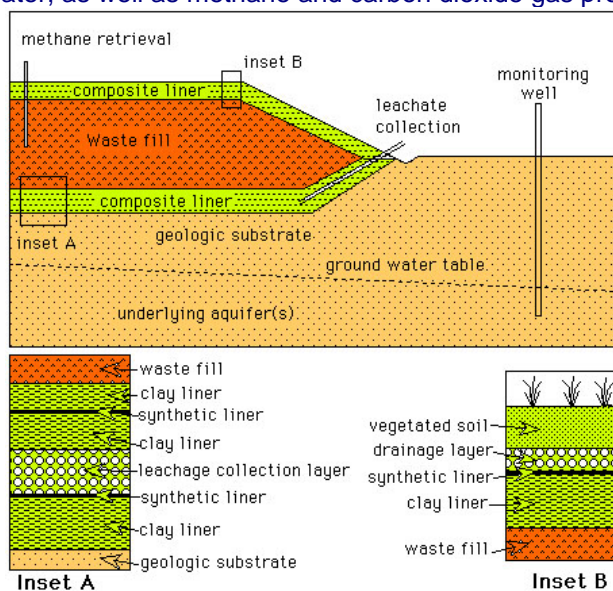
Swan Hills Special Hazardous Waste Treatment Facility <http://www.townofswanhills.com/aswt.html>

Some of the hazards that can occur when solid waste, containing chemicals harmful to the environment, are not properly disposed of include:

- air pollution (controlled emissions - scrubbers)
- leaching (prevented by plastic liners and compacted clay foundation at the landfill site)

Landfill Construction and Design

Activities around a sanitary landfill often evoke a N.I.M.B.Y. response. There are so many negative impacts of landfills that the activities to make sure they are safe must be monitored daily. The problems that can be encountered include: wind dispersal, scavengers and disease, leaching into groundwater, as well as methane and carbon dioxide gas production.



Secure Landfills

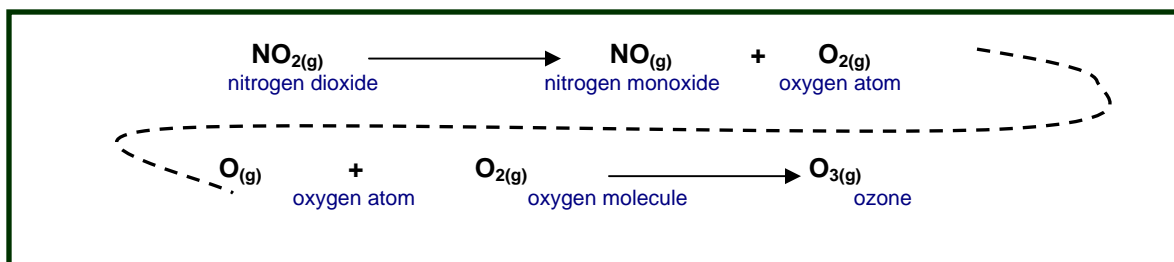
To reduce these problems, a sanitary landfill is designed to ensure that possible negative impacts are addressed and the landfill site is a secure and safe operation.

Bioremediation – Mother Nature to the Rescue

Bioreactors are a new technology that speeds up the rate of biodegradation by adding water to organic waste in a sanitary landfill site. *Planting vegetation* also encourages faster biodegradation because the populations of bacteria and fungi are larger around plant roots and this higher level means more microbial activity.

Phytoremediation is a technique that can be used to reduce the concentration of harmful chemicals in the soil or groundwater. Plants have been used to clean up metals, hydrocarbons, solvents, pesticides, radioactive materials, explosives, and landfill leachates. The plants are able to absorb and accumulate large amounts of these chemicals. When the plants have matured, they are harvested, burned or composted. In some cases, the metal can be recycled. When most of the harmful chemicals are removed by phytoremediation from the soil, then other plants can be planted there.

Photolysis is the breakdown of compounds by sunlight. The formation of ozone is an example of this process (outlined below)



Another example of photolysis is photodegradable plastic. Photodegradable plastic is made of chemicals that react when exposed to sunlight. In three months, the plastic becomes a fine powder that is easier to dispose of. (This type of plastic will only degrade if it is exposed to sunlight – if it is buried, it will last in its original shape for hundreds of years.)