Factsheet #2: Classifying Water Pollutants

Chemical Pollutants
Chemical water pollutants are water-soluble substances. Chemical substances can enter water sources through natural processes such as the leaching of minerals from soil, rocks, and mineral deposits. Chemical substances can also enter water sources as a by-product of manufacturing processes and power generation, or through home use of chemicals and household products.

**Organic**: oil and dyes, synthetic detergents, chlorinated hydrocarbons (DDT, PCBs), refined hydrocarbons, phenols and carboxylic acids, carbohydrates, sugars

**Inorganic**: acids, bicarbonates (acid salts), alkalis, chlorine, metallic salts, nitrates, phosphates, sulphates, hydrogen sulphide, radioactive isotopes

Biological Pollutants
It is not easy to classify biological pollutants as either natural or manufactured. For example, algae may be present naturally, but nutrients added by people can cause abundant algae growth, with serious results for the quality of the water. Excessive algae growth greatly increases the water's biological oxygen demand.

**Pathogenic forms**: bacteria, viruses, protozoans, fungi, algae, disease-producing parasitic worms

**Algae**: excess growth caused by an excess of nutrients (decay uses up oxygen)

**Aquatic weeds**: use oxygen as they grow; can choke waterways

Physical Pollution
Physical water pollution refers to material that is either suspended or floating in the water. Physical pollutants may be added naturally to the waterway or placed there as the result of human activities, often in larger quantities than nature can easily handle and purify.

**Floating matter**: foam and scum, wood and leaves

**Suspended matter**: silt, sand, gravel, metal pieces, cinders, rubber, plastic, wood chips, paper, pulp, solid sewage material, animal carcasses

Thermal Effects
Heated water may be discharged into streams, lagoons, reservoirs, or the ocean by electric power plants or desalination plants. Heat reduces the ability of water to dissolve oxygen, and the loss of oxygen in the water harms fish and other aquatic life.
Factsheet #3: Effects of Pollutants on Water

Sediments
Particles of soil, sand, silt, clay, and minerals wash from land and paved areas into streams, wetlands, and oceans. In large, unnatural quantities these natural materials can be considered a pollutant. Construction projects often contribute large amounts of sediment. Certain wood-cutting practices affect sediments in run-off. Sediments may fill stream channels and harbours that later require dredging—and the dredging itself will stir up the same sediments. These sediments suffocate fish and shellfish populations by covering fish spawning areas and clogging the gills of bottomfish and shellfish. They also cloud the water and prevent sunlight from reaching seagrass and corals, causing their death.

Petroleum Products
Oil and other petroleum products like gasoline and kerosene can find their way into water from ships, oil refineries, power plants, gas stations, and streets. Oil spills kill aquatic life (fish, birds, shellfish and vegetation). Weathered oil becomes tarry and may make sand so hard that worms, molluscs, and the like can no longer live there. Birds are unable to fly when oil loads their feathers. Shellfish, crabs, and small fish are poisoned. Fuel oil, gasoline, and kerosene may leak into groundwater through damaged underground storage tanks.

Human and Animal Wastes
Human wastes that are not properly treated at a waste treatment plant or in domestic septic systems, and are then released into water, may contain harmful bacteria and viruses. Typhoid fever, polio, cholera, dysentery, diarrhea, hepatitis, flu, and the common cold are examples of diseases that can be caused by bacteria and viruses in contaminated water. The main source of the problem is sewage getting into the water—which sometimes happens as a result of breakdown of waste treatment systems caused by hurricanes. People can come into contact with these microorganisms by drinking the polluted water. Often, unexpected flooding of barnyards or stock pens can suddenly increase the toxic effects of animal waste in water. Animal waste can also act as a fertilizer and create damage by increasing nutrients (see “Fertilizers” below).

Organic Wastes
Domestic sewage-treatment plants, food-processing plants, paper mills, and leather-tanning factories release organic wastes that bacteria consume. If too much waste is released, the bacterial populations increase and use up the oxygen in the water. Aquatic creatures, especially fish, die if too much oxygen is consumed by decomposing organic matter.

Inorganic Chemicals
Detergents, pesticides, and many synthetic industrial chemicals are released to waterways. Many of these substances are toxic to fish and harmful to humans. They cause taste and smell problems and
HUMAN IMPACTS ON MANGROVES

Water Pollution Today

Industrial waste

Agricultural and urban run-off

Aerial spraying
often cannot be treated effectively. Some are very poisonous at low concentrations. Inorganic chemicals and mineral substances, solid matter, and metal salts commonly dissolve in water. They often come from mining and manufacturing industries, oilfield operations, agriculture, and natural sources. These chemicals interfere with natural stream and wetland purification; they also corrode expensive water-treatment equipment and increase the cost of boat maintenance.

**Fertilizers**

The major source of agricultural and golf-course pollution is surplus fertilizers in the run-off. Fertilizers contain nitrogen and phosphorus that can cause large amounts of algae to grow. The large algal blooms cover the water’s surface, and the algae die after they have used up all the nutrients. Once dead, they sink to the bottom, where bacteria feed on them. The bacterial populations increase and use up most of the oxygen in the water, and once the free oxygen is gone, many aquatic animals die. This process is called eutrophication.

**Heated Water**

Heat reduces the ability of water to dissolve oxygen. Electric power plants use up large quantities of water in their steam turbines. The heated water is often returned to streams, lagoons, reservoirs, or the ocean. The loss of oxygen in the water harms fish and other aquatic life. The same impact occurs with desalination plants, which heat up the water during the reverse-osmosis process and then discharge it into the ocean. Desalination plants also produce large quantities of very saline water, which can damage the areas where it is discharged.

**Acid Precipitation**

The pH is the measure of acidity in a solution. Aquatic animals and plants are adjusted to a rather narrow range of pH levels in water. When water becomes too acid because of the presence of inorganic chemical pollution or acid rain, fish and other organisms die.

**Pesticides (Insecticides, Herbicides, Fungicides)**

Agricultural chemicals designed to kill or limit the growth of certain life forms are a common source of pollution. Farmers and golf-course developers use them to limit the negative effects of “undesirable” species on crop production and golf courses. Irrigation, groundwater flow, and natural run-off bring these toxic substances to mangrove wetlands, and oceans.
Factsheet #4: Pollution Sources

Down the Drain
When most people in the Cayman Islands rinse something down their drain, flush their toilet, or do a load of wash, the wastewater either goes to a sewage treatment plant—such as the one serving the West Bay Road area—to be purified or runs through a septic system, which operates like a tiny sewage-treatment plant. The big plants remove dirt, biodegradable materials such as food waste, and many other pollutants from the water before the water is dumped into the waterways—usually the ocean. They also treat the water to kill harmful bacteria and viruses. Your septic tank does much the same. But neither the plants nor your own septic system can remove all the chemical pollutants. For example, chemicals that are used in paint thinners and phosphates that are used in many detergents pass right through some sewage treatment plants.

Off the Streets
Oil, litter, dirt, and anything else that’s on the streets washes into storm drains or ditches. In most islands in the Caribbean, including parts of the Cayman Islands, these drain into a series of underground pipes that eventually dump directly into waterways or the ocean.

Industrial Waste
Factories that make chemicals, paper, medicines, steel, and many other products create a lot of waste. At one time, industries could legally dump waste into waterways or the ocean. But on some islands, pollution-control laws now limit the waste that industries can dump into surface water. These laws have greatly reduced water pollution in countries where they are in effect. However, not all types of industrial waste are regulated, and in some places there are few if any controls. In addition, some experts feel that the controls are not strict enough to protect aquatic systems.

Trashing the Water
When trash gets thrown overboard, it can create an ugly mess—both in the water and on the shore where it washes up. Trash can also harm or even kill wildlife. For example, thousands of seabirds and marine mammals die each year after eating or becoming entangled in plastic debris floating in the ocean or in mangrove swamps.
Activity 5-E: What About Water? Home Analysis

**Summary**
We all need water to survive, but we take it for granted that it will always be available. The same is true for the many species that rely on wetlands habitat for their survival. With this home review, students can discover where their water comes from and where it goes, and find ways to protect and improve water quality.

**Learning Objectives**
Students will be able to:
(a) understand where their water supply at home comes from;
(b) determine where the waste water in their homes goes;
(c) understand where wildlife gets the water it needs to survive; and
(d) find ways to improve water quality in their homes and on their islands.

**Age Levels**
9 and up

**Subject Areas**
Science, social studies

**Time**
1–2 lessons, or more

**Materials**
Copies of factsheets on pages 3-7 through 3-11 showing water/wetland pollutants
Copies of questionnaire on page 5-26
Chalkboard or paper and easel
Pencils

**Background**
Begin by reviewing the factsheets on pollution in Section 3, “Human Impacts on Mangroves”. Many problems caused by water contamination have occurred in the past and continue to happen now that affect our lives and those of the animals we share our islands with. Take a look at water on your island and how it is used and disposed of. For example, review the following information:

**Home supplies:** Look at wells, cisterns, and trucked or piped water from a central processing plant. How is water used in your home?

**Sewage:** Not too many years ago, most people used outhouses. These have been replaced, in most places, by septic systems and modern sewage collection and treatment systems. Find a way to study how these systems function.

**Contamination:** After major hurricane damage, there are often problems with the spread of gastrointestinal diseases through contaminated water. Diseases like typhoid and cholera frequently occur because of water contamination. Discover how this happens.

A newer method of septic and sewage disposal is the use of deep wells.
However, this can cause contamination because the pollutants enter the salt water lying under the island and eventually seep through to the ocean. This is because limestone is very porous and allows water to pass through it, which enables the pollutants to reach the ocean. Many homes are close to the shoreline, meaning pollutants can enter the ocean more quickly.

**Wells:** Many islands get their water from wells that tap down into the freshwater lens that lies under the islands, sitting on top of the salt water.

**Seawater:** Many people in the olden days used to drink a glass of seawater regularly for its therapeutic values.

**Birds and the water supply:** Wetland birds require fresh water just as humans do, and they obtain it from wetlands. Other birds not always found in wetland areas also need water, and they, too, often use wetlands to find it. However, in times of drought, when wetlands dry up, the birds become more inventive—for instance, getting water from heavy early-morning dew.

**Procedure**

1. Review the material in the background and on pages the pollution factsheets from Section 3, “Human Impacts on Mangroves”.
2. Discuss the way water is used on your island: where it comes from, where it goes, and how it gets polluted.
3. Point out that birds and animals have to drink fresh water daily, and most of them get this from wetland areas.
4. Give students copies of the questionnaire on page 5-26, and have them take the questionnaires home and ask parents or other older people to give them answers.

**Discussion/Reflection**

When students have returned with their completed questionnaires, discuss the following concerns with them.

- Do you think there is a water problem on this island?
- If there were a water problem for humans and birds, how would you resolve it?
- How do birds adapt to lack of water?

**Extensions**

Students can extrapolate what would happen to birds (and humans) during drought conditions when fresh water is in short supply.
WATER QUESTIONNAIRE

Wells, Septic Systems, and Other Needs

1. Describe the well at your house. How deep is it? Is the water sweet and pure?

2. If you don’t have a well, where does the water you drink come from?

3. How does the septic system work at your house?

4. Ask your grandfather or grandmother (or another older person) if they used to drink a glass of seawater regularly.

5. If they did, why did they?

6. Where do birds get their fresh water?

7. Have you seen birds drinking? How do they do it?