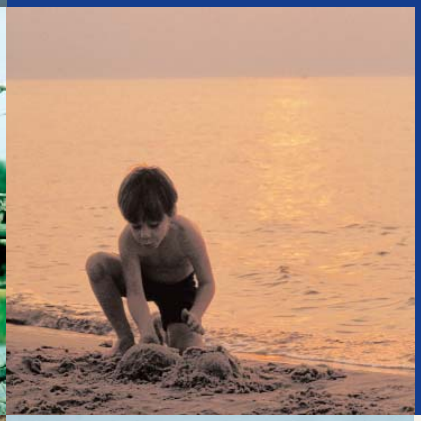
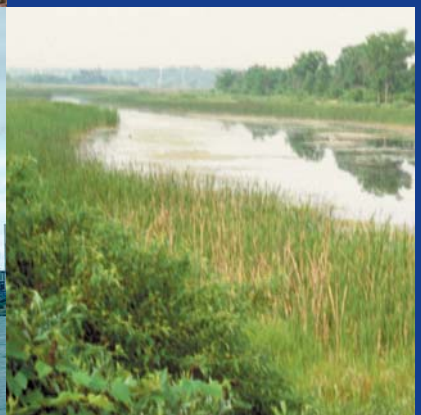
THE SOURCE WATER PROTECTION PRIMER





POLLUTION PROBE

CLEAN AIR. CLEAN WATER.

POLLUTION PROBE IS A NON-PROFIT CHARITABLE ORGANIZATION THAT WORKS in partnership with all sectors of society to protect health by promoting clean air and clean water. Pollution Probe was established in 1969 following a gathering of 240 students and professors at the University of Toronto campus to discuss a series of disquieting pesticide-related stories that had appeared in the media. Early issues tackled by Pollution Probe included urging the Canadian government to ban DDT for almost all uses, and campaigning for the clean-up of the Don River in Toronto. We encouraged curbside recycling in 140 Ontario communities and supported the development of the Blue Box programme. Pollution Probe has published several books, including *Profit from Pollution Prevention*, *The Green Consumer Guide* (of which more than 225,000 copies were sold across Canada) and *Additive Alert*.

Since the 1990s, Pollution Probe has focused its programmes on issues related to air pollution, water pollution, climate change and human health, including a major programme to remove human sources of mercury from the environment. Pollution Probe's scope has recently expanded to new concerns, including the unique risks that environmental contaminants pose to children, the health risks related to exposures within indoor environments, and the development of innovative tools for promoting responsible environmental behaviour.

Since 1993, as part of our ongoing commitment to improving air quality, Pollution Probe has held an annual Clean Air Campaign during the month of June to raise awareness of the inter-relationships among vehicle emissions, smog, climate change and human respiratory problems. The Clean Air Campaign helped the Ontario Ministry of the Environment develop a mandatory vehicle emissions testing programme, called Drive Clean.

Pollution Probe offers innovative and practical solutions to environmental issues pertaining to air and water pollution. In defining environmental problems and advocating practical solutions, we draw upon sound science and technology, mobilize scientists and other experts, and build partnerships with industry, governments and communities.

Unless otherwise noted, photos throughout *The Source Water Protection Primer* are taken from the Great Lakes Image Collection, United States Environmental Protection Agency Great Lakes National Program Office (www.epa.gov/glnpo/image).

POLLUTION PROBE
CLEAN AIR. CLEAN WATER.

MAY 2004

Pollution Probe is pleased to present the latest in a series of popular Primers — *The Source Water Protection Primer.* Many Canadians are talking about Source Protection — and there is a wide consensus that it is the right thing to do and that it is time to make it happen. *The Source Water Protection Primer* has been created to inform public discussion on what source protection is and how we can make it happen.

Source Protection has been a priority for Pollution Probe for several years. Our November 1998 conference *The Water We Drink* and the September 1999 report of this conference recommended that source protection should become a priority. This was before the tragedy of Walkerton in 2000, which sadly opened our eyes to the wide range of issues surrounding the provision of safe drinking water.

In 1999, we said, "In the past, the emphasis has been on treating "dirty" or contaminated raw water in order to make it safe to drink. As a result, we have developed considerable expertise in terms of drinking water treatment techniques. Now we recognize that much more needs to be done to protect the sources of our drinking water. Better source protection means preventing the kind of pollution that later must be removed or treated, and it means paying more attention to watershed management. It means taking a prevention approach, rather than an end-of-pipe treatment approach. It means being more careful about land use and urban development, about where and how development occurs, and about agricultural uses, including livestock operations. It means protecting the groundwater and surface water in a watershed area. Source protection means taking an ecosystem approach to watershed management — it may also mean a more cost-effective approach to providing clean, safe drinking water over the long haul." All still needed and more pressing than ever.

Together with its sister document, *The Drinking Water Primer,* I am confident that *The Source Water Protection Primer* will be a timely and helpful contribution to bringing us all closer to having the clean, safe water that we need for good health, a clean environment and the sustainable development of our communities.

Rick Findlay
Director, Water Programme
Pollution Probe

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What is Source Water?

Source water is untreated water from streams, lakes, or underground aquifers that people use to supply private wells and public drinking water systems.

Source water protection is about protecting both the quality and the quantity of these water sources, now and into the future.

Source water comes from one of two sources: surface water or groundwater.

Surface water is water that is open to the atmosphere and includes lakes, rivers, streams, creeks and oceans. Approximately 74 per cent of Canadians get their drinking water from surface water sources.

Groundwater is water found beneath the Earth's surface between the cracks and spaces in soil, sand and rock. Twenty-six per cent of Canadians use groundwater to meet their daily water needs (municipal, domestic and rural). According to Environment Canada, this includes all of Prince Edward Island, more than 60 per cent of New Brunswick and Yukon, and more than 20 per cent of British Columbia, Ontario and Québec.

Source: *Comstock*

TEXT BOX 1

The Multi-barrier Approach

Source protection is just one of many barriers used in a "multi-barrier approach" to ensuring safe drinking water. Other key elements of the multi-barrier approach are effective water treatment, protection of the water distribution system, and adequate testing and training. Preventing contaminants from reaching water sources is an important step in protecting our drinking water.

The Importance of Source Water Protection

Until recently, most Canadians believed that their drinking water was safe. However, in recent years, outbreaks of waterborne diseases in Walkerton, Ontario, and North Battleford, Saskatchewan, have revealed how easily water can become contaminated and how damaging the consequences can be.

Protecting water at the source is an important way to ensure the health of humans, ecosystems and economies. Source water protection also works to ensure that a clean and safe environment is available for future generations.

Human Health

Protecting sources of water is essential to ensuring human health. According to The 3rd World Water Forum, held in 2003, every year at least five million people die from water-related diseases worldwide. These diseases are transmitted either directly, as a result of infection from consuming contaminated water or food, or indirectly, by ingesting disease-carrying organisms. The majority of those affected by water-related mortality and morbidity are children under the age of five.

While more prevalent in developing countries, threats to human health as a result of drinking water contamination also exist in industrialized nations such as Canada. This susceptibility was tragically brought home in May 2000, when seven people died and 2,300 became sick after ingesting *Escherichia coli (E. coli)* 0157:H7 bacteria that had entered the water distribution system in Walkerton, Ontario.

Preventing contaminants from entering water sources is an effective way to help ensure clean drinking water and thus prevent human disease. This is important because conventional water treatment methods cannot effectively remove many hazardous chemicals. While source water protection works to everyone's benefit, it is of particular concern for rural consumers whose geographic location may prevent them from having access to municipally treated water.

Ecosystem Health

An ecosystem is a biological community consisting of interacting organisms and their surrounding physical environment. Ecosystems have four main components: air, water, land and living creatures (i.e., plants and animals, including humans). Each component of an ecosystem performs or contributes to a unique service or function upon which all life depends.

Every ecosystem on Earth depends on water, of varying amounts, for its survival. If either water quality or water quantity is in any way degraded, this can have a serious adverse impact on an ecosystem. Similarly, when ecosystems become degraded, this has a negative impact on water.

Economic Health

While there are costs associated with protecting water sources, they are investments that serve to generate economic vitality and growth. Communities with clean water sources attract human settlement, development and business.

TEXT BOX 2

Recreational Beach Water Quality

If we don't adequately protect source water, this can impact other water uses besides drinking water. Lack of source protection can, for example, also affect beach water quality.

Swimming in water contaminated with bacteria can cause skin rashes and eye, ear, respiratory and throat infections, as well as stomach aches and diarrhea. Compared to wading, health risks are higher with total immersion, especially if water is swallowed.

The number of *E. coli* bacteria is currently the main indicator used to assess human health risks associated with the use of recreational water (some jurisdictions, such as Europe, also monitor other parameters). Health Canada recommends that signs be posted at beaches if, based on at least five water samples collected in a 30-day period, the geometric mean indicates there are 200 *E. coli*/100 ml or more present in the water. In Ontario, the standard is more stringent at 100 *E. coli*/100 ml. In comparison, the European Union standards are much less stringent — beaches are posted when the faecal coliform level, including *E. coli* , is equal to or greater than 2,000 *E. coli*/100ml.

Economic benefits of source water protection measures can also be measured in terms of cost savings – that is, the damage costs that may have resulted if water sources were not protected. Tangible direct costs include those associated with locating new drinking water sources, constructing new treatment systems (e.g., new wells or intakes), cleaning up contaminated sites, and rehabilitating lost habitats. Indirect financial costs include decreased property values and medical treatment of people having waterborne illnesses. More difficult to measure in economic terms, but very important, is the loss of citizens' confidence in both the safety of their drinking water and the ability of community leaders to look after their interests.

According to the US Environmental Protection Agency (US EPA), remediating groundwater can be 40 times more expensive than taking steps to protect the water at the source. Preventing contamination at the source also reduces the costs of treating water later in the drinking water treatment process.

There are considerable economic benefits associated with protecting water quantity, as well as water quality. Changes in lake levels and river flows can have dramatic impacts on power generation, manufacturing and trade. The United States Great Lakes Shipping Association states that, "every inch of lost clearance from low water levels . . . can cost shipping vessels up to $11,000 per day because of reduced cargo carrying capacity."

Future Generations

Our actions today affect the quantity and quality of water available for future uses. The United Nations warns that if current trends of wasting and polluting freshwater continue, two out of every three people on Earth will suffer moderate to severe water shortages in little more than two decades from now. It is imperative that we take measures to protect water sources today.

To appreciate the importance of source water protection, it helps to understand the ways that water is collected and travels. The first thing to know is that the amount of water on the planet has been roughly constant since the Earth was formed more than four and a half billion years ago. The water you drink today could be composed of the same water molecules that Canada's first Prime Minister, Sir John A. MacDonald, drank in the mid-19th century, or even the same molecules drank by a prehistoric animal many millions of years ago.

Source: *Comstock*

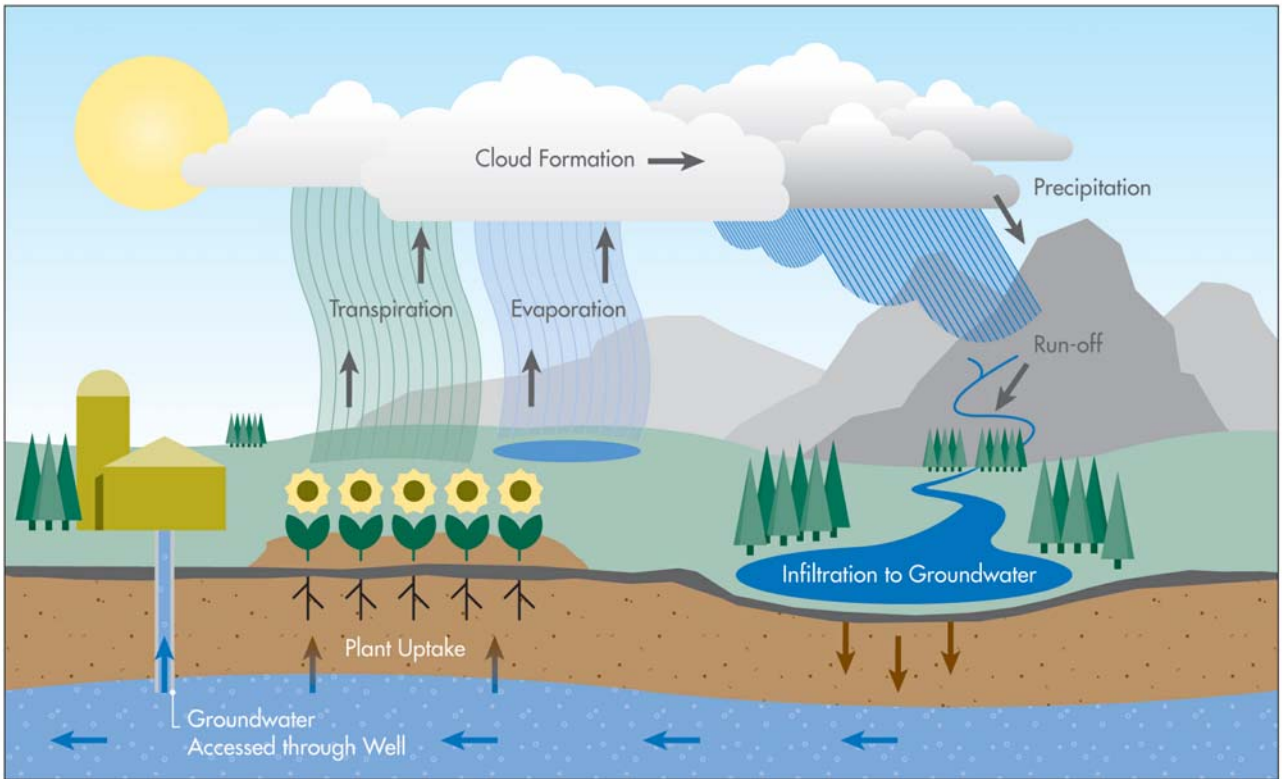
The Hydrologic Cycle

The endless circulation of water from the atmosphere to the Earth and back to the atmosphere is called the hydrologic cycle (see Figure 1). The basic stages of the hydrologic cycle are: evaporation, transpiration, condensation and precipitation. These are described below.

EVAPORATION — Water molecules bind together to form a body of water, such as a lake, river, or even a puddle. When the sun heats the molecules on the surface of a water body they become energized and break away from each other. The molecules evaporate and rise as invisible vapour into the atmosphere.

Figure 1: **Hydrologic Cycle**

Source: www.epa.gov/seahome/groundwater/src/hydrocyc.htm



TRANSPIRATION — Plants also give off water vapour into the atmosphere in a process known as transpiration. They do this in much the same way that humans perspire. Water that has been absorbed by the plants, usually through the roots, moves to the surface of the plants' leaves and evaporates into the air.

CONDENSATION — As the water vapour rises into the atmosphere, it cools and condenses, often attaching itself to tiny particles of dust in the air. When water vapour condenses, it turns back into a liquid. The water particles collect together and form clouds.

PRECIPITATION — When the clouds become heavy with water particles, the particles fall back to the Earth as precipitation in the form of rain, snow, freezing rain or hail, depending on the temperature of the surrounding air.

Some of the precipitation is evaporated before it reaches the Earth. Some lands on plants instead of on the ground and is transpired. The water that lands on the surface of the Earth may evaporate, rising up into the atmosphere again, or it may percolate into the ground or runoff into a nearby body of water.

PERCOLATION — Some of the precipitation that falls onto the Earth seeps into porous soil and cracks in rocks. This water moves downward beneath the Earth's surface until it settles in an aquifer (a collection of water underground). Water that percolates through the soil in this way may continue to flow under the ground, or it may re-surface somewhere downstream.

SURFACE RUNOFF — Some of the water that lands on the ground flows over the surface of the land and runs off into nearby streams, rivers and lakes. The greater the slope of the land, and the less porous the soil, the more runoff there will be.

TEXT BOX 3

Urban Development and Surface Runoff

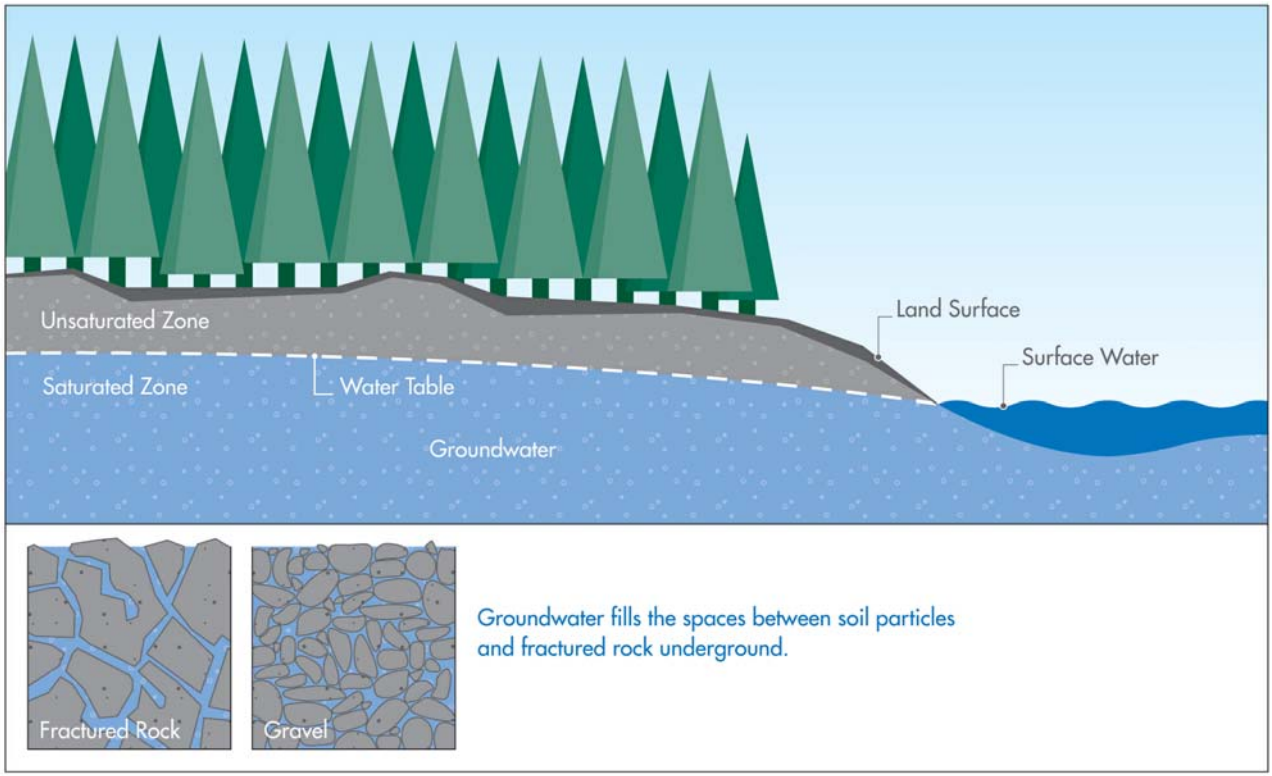
Unlike rural and natural areas, an urban environment provides limited opportunity for rain or snow to percolate into the ground. The hard surfaces of pavement and building materials are solid and impermeable. As a result, the rain and snow have nowhere to go, other than directly into the storm sewers on the street. Contaminants, such as pet droppings, oil, chemicals and road salts, are carried with the rain or snow through the sewers, to wastewater treatment plants or directly into lakes and rivers. In addition, according to the US Natural Resources Defense Council, impervious surfaces significantly change natural patterns of water movement, affecting river flows and the recharge of underground water supplies. For more information on the effects of urban development on water sources, see Chapter 3.

Saturated and Unsaturated Zones

Water that seeps into the ground travels downward until it reaches the depth at which other water sits – water that has already filled the openings in the soil or rock. The area where percolating water comes to rest is called the saturated zone (see Figure 2), the place where water has completely saturated, or filled up, the spaces beneath the underground soil and rock. The top of the saturated zone is called the water table. The water table rises and falls depending on several factors, such as the season, temperature and amount of precipitation. The area between the Earth's surface and the water table is called the unsaturated zone. In the unsaturated zone, there is both air and water between the spaces of the soil or rock.

Figure 2: **Saturated and Unsaturated Zones**

Source: US Geological Survey, adapted by The Groundwater Foundation.

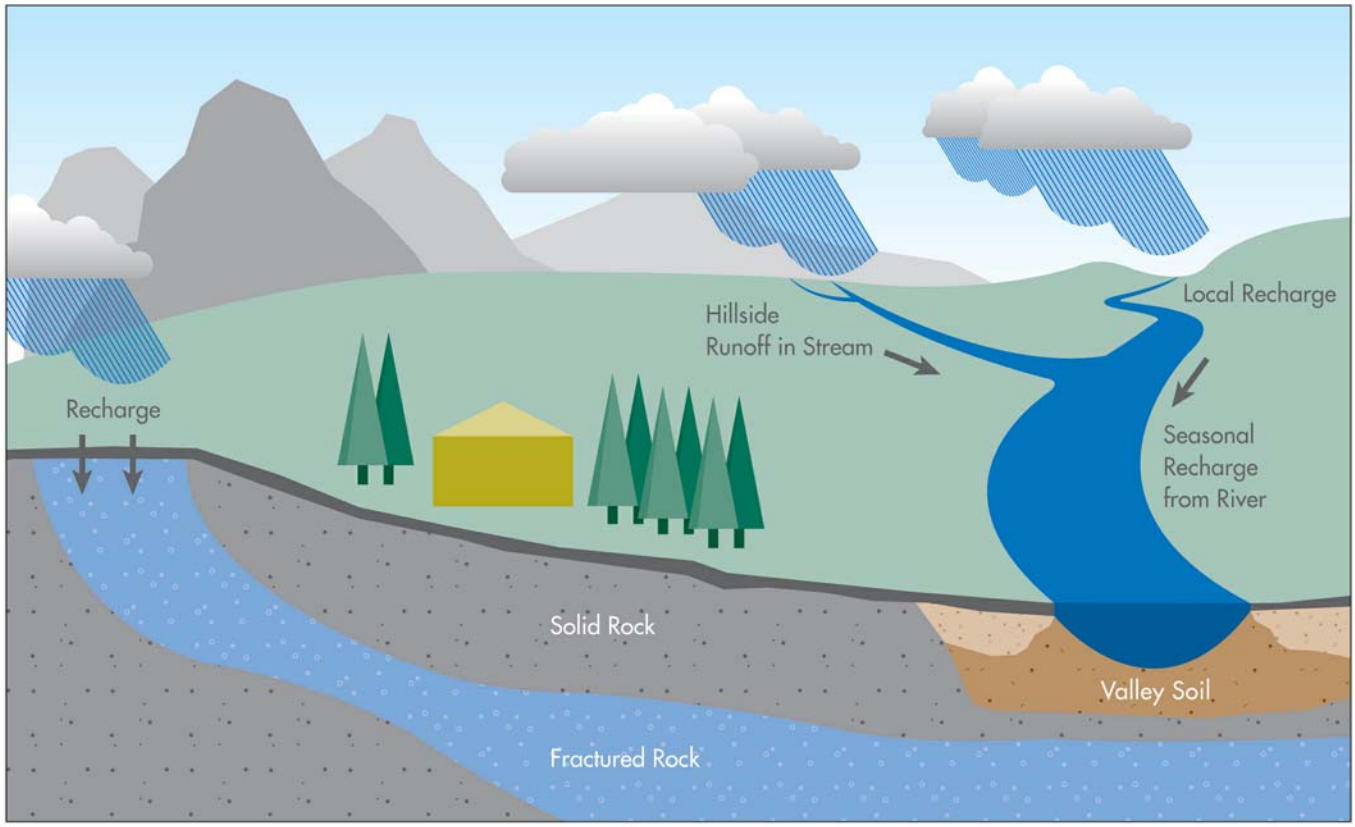


Groundwater Recharge

An aquifer is an area of soil or rock underneath the ground that is porous and permeable, and that contains or serves to transport water to another place. Water that seeps into an aquifer is called recharge (see Figure 3). Much of the natural recharge of an aquifer occurs during the spring, and comes from melting snow and falling rain.

Figure 3: **Recharge Area**

Source: http://groundwater.orst.edu/under/images/rechargeb.html



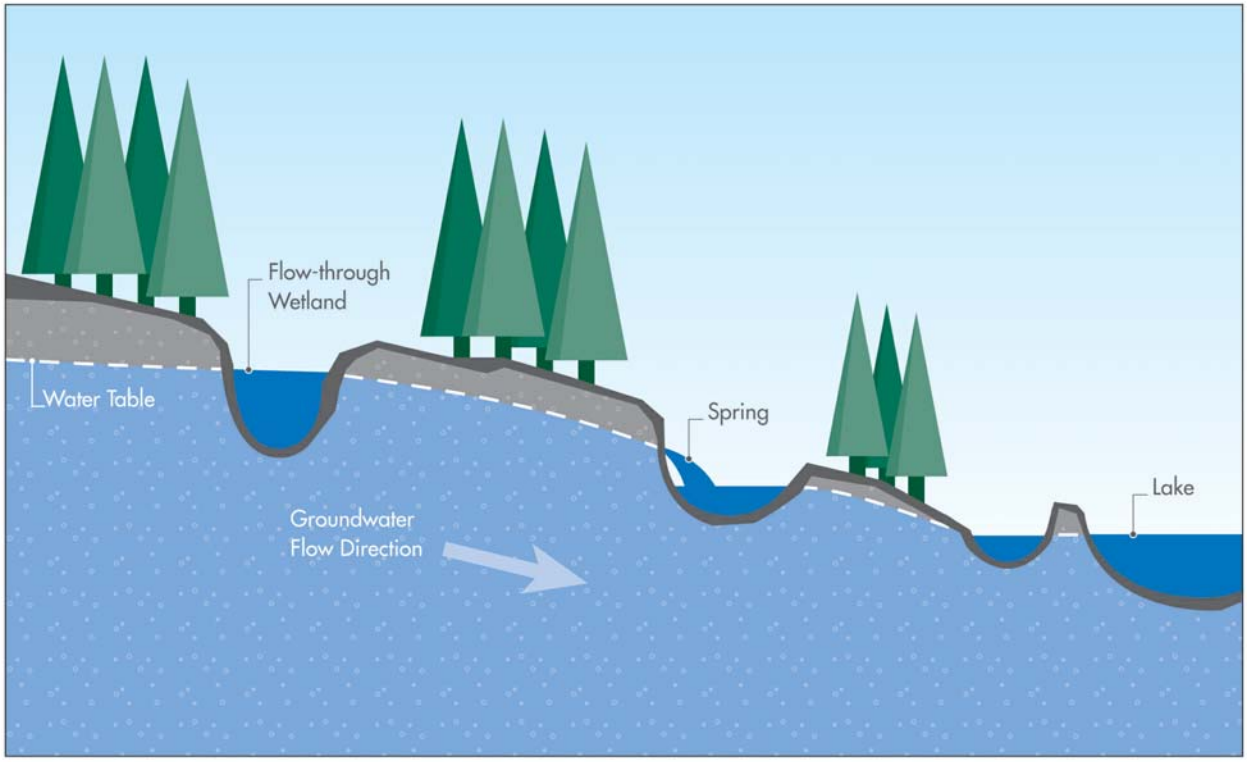
The land where the rain or snow seeps into the aquifer is called a recharge area. Typically, recharge areas have permeable soils, such as sand or gravel, which allow the water to percolate easily into the ground. Once beneath the surface of the Earth, the water is referred to collectively as groundwater.

Groundwater Discharge

Groundwater flows from underground aquifers through the Earth to discharge points or discharge areas, such as springs, rivers, streams, lakes, wetlands and oceans (see Figure 4).

Figure 4: **Groundwater Discharge Points**

Source: http://groundwater.orst.edu/under/images/dischargeb.html



Groundwater Travel

Groundwater moves very slowly from recharge areas to discharge areas. The rate at which water flows through an aquifer greatly depends on the porosity and permeability of the soil or rock. The more porous the soil or rock, the greater the volume of water the aquifer can store. The more permeable the soil or rock, the faster water will flow through connected openings. Groundwater that flows through gravel, which is moderately porous and permeable, will usually move much more quickly than through bedrock, which has few openings or cracks.

Depending on the material it flows through, water in some groundwater sources may spend hundreds of years underground, and in others only a few weeks. The different rates of flow explain why groundwater that is contaminated can take days, months, or even decades, to move just a few metres from a groundwater source to a lake, or to an aquifer from which an individual or community draws well water.

As groundwater flows through soil and rock, natural cleansing processes may remove many of its impurities. These cleansing processes can, for example, dilute contaminants or, in some cases, biochemically transform them into other, less harmful compounds. However, not all contaminants can be diluted or transformed.

Groundwater can become polluted due to human activity. Sometimes human activities can pollute groundwater so severely that the damage cannot be reversed. Once polluted, aquifers are very difficult and extremely costly to clean up.

TEXT BOX 4

Groundwater and Wetlands

Wetlands refer to lands that are wet for prolonged periods of time. They include bogs, ponds, estuaries and marshes. Wetlands are among the most important ecological areas on Earth. They filter out sediment and pollution from the surrounding environment. Water that is discharged from a wetland is cleaner than that which entered it. Wetlands also store excess water, replenish local and regional groundwater supplies, and provide important fish and wildlife habitats.

Canada contains one quarter of the world's wetlands. Unfortunately, many of our wetlands have been threatened or destroyed. Throughout North America, urbanization, agriculture, road construction and hydroelectric projects contribute to growing wetland destruction. While most wetlands in the northern half of Canada are still in their natural state, many in southern Canada have already been destroyed or are experiencing pressure from human activity and development.

TEXT BOX 5

Recent Groundwater Discovery

In August 2003, a previously unknown aquifer was discovered in High Park in Toronto, Ontario.The discovery occurred when the City of Toronto was drilling a new monitoring well for groundwater research.Scientists believe that the aquifer may transport water from Georgian Bay or the Oak Ridges Moraine into Lake Ontario.

It is important to note that groundwater supplies are not endless. A supply of groundwater can be depleted if water is taken out of the ground more quickly than it can become naturally recharged. Depletion can also occur naturally during periods of extended drought.

Everything is Connected

As the hydrologic cycle demonstrates, both types of source water – surface water and groundwater – are interconnected.

Surface water is simply the surface extension of groundwater. It is found where the water table intersects the surface of the Earth. Surface waters are often fed by groundwater discharges. Contributing significantly to surface water flows, groundwater sources can prevent streams and rivers from drying up during droughts.

In turn, some groundwater reserves are augmented by water that seeps underground from surface streams and rivers. The term “under the direct influence of surface water” is often used to refer to a groundwater source that is located near enough to surface waters to receive direct surface water recharge.

The close relationship between surface and groundwater means that one cannot be affected in isolation of the other. If a water source becomes contaminated, there is a good possibility that the pollutants will eventually make their way into, and potentially contaminate, another water source.

Figure 5: **The Oak Ridges Moraine, Ontario**

Source: http://web.onramp.ca/rivernen/orm_1.htm

TEXT BOX 6

The Oak Ridges Moraine, Ontario

The Oak Ridges Moraine in Ontario is an example of a vital storage reservoir and recharge zone for numerous aquifers that feed wetlands, lakes, streams and rivers. It forms the headwaters for more than 65 rivers and streams, including many of the watersheds in the City of Toronto. The moraine also provides critical habitat for many species threatened by urban sprawl. The Oak Ridges Moraine is a source of drinking water for more than a quarter of a million people.

Pure water does not exist in the natural environment. Water is always found in combination with minerals and chemicals of one kind or another. Sometimes these compounds are present naturally; other times they are present as a result of human activity.

Some naturally present contaminants have the potential to cause harm to humans. These include metals (such as arsenic, mercury and lead), radioactive compounds (such as radium) and microorganisms (such as parasites, bacteria, protozoa and toxic blue-green algae). Water can become contaminated with these compounds and microorganisms if they are naturally present in the surrounding soil or rock.

At other times, water contamination is a result of human activity. Agriculture, industrial activity and urban development all affect the quality and quantity of surface water and groundwater sources. Some of these land-use activities, such as urban development, decrease the surface area available for water to filter into the ground. As a result, water simply flows across the land's surface (called "surface runoff") instead of recharging groundwater. Furthermore, water quantity can be threatened by overuse and inefficient use, and human activity can directly and indirectly introduce contaminants into both surface water and groundwater.

Source: *Corbis*

TEXT BOX 7

Protecting Water Quantity

Protecting water *quantity* goes hand in hand with protecting water *quality.* Human activities can negatively affect water quantity through overuse, inefficient use, and inappropriate allocation of water sources. While these issues are not explored in depth in *The Source Water Protection Primer* (the greater focus here is on drinking water quality), there are several useful information sources and websites that do offer detailed information on these issues. For example, Environment Canada's website has water efficiency and conservation publications that can help you become more water efficient (see www.ec.gc.ca/water/en/links.cfm?category_id=1&sub_section_id=20).

Types of Contaminants

A number of human activities generate and introduce contaminants into the environment. Some of the contaminants referred to in the remainder of this chapter are briefly described below:

Microorganisms

Microbiological contamination of water results from the presence of microorganisms, such as bacteria, parasites and viruses, that can cause disease in humans. *Escherichia coli (E. coli)* is one of them. Though *E. Coli* is naturally present in our intestines, some types can cause gastrointestinal diseases, including a severe form of diarrhea that can lead to kidney failure and death. Sources of microbiological contamination include untreated sewage, faulty septic systems, urban stormwater, agricultural livestock operations and wildlife.

Nutrients

Nutrients occur naturally in the environment and are essential to plant growth. Human activities, however, have contributed to excess levels of nutrients, such as nitrogen and phosphorus, in the environment. High levels of nitrates (one form of nitrogen) in drinking water can cause health problems in humans, and especially in babies and fetuses. Excessive nutrients in water sources can also cause environmental impacts, such as eutrophication. Eutrophication occurs when a body of water becomes enriched with nutrients, which leads to excessive plant growth. This depletes oxygen levels in the water and can cause aquatic animals to suffocate. Eutrophication can also result in foul-tasting drinking water. Nutrients are present in faecal matter, fertilizers,

sewage treatment effluent, landfill sites and agricultural livestock operations.

Heavy Metals

Certain heavy metals, such as arsenic, cadmium, copper, mercury and lead, are toxic to humans and wildlife. According to the International Agency for Research on Cancer, long-term consumption of drinking water containing arsenic at levels close to or higher than the established guideline value of 0.025 milligrams per litre increases the risk of skin cancer and tumours of the bladder, kidney, liver and lung. This guideline was under review at the time the Primer was written, with a new guideline expected to be posted in the near future. Heavy metals can enter soil through air pollution and through the land application of municipal sewage sludge and industrial sludge, effluents from irrigation, mineral fertilizers, leaching from natural-occurring minerals and animal manure.

Endocrine-disrupting Substances

These substances have the ability to alter or disrupt the endocrine systems of fish, invertebrates, birds and mammals. Endocrine-disrupting substances can harm biological functions, such as growth, embryonic development and reproduction. Known sources include a number of pesticides, such as DDT and atrazine, industrial effluents, such as phthalates, and municipal effluents and agricultural runoff containing natural hormones and synthetic steroids.

Types of Contamination

There are two types of surface water and groundwater contamination – point source pollution and non-point source pollution.

Point source pollution enters the environment at a specific place from an identifiable source. Examples of point source pollution are:

- industrial point discharges, as well as spills and leaks of industrial chemicals;
- municipal wastewater effluents;
- landfill site leachate;
- wastes from existing and abandoned mining sites;
- on-site septic systems; and,
- leaking underground oil and gas storage tanks.

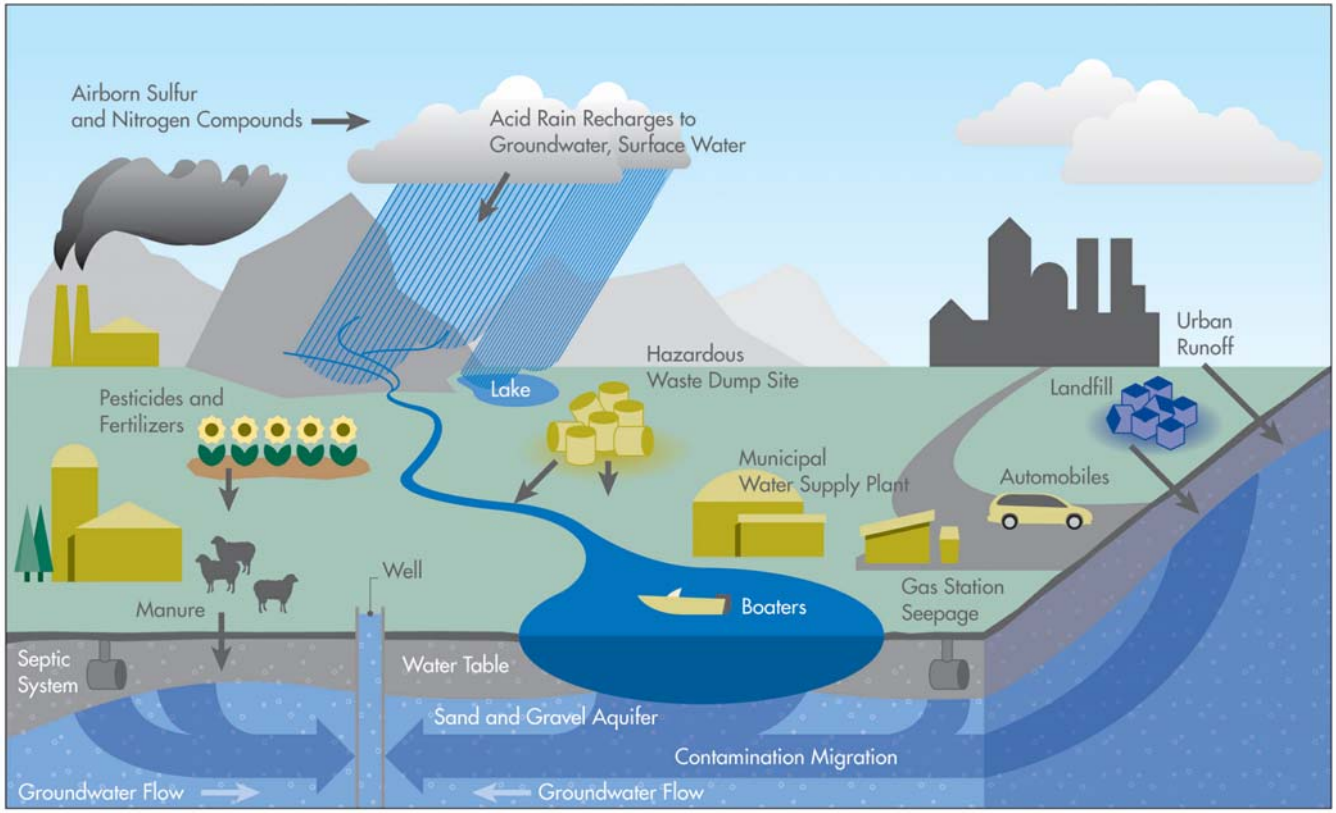
Non-point source pollution comes from many diffuse sources. Non-point source pollution is caused when water that runs over land picks up natural and human-made pollutants and deposits these pollutants directly into surface waters, or into groundwater through percolation.

Examples of non-point source pollution include:

- agricultural runoff, which can contain oil, grease, fertilizers, pesticides, bacteria and nutrients from livestock and manure;
- urban runoff from buildings, streets and sidewalks that carry sediment, nutrients, bacteria, oil, metals, chemicals, pesticides, road salts, pet droppings and litter;
- bacterial and petroleum products from recreational boating;
- saltwater intrusion; and,
- acid precipitation and other forms of air pollution that fall into surface waters and onto the land.

Figure 6: Human Activities Affecting Source Water

Source: www.groundwater.org/gi/sources of gwcontam.html



Point Sources of Pollution

Industrial Discharges

Industries can produce contaminated effluent (i.e., polluted water) and waste. Before this effluent and waste is discharged into the environment, steps must be taken to ensure that any pollutants present are at safe levels.

Industries that produce paper and textiles, and those that process leather, generate effluents containing acids, oils, fuels and solvents. Ore and metal processing industries, and those that use metal compounds in manufacturing, can produce effluent that contains heavy metals. Many metals are highly toxic, and some are carcinogenic. Even if they are present at low concentrations in water, heavy metals can pose a significant threat to human and ecosystem health. Service industries, such as metal workshops, dry cleaners, photo processors and printers, also use considerable quantities of toxic, or potentially toxic, substances. The petrochemical, pharmaceutical, food and beverage industries, and many others, are all potential polluters of water sources.

Methods of effluent disposal, materials storage practices and pollution control techniques all influence the impacts that discharges generated by businesses will have on water sources. Improper storage and release of chemicals on commercial and industrial sites can have severe adverse impacts on water quality. To protect water sources, wastes must be properly treated before they are discharged to watercourses. It is also important to note that industrial chemical spills and leaks from train derailments and traffic accidents can contaminate water sources.

Municipal Wastewater Effluents

Municipal wastewater (or sewage) treatment plants are designed to treat waste that is discharged by residents, businesses and industries. The quality of the water that leaves a treatment plant depends on a variety of factors, such as the type and efficiency of the treatment and disinfection processes used, as well as the quantity and types of waste received from these sources.

The type of process used by a sewage treatment plant affects the quality of effluent that is discharged to the receiving lake or river. Conventional treatment may consist of up to three treatment processes – primary, secondary and tertiary.

Wastewater first enters a primary treatment process where mechanical screening and settling are used to separate and remove solids and greases. Next, the wastewater may enter a secondary treatment process where oxygen and microorganisms are introduced into the water. The microorganisms consume organic matter and many of the

TEXT BOX 8

What Type of Water Treatment Does Your Municipality Use?

To find out the types of sewage treatment processes that are used in your municipality (as of 1999) see Environment Canada's Municipal Water Use Database (MUD) at www.ec.gc.ca/water/mud/en/index.cfm. For data from previous years, see www.ec.gc.ca/water/en/manage/use/e_data.htm. The database contains information on water use, treatment and pricing for many municipalities in Canada with populations greater than 1,000, as well as a sample of some randomly selected municipalities with populations less than 1,000. Environment Canada expects to update the MUD database for the year 2001 by the spring of 2004.

pathogens that may be present. The water then flows into a tank where the microorganisms and any remaining solids are settled out. Some of the settled portion is sent to a solids handling process; some is recycled back to replenish the population of microorganisms used in the secondary treatment processes. From here, if a particular problem has been detected in the incoming wastewater, the water may enter a tertiary treatment facility where processes, such as chlorination or ultraviolet disinfection, are used to kill specifically identified harmful microorganisms. The treated water is then released into the receiving water body.

Some municipalities use only a primary process to treat wastewater, while others use primary, secondary and tertiary treatment processes. Many parts of Canada continue to discharge completely untreated, or poorly treated, sewage directly into Canadian waters.

Since treatment processes can differ so greatly, municipal wastewater effluents can consist of residues of human waste, solids and debris, nutrients, pathogens, toxics, endocrine disrupting substances, unmetabolized pharmaceuticals, ingredients from household and personal care products, and potentially toxic chemicals and contaminants. According to an Environment Canada report entitled *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada,* "municipal wastewater effluents comprise the largest source of effluent discharge to Canadian waters, and population growth and urbanization will continue to increase them."

Some municipal wastewater effluents and sources of water have even been found to contain trace amounts of pharmaceutical drugs. While the concentrations of these drugs are low, their effects on drinking water and human health are unknown. According to Environment

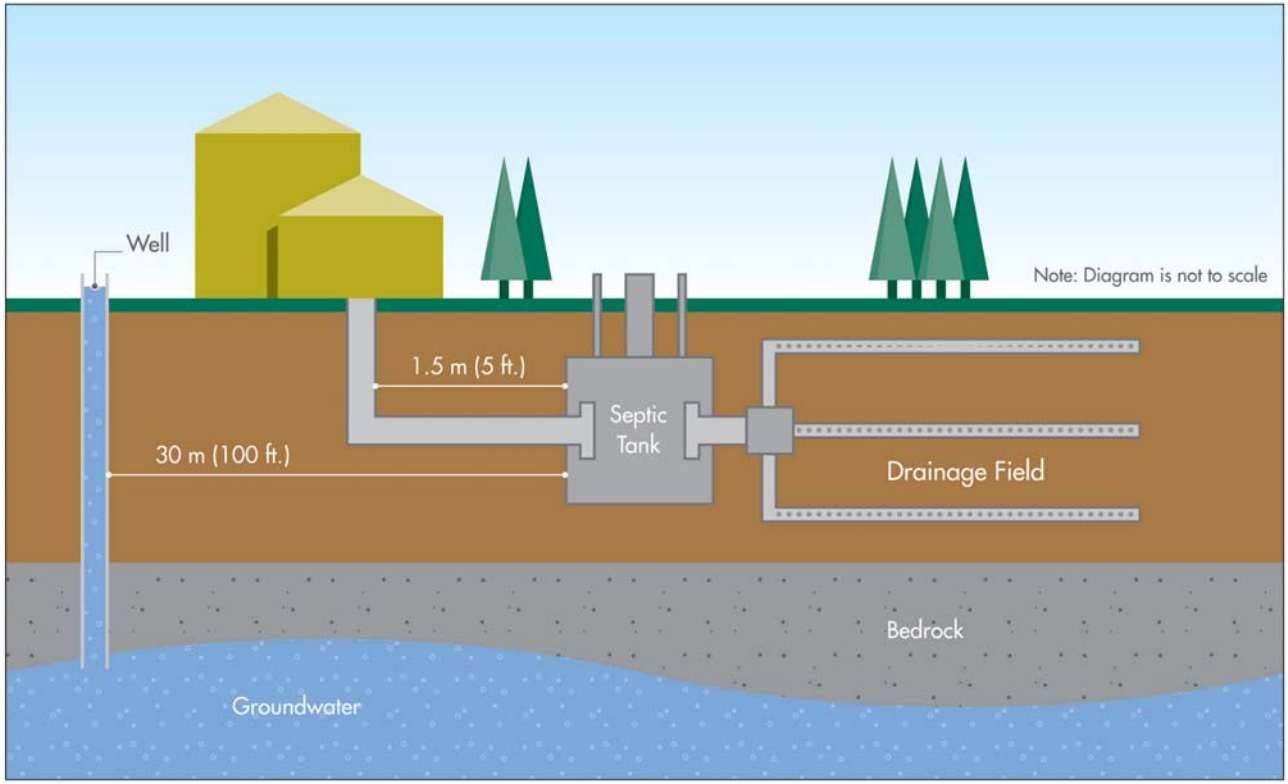
Canada, emerging science indicates that exposure to some pharmaceutical and personal care products may pose health threats to humans, aquatic life and wildlife. Environment Canada and Health Canada are working together to study whether the levels of these products found in water pose an unacceptable risk to the environment and human health.

Septic Systems

Septic systems are designed to treat the wastewater produced by households. They are commonly found in rural or cottage areas where houses are spaced far enough apart that a sewer system for the community

Figure 7: **Septic Systems**

Source: New Brunswick Environment Industry Association. *All About Your Septic System.* p. 4.



would be too expensive to install. A typical septic system includes a septic tank and drainage field (see Figure 7). Water flows into the septic tank where bacteria naturally found in the wastewater break down or digest the solids that are present. The liquid effluent is then discharged to the drainage field, which typically contains perforated pipes buried in trenches filled with sand and gravel. The water is slowly absorbed and filtered by the ground in the drainage field. If used properly and well maintained, septic systems can treat wastewater effectively.

Improper septic tank use, or poor maintenance, can create serious local contamination problems. Septic systems may be unable to treat certain contaminants, such as phosphorus, pharmaceuticals and some cleaning products. These can seep into the ground, sometimes contaminating well water and other water sources. Some substances, such as paints and cleaners not intended for down-the-drain disposal, may actually damage the septic system. Poorly maintained, improperly installed or overused septic systems can contaminate groundwater if untreated sewage leaks out of the pipes and tanks. As failing septic systems can create serious local contamination problems, they must be located a safe distance from wells.

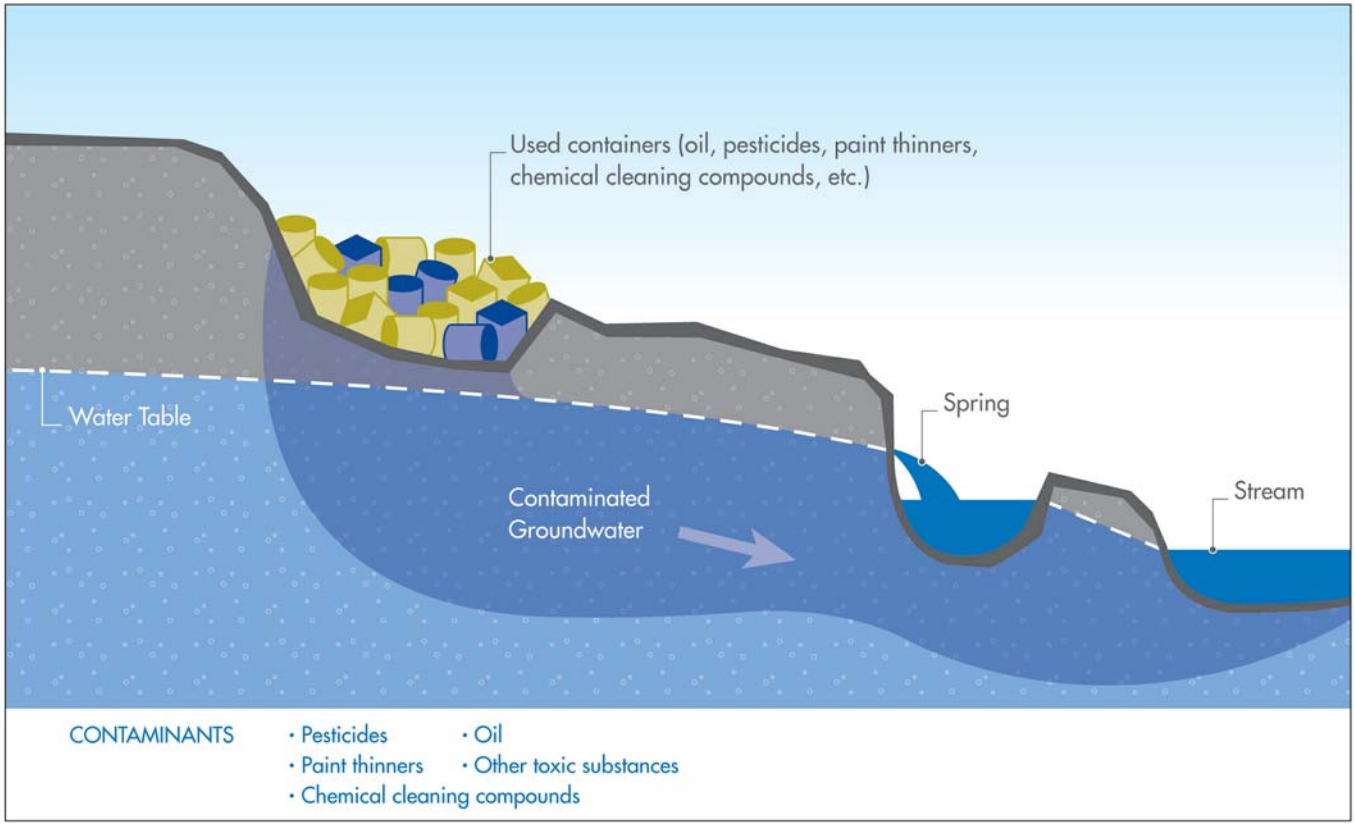
Landfill Sites

The garbage bags that we place on the curb are often transported to landfill sites. Compared to dumps of the past, landfill sites today are highly engineered – bottoms are lined to prevent contaminants from seeping or leaching out. When full, the landfill sites are covered with clay caps. Leachate (water that enters the landfill and mixes with the waste) seeps to the bottom of the landfill and is collected by a system of pipes. The leachate is then discharged to a sewer, hauled to a sewage treatment plant, or treated on-site before being discharged to a waterway. Modern landfill sites are generally located in areas where the soil is clay-like and impermeable, and away from lakes, rivers, wells and aquifers.

Older sites, many of which have been abandoned, were built before adequate controls and landfill liners were in place. As a result, leachate from many older landfill sites has seeped into the soil, entered the water table, and polluted groundwater and surface water (see Figure 8). Ontario has more than 2,400 abandoned landfill sites, which are either current or potential sources of contamination. According to an Environment Canada report entitled *Threats to Sources of Drinking Water and Aquatic Ecosystem Health in Canada* "it is now accepted that all landfills will eventually release leachate to the surrounding environment and therefore all landfills will have some impact on the water quality of the local ecosystem."

Figure 8: **Contamination from Landfill Sites**

Source: New York State Water Resources Institute Centre for Environmental Research, Cornell University. 1998. *Ground Water Contamination, Bulletin No. 2.* p. 3.



Landfill sites are not equipped to handle hazardous materials. Special hazardous waste management facilities have been established across Canada to handle these wastes. Individuals are responsible for disposing of toxic products at permanent household waste depots, or on special collection days established within municipalities.

TEXT BOX 9

Cemeteries and Source Water Contamination

Cemeteries are another potential source of water contamination. Formaldehyde used in the embalming process is toxic. As human bodies decompose, the embalming fluid can seep into groundwater. In the 19th century, arsenic was used in the embalming process. Today, traces of that toxic substance have been found in groundwater located near cemeteries.

Tailings, Tailings Ponds and Abandoned Mines

Tailings are the wastes that are left over after mining companies have ground down and processed rock to extract minerals, such as gold, copper and nickel. Tailings usually contain toxic substances, such as cyanide and arsenic, and are stored in tailings ponds. Contaminants from these ponds may leach into groundwater or, if a pond bursts, flow into nearby streams and rivers. Abandoned mines are also potential sources of pollution. There are approximately 10,000 abandoned mines in Canada today, and 6,000 abandoned tailings ponds.

Underground Storage Tanks for Oil and Gas

In the 1950s and 1960s, large numbers of steel tanks used for storing oil and gas were installed underground, such as at gasoline filling stations. If not protected from corrosion, steel tanks begin to leak after fifteen years or so, allowing oil or gas to leak out of the tanks and seep through the soil and into the groundwater. In the past 20 years, there has been an increasing number of reports of leaking underground storage tanks, in some cases resulting in significant contamination. If only one litre of gasoline leaks from these tanks, it can be enough to foul one million litres of groundwater. Householders who draw drinking water from nearby wells usually notice the problem when they taste or smell gasoline in the water – often long after the aquifer has been contaminated.

According to Environment Canada, during the last decade, releases of gasoline containing MTBE (methyl tertiary-butyl ether) from gasoline storage tanks have contributed to significant drinking water contamination problems, particularly in the United States. MTBE is a synthetic organic compound used in gasoline to improve octane levels and to reduce vehicle emissions. The US EPA has stated that low levels of MTBE can make water undrinkable due to its offensive taste and odour. At higher

levels, MTBE may pose a risk to human health. The European Commission claims that if European standards for the construction and operation of underground storage tanks are enforced, MTBE contamination is unlikely.

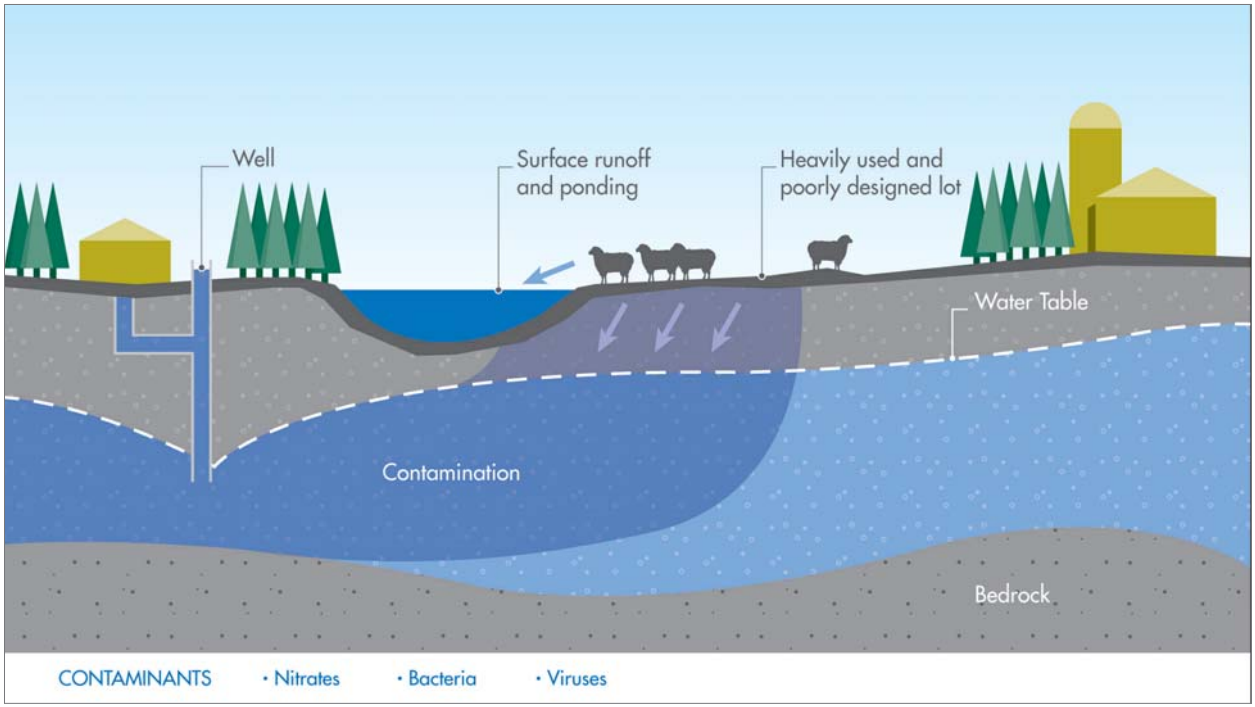
Non-point Sources of Pollution

Agricultural Activities

If not properly managed, agricultural activities can contaminate both surface water and groundwater sources. Grazing, ploughing, fertilizer application, pesticide spraying, irrigation and animal faecal matter are all potential sources of agricultural non-point source pollution.

Figure 9: **Agricultural Runoff**

Source: New York State Water Resources Institute Centre for Environmental Research, Cornell University. 1998. *Ground Water Contamination, Bulletin No. 2.* p. 9.



Specifically,

- Cattle grazing on steep slopes can increase runoff and sedimentation of streams.
- Excessive or improper application of fertilizer can lead to nutrient overload. Some fertilizers, such as manure, sewage treatment sludge (biosolids), and untreated sewage (septage), may contain microbiological and other contaminants that can pollute water.
- Faecal matter from confined animal facilities and feedlots, as well as from animals walking or defecating in streams, can contaminate water with bacteria, such as *E. coli,* or microbial pathogens, such as *Cryptosporidium.*
- Factory farming of hogs or cattle, where liquid waste is deliberately forced into the ground through boreholes, can lead to water contamination.

After rain or spring snowmelts, agricultural runoff can carry contaminants from these activities off-site and into surface water. The contaminants can also percolate into groundwater sources (see Figure 9).

Urban Runoff

Through the hydrologic cycle, natural landscapes, such as forests and wetlands, trap rainwater and snowmelt, and filter it as it percolates into the ground. In contrast, paved surfaces such as roads, bridges and parking lots, and other impermeable areas such as the sites of airports and buildings,

Figure 10: **Drain (Catch Basin)**

interrupt the natural hydrologic cycle by preventing percolation and thereby decreasing the amount of water available for recharge. Instead of seeping slowly into the ground, water remains on the surface, accumulates and runs off in large amounts, creating the potential for flooding and erosion. This runoff is referred to as stormwater. As it flows, the stormwater also picks up and carries away contaminants lying on these urban surfaces, such as oil, gasoline and other potentially hazardous chemicals. The polluted water flows directly into waterways, or into drains (also called catch basins), and then into city storm sewer systems (see Figure 10).

Some cities have separate collecting systems for residential wastewater and stormwater. Residential wastewater is collected in sanitary sewers and typically flows to a municipal wastewater treatment plant. Stormwater is collected in storm sewers. This water, together with the pollutants it has picked up from washing over the land, then empties directly into a nearby lake or river, without treatment.

Some older municipalities have combined sewer systems. In this case, there is only one sewer pipe, which carries both the wastewater from your home and the stormwater runoff collected on the street. The combined sewers carry all of this wastewater to the municipal wastewater treatment plant. During normal conditions, all of the wastewater can usually be treated at the treatment plant. However, during heavy rains, the volume of the combined wastewater may exceed the capacity of the treatment plant. In such cases, some of the untreated wastewater, including human wastes, will overflow directly into nearby waterbodies without treatment. The untreated wastewater can adversely affect water quality.

To combat these problems, some municipalities have set up tanks to catch stormwater runoff and contain it until it can be treated at a sewage treatment plant when the demand is lower.

Pesticides

Pesticides are chemical and biological agents used to control pests (i.e., any organism that is unwanted by humans at a specific time or in a specific place). Pesticides are grouped according to the pests they control. For example, insecticides are used against insects, such as mosquitoes and other biting flies, while herbicides are used against unwanted plants, such as dandelions and crabgrass. Pesticides work

TEXT BOX 10

The City of Toronto's Wet Weather Flow Management Master Plan (WWFMMP)

The City of Toronto has developed a WWFMMP, designed to reduce and ultimately eliminate the adverse impacts of wet weather flow (stormwater runoff) within the City of Toronto. It aims to achieve a measurable improvement in water quality over the next 20 years, while balancing environmental, social and economic factors. For more information, see www.city.toronto.on.ca/wes/techservices/involved/wws/wwfmmp.

by destroying a major organ of an organism, or disrupting a vital process, such as photosynthesis in plants. As a result, any organism that has an organ or process similar to the one targeted by the applied pesticide can be harmed by it. According to Environment Canada, more than 30 registered pesticides (primarily insecticides) can poison wild birds in Canada, either through ingesting insects targeted by the pesticides or by absorbing the chemicals through their skin or lungs.

Pesticides can be washed away from the application site into storm sewers or surface waters, and can seep into the ground, thus contaminating water sources and drinking water supplies. According to the US EPA, pesticides found in drinking water can harm human health. Specifically, in large amounts, some pesticides can cause long-term health effects, such as cancer or organ damage and reproductive effects in laboratory animals.

Road Salts

Canadian road authorities and citizens use huge amounts of road salts to melt snow and ice in the winter. During the winter of 1997/98, an unusually mild winter with lower than average snowfall, five million tonnes of road salts were spread on roads in Canada.

The salt melts the snow, which then runs off roads and other surfaces, carrying some of the salt with it. Together with the melted snow, the chemicals that make up the salt can seep into the ground or be carried into nearby streams, ponds and rivers. Road salts contain sodium and chloride, which can cause significant damage to vegetation and can harm aquatic life, birds and other animals.

Road salts can also affect the taste of nearby well waters, sometimes to the point at which the water becomes undrinkable. Canadian Drinking Water Guidelines have set the maximum concentration of chloride in water based on aesthetic objectives, rather than human health concerns. However, some people may be concerned about the impact of additional sodium or chloride in their diet.

In September 2003, Environment Canada released a proposed code of practice, expected to be published in 2004, recommending that road authorities implement strategies to reduce the harm caused to the environment by road salts, while maintaining road safety.

Recreational Boating

Canadians regularly enjoy recreational boating, and many use motorboats during the summer and over the fishing season. Boating activity can contribute to water pollution in a number of ways, including oil, gas or paint spills from boat maintenance, discharge of sewage from boats, stormwater runoff from marina parking lots, and the physical

alteration of wetlands and aquatic habitats during the construction and operation of marinas. Surface waters can become contaminated with boating cleaners, anti-fouling agents and petrochemical products. While boats and marinas may individually release only small amounts of pollutants into waterways, multiplying these amounts by the thousands of boaters and marinas that use them can cause significant water quality problems in lakes, rivers and coastal waters.

In addition, boats with two-stroke motors release more pollutants to air and water than those with four-stroke motors. According to the Federation of Ontario Cottagers' Association, approximately one-quarter of the mixed oil and fuel fed to a two-stroke motor is released unburned through the exhaust system. The engine's emissions contain approximately 100 pollutants, some of which are released into the air and some into the water.

Saltwater Intrusion

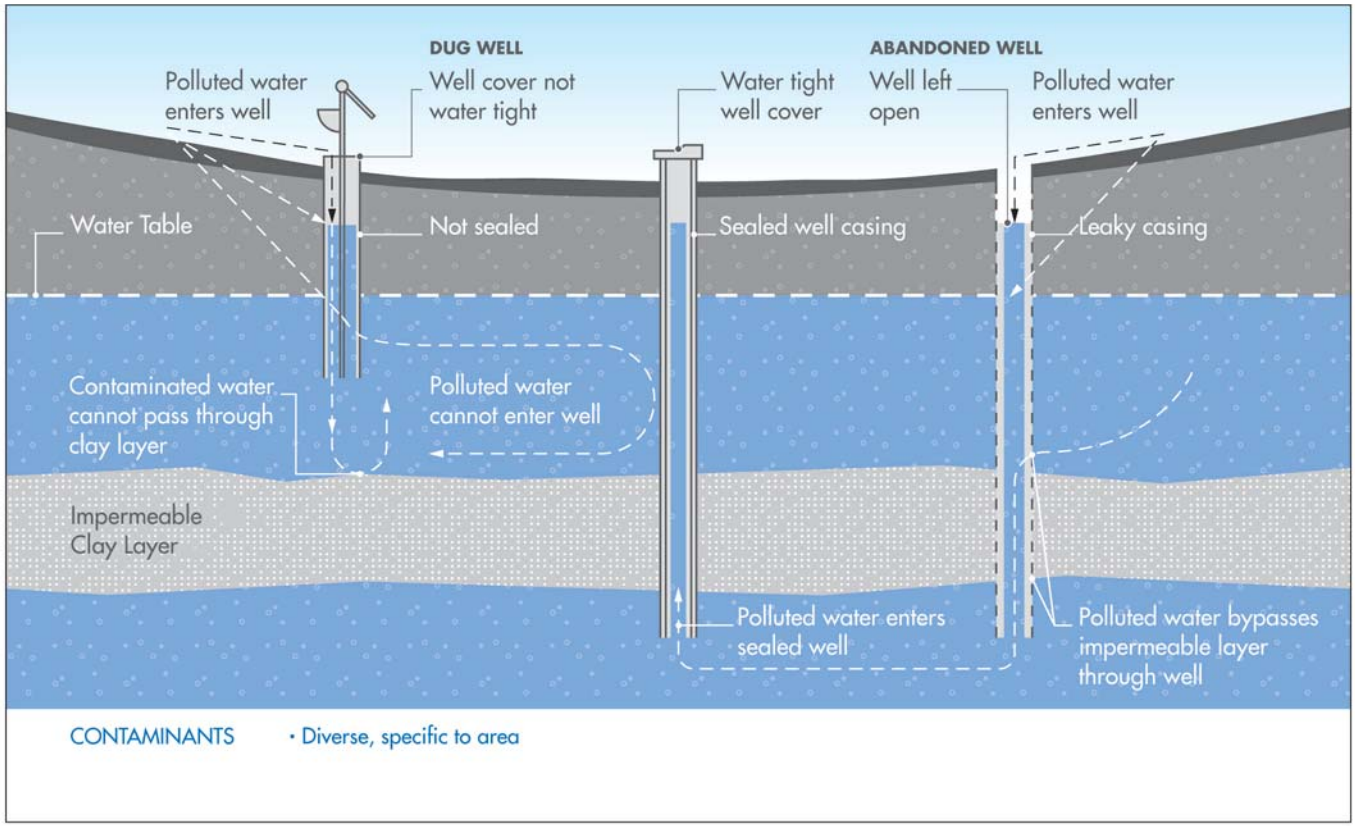
Under natural conditions, aquifers close to coastal waters may discharge freshwater into the oceans. However, the reverse can also occur when saltwater (brine) invades freshwater aquifers. This has happened in some communities on Canada's coasts, especially in areas where groundwater has been pumped out of the ground at a high rate. Once contaminated with brine, aquifers cannot be used for drinking or irrigation purposes. This can have severe impacts on households, farms and communities. The key to controlling this problem is to maintain a proper balance between the amount of water pumped out of an aquifer and the amount of water going back in to recharge it. Another option is to drill relief wells, a technique that some provinces, such as Prince Edward Island, are using to prevent salt water from fouling drinking water supplies.

Air Pollution

Air pollutants released to the atmosphere from motor vehicles, coal plants, industries and other sources eventually fall directly on surface waters, or enter waterbodies through surface runoff and percolation. The place where airborne pollutants return to the Earth's surface may be hundreds of miles away from where they were first generated. This is because airborne pollutants are carried, sometimes significant distances, by air currents. The long-range transportation of air pollution has, for example, resulted in dioxins from Canada, the United States and Mexico being carried north to the Arctic, and sulphate aerosols (that cause acid rain) travelling from Ontario to the Atlantic Provinces. (For more information on the long-range travel of pollutants, refer to Pollution Probe's Acid Rain, Smog and Mercury Primers at www.pollutionprobe.org/Publications/Primers.htm.)

Figure 11: **Wells**

Source: New York State Water Resources Institute Centre for Environmental Research, Cornell University. 1998. *Ground Water Contamination, Bulletin No. 2.* p. 9.



Other Impacts on Source Water

Wells

Wells are used to extract water from aquifers and, in most cases, provide reliable and ample supplies of water for residential, agricultural and industrial uses. Wells can also provide access points to aquifers for non-point source pollution, such as animal wastes and lawn and agricultural chemicals. Most polluted well water is caused by contamination sources being located too close to the well, by improper well construction or operation, or by inadequate well maintenance. Abandoned wells that are not sealed properly are another potential source of pollution (see Figure 11). (For more information on maintaining wells, see Chapter Six.)

Climate Change

Global climate change is becoming an increasingly important factor in source water protection. Human activities are altering the chemical composition of the atmosphere through the build-up of greenhouse gases that trap heat and hold it close to the Earth's surface. Scientists believe that, because of our activities, the Earth's climate is changing, and we are seeing a rise in global temperature and more frequent extreme weather events. In Canada, there is a concern that the warming of the Earth's atmosphere will reduce the amount of water in lakes, rivers and streams due to reduced precipitation and increased evaporation. This will influence the hydrologic cycle, and hence all sources of water. Increases in water temperature will almost certainly change the numbers and types of bacteria and algae in lakes. It is not known exactly how this will affect water quality. (For more information on the potential effects of climate change on human health, see Pollution Probe's Primer on Climate Change and Human Health at www.pollutionprobe.org/Publications/Primers.htm.)

In order to protect drinking water quality and quantity, governments, organizations and communities are designing and adopting source protection plans. A source protection plan is a management strategy designed to minimize the impacts that human activities and natural events have on water sources. Such a plan should take a comprehensive ecosystem approach to water management, recognizing the need for clean drinking water, sustainable services for other human uses, and protecting the integrity of ecosystems.

A Watershed Approach

Source protection plans are designed around the functioning of watersheds. A watershed (or catchment) is an area of land from which surface runoff, including water, sediments, nutrients and contaminants, drain into a common water body, such as a lake, river, stream, creek or estuary. Watersheds include all water and water-dependent land features, including wetlands, forests, towns, humans and other living things. They are of differing shapes and sizes, and cut across municipalities, provinces and countries. Every point on the surface of the Earth is situated in a watershed.

Watersheds are typically defined by the land area from which both surface water and groundwater drain into a common stream system. This is not always the case, however, because groundwater may flow in a different direction than the water on the surface. While the flow of both surface water and groundwater is influenced by gravity, groundwater flow also depends on the hydraulic characteristics of the aquifer. The result is that groundwater aquifer boundaries may be different than watershed boundaries, and groundwater may flow under or through one or more watersheds on the surface. When designing source protection plans, therefore, it is important to understand the relationship between groundwater and surface water, as effective groundwater protection may require several surface watershed groups to work together.

Watersheds are separated from one another by a land ridge or divide. One way to identify watershed boundaries is by connecting all of the highest points of land in the area around the receiving body of water (see Figure 12).

Using watersheds as the basis for source protection plans makes sense because water continuously moves through watersheds and influences numerous life cycles and physical processes, without regard for jurisdictional or political boundaries. Source protection plans acknowledge that the activities of an upstream community affect the quantity and quality of a downstream community's water supply, even if that downstream community is in another municipality. Given that impacts are felt at the watershed level, watersheds are considered the most ecologically appropriate units for managing water.

Figure 12: An Example of a Watershed

Source: www.epa.gov/OWOW/win/what.html

TEXT BOX 11

The Polluter Pays Principle

"Regardless of the funding method chosen for source water protection planning, we should also adopt the "polluter pays" principle. The principle assigns polluters responsibility to remedy contamination for which they are responsible. This is one of the only ways to change behaviours and curb pollution at its source (as opposed to just charging consumers with rate surcharges)."

Mike Price, General Manager, Water and Wastewater Services, City of Toronto

Designing a Source Water Protection Plan

Successful source protection plans developed on a watershed basis are tailored to the unique circumstances of local communities. These plans include assessing the sources of water and setting courses of action to deal with the assessment results. The following nine steps should be considered when developing a source protection plan.

1. INVOLVE STAKEHOLDERS — FROM DEVELOPMENT TO IMPLEMENTATION: Involve local leaders and members of the watershed community early in the process to ensure a successful source protection plan. Stakeholders could include municipal, provincial and federal government agencies, including but not limited to: ministries of environment, natural resources, agriculture and public health agencies; environmental groups; industry and business representatives; farmers; scientists; planners; engineers; academics; First Nations; and individuals who are interested in or play key roles in the watershed community.

2. DEFINE THE SOURCE PROTECTION AREA: Calculate the amount of water flowing through the entire watershed, including the amount that enters (precipitation and stormwater runoff), leaves (through transpiration and human consumption) and is stored (by infiltration) on an annual basis. Characterize the aquifers in the watershed, including groundwater flow directions, and recharge and discharge areas, to identify the locations where groundwater is vulnerable to contamination. Obtain information on the cultural and social characteristics of the watershed community to better understand the community's needs, and to gather information that will be useful when holding public consultations.

3. IDENTIFY POTENTIAL THREATS: Make an inventory of the potential threats to the watershed's long-term sustainability. Include potential point and non-point sources of contamination. Include activities that impact water quantity, such as urban development.

4. DEFINE GOALS, OBJECTIVES AND TARGETS: Define the goals, objectives and targets of the source protection plan from ecological, social and economic perspectives. Be sure to consider the needs of the watershed, now and into the future.

5. MAP THE AREA: Map the source protection area and the potential contamination sites. Include data on soil, geology, topography, forest cover, wetlands, crops and water wells. A Geographic Information System (GIS) could be used to help manipulate, analyze and present the information. GIS is a system of computer software, hardware, data and personnel designed to manipulate, analyze and present information that is tied to a geographical area – in this case, the watershed.

6. RANK THREATS AND IDENTIFY VULNERABLE AREAS: Rank the potential threats identified in Step 3 according to their degree of risk in impairing water sources. Identify the areas in which water sources are vulnerable to these threats. Decision makers can use this information to prioritize and decide which threats need to be managed most immediately to prevent, reduce or eliminate risks to water sources.

7. CREATE AND IMPLEMENT A SOURCE PROTECTION PLAN: Use the information gathered in Steps 2–6 to determine the types of management approaches that would achieve the goals outlined in Step 4. Management approaches could involve a combination of protection, mitigation and rehabilitation measures. Create a source protection plan that illustrates how the watershed should look and

TEXT BOX 12

From Source to Tap: The Multi-barrier Approach

The Federal-Provincial-Territorial Committee on Drinking Water and the Canadian Council of Ministers of the Environment (CCME) prepared a report called, *From Source to Tap: The Multi-barrier Approach to Safe Drinking Water.* The report outlines the essential elements of the multi-barrier approach for safe drinking water. With respect to source water protection, it calls for a coordinated approach among stakeholders to develop short- and long-term source water protection plans on a watershed management basis that will prevent, minimize or control potential sources of pollution. Some of the components of source water protection include public awareness, monitoring, partnerships and guidelines. For more information, see www.ccme.ca/assets/pdf/mba_eng.pdf.

TEXT BOX 13

More Information on Source Protection Plans

There are many useful publications and websites that describe the methodology behind designing and implementing source protection plans. Here are just a few:

US EPA Website — www.epa.gov/safewater/protect.html

Watershed Management on a Watershed Basis: Implementing an Ecosystem Approach. Ontario Ministry of Natural Resources report, at www.mnr.gov.on.ca/MNR/water/publications/wm_wbasis.pdf

Protecting Ontario's Drinking Water: Towards Watershed-based Source Protection Planning. Ontario Ministry of the Environment report, at www.ene.gov.on.ca/envision/techdocs/4383.htm

Watershed Management in Ontario: Lessons Learned and Best Practices. Conservation Ontario report, at www.conservation-ontario.on.ca/projects/watershed.htm

Examples of effective watershed management plans that have been implemented by Canadian municipalities, associations and communities are described in the next chapter. If you are interested in starting a source protection plan for your community, contact local, provincial or federal government agencies, or a conservation authority, if one exists in your area. (For more information, see Chapter Seven.)

function, and that identifies areas that are candidates for preservation, protection, enhancement or rehabilitation. Begin implementing the plan.

8. ESTABLISH REGULAR MONITORING AND REPORTING PRACTICES: Regularly monitor the quality and quantity of surface water and groundwater. Ensure that the water analyses obtained are meaningful. Use the monitoring information that has been gathered to:

- identify the type and quantity of contaminants threatening water sources, and the types of contaminant controls that need to be put in place;
- monitor changes once the source protection plan has been implemented;
- inform watershed managers and the public on the state of the watershed and whether planning goals are being met;
- make changes to the plan and its implementation as needed; and,
- advise decision makers who are responsible for the development of water quality and quantity legislation and regulations.

9. OBTAIN FUNDING: Secure adequate funding for source water protection from plan development to on-the-ground implementation. Establish cost-sharing partnerships among agencies involved in the watershed. Use the broad scope of watershed planning, involving developers, local governments, provincial agencies, reviewers and landowners, to enhance opportunities for partnership funding.

In Canada, a number of federal, provincial and municipal agencies are responsible for various aspects of water management. Many laws and regulations exist to govern water protection and use, such as pollution prevention controls and limits on the discharge of industrial and municipal effluents. In addition, laws that govern other issues not directly pertaining to water may still have an impact on source protection. Some examples include laws regulating the use of pesticides and those pertaining to urban development.

Jurisdictional issues and authorities vary across Canada. Responsibilities are divided and some are shared among different levels of government. For example, in Ontario, the Ministry of the Environment, Ministry of Natural Resources, Ministry of Municipal Affairs, Ministry of Agriculture and Food, and Ministry of Health and Long-Term Care are all involved in various aspects of source protection. No one agency is responsible for overall coordination of water management.

TEXT BOX 14

Water Systems in First Nations Communities

To assess the status of water and wastewater systems of First Nations communities, Indian and Northern Affairs Canada evaluated the performance, operating practices and operator qualifications of, and defined quality objectives for, 740 community water systems. The assessment was based on an on-site inspection of each facility and recent drinking water quality and wastewater effluent quality data. The results indicated that 29 per cent of the community water systems assessed posed a potentially high risk that could negatively influence water quality. Another 46 per cent were classified as medium-risk systems, and the remaining 25 per cent were in the low or no risk category.

Federal Initiatives

The federal government has responsibility for water on federal lands, including Canada's three territories, national parks and First Nations communities. However, Canada's territorial governments are acquiring more provincial-like responsibilities for water management. Federal jurisdiction applies to the conservation and protection of oceans and related resources, as well as to fisheries, navigation and international relations, including responsibilities related to the management of boundary waters shared with the United States.

According to the March 30, 2003 issue of Environment Canada's COMPRO Update Newsletter, "there is no source protection legislation or activity on the horizon federally." The federal government does, however, play a significant role in protecting water quality by regulating toxic substances, protecting and conserving fish habitat, conducting water quality research and promoting pollution prevention. The federal and provincial governments share responsibility for agriculture, health, national and inter-provincial water issues, and work in co-operation through a joint federal-provincial-territorial committee to develop national drinking water quality guidelines, which are used to assess and address water quality issues.

Government water policies and legislation are undergoing significant changes in Canada. To keep up-to-date on what the federal government is doing to protect water sources, refer to the resources listed in Chapter Seven.

Provincial Initiatives

Canadian provinces have the primary responsibility for most areas of water management and protection. Overall, provincial governments are responsible for the management of water resources, including the provision and regulation of water flows, drinking water and wastewater services, and authorization of the use and development of water resources. They also have the authority to legislate in areas of water supply and pollution control, as well as in the development of thermal and hydroelectric power plants.

Below are highlights of a few initiatives, current as of February 2004, that some provincial governments were undertaking:

New Brunswick

New Brunswick legislation protecting sources of water includes the Watershed Protected Area Designation Order, which was designed to protect the province's 30 designated watersheds from contamination. The program is based on two integrated components: protected areas and permitted activities within those protected areas.

In New Brunswick, each municipal watershed will now be designated as a Protected Area that includes three zones. Protected Area A consists of all lakes,

rivers and streams (or watercourses) in the watershed. Protected Area B is a setback or buffer zone that comprises the entire area located within 75 metres of the banks of the watercourses. Protected Area C defines the remainder of the watershed's drainage area.

The Watershed Protected Area Designation Order prohibits some activities anywhere within a drinking water supply watershed. Other activities are permitted within the remainder of the drainage area, but not within the setback zone. For example, it is permissible to operate motor vehicles on existing provincial highways that pass through setback zones, but not to install new petroleum tanks in the setback zone.

A second piece of legislation aimed at source water protection is the Wellfield Protected Area Designation Order. The goal of this program is to identify and designate protected areas that encompass the entire recharge area associated with and surrounding a wellfield (a group of wells that together supply a public water system). An individual or corporation convicted of violating this designation order may be required to pay fines ranging from $50,000–$1,000,000 for each day that the violation continues.

For more information on New Brunswick's Watershed Protection Plan, see www.gnb.ca/0009/0371/0004/index.htm.

Nova Scotia

Nova Scotia has adopted a multiple-barrier water management approach to source water protection, and has implemented programs to prevent contaminants from entering drinking water sources. In the fall of 2002, the province released a Drinking Water Strategy – a three-year plan that will be implemented by the Nova Scotia Department of Environment and Labour. The strategy includes working with municipalities to develop and strengthen their drinking water source protection plans, establishing watershed management plans, endorsing farmers' efforts to develop nutrient management plans, and increasing education initiatives to enhance source protection. Other components of the strategy include ensuring adequate treatment and water quality monitoring, as well as regular auditing.

For more information on Nova Scotia's Drinking Water Strategy, see www.gov.ns.ca/enla/water/h2ostrat.pdf.

Québec

In the fall of 2002, the Québec government implemented the Québec Water Policy to protect water sources, manage water sustainably and protect public health and ecosystems. The Québec government has made more than 50 commitments to better manage, protect and restore water. Some of these commitments include: focusing on public health protection; providing the citizens of Québec with access to water that meets basic needs and facilitates leisure activities; implementing integrated watershed-based management plans; establishing watershed management agencies to protect and restore ecosystems and foster citizen participation; and supporting volunteer organizations that are working to prevent degradation of aquatic and wetland environments.

For more information on the Québec Water Policy, see www.menv.gouv.qc.ca/eau/politique/index-en.htm.

Ontario

Justice Dennis O'Connor was appointed to examine the causes behind the Walkerton, Ontario, tragedy that occurred in May 2000, after *E. coli* 0157:H7 bacteria entered the community groundwater supply through a local well. Seven people died and more than 2,300 became ill. Justice O'Connor produced two reports, one of which provided recommendations to the provincial government calling for a multiple-barrier water management approach to prevent a similar tragedy from occurring again. He concluded that source protection is one of the most effective and efficient means of protecting the safety of Ontario's drinking water, and made 22 recommendations related to source protection planning, including the need to develop legislation that would require source protection plans to be developed and implemented locally for every watershed in Ontario.

Most recently, the provincial government developed a "White Paper on Watershed-based Source Protection Planning," which describes an approach for the development of a watershed-based source water protection program in the province and it sets out the legislative framework proposed for the planning components of the plans. In February 2004, the White Paper was put before Ontarians for discussion and comment. The government has also established a Technical Expert Committee and an Implementation Committee to bring forward recommendations on innovative funding mechanisms and incentives, best management strategies to protect watersheds and a process for assessing threats to water sources.

For more information on the White Paper on Watershed-based Source Protection Planning, see www.ene.gov.on.ca/envision/water/spp.htm.

TEXT BOX 15

Protecting Ontario's Water Quantity on a Watershed Basis

On December 18, 2003, the Ontario government announced an immediate one-year moratorium on new and expanded water-taking permits for products such as beverage manufacturers (including bottled water), fruit or vegetable canning or picking operations, ready-mix concrete manufacturers, and aggregate processes, and for the manufacturing and production of products where more than 50,000 litres of water per day is required. The government said in a press release on the issue, "Ontario cannot continue to permit water bottlers and others who transfer a significant amount of water out of a watershed to take more and more water, until it fully understands the consequences of these additional stresses on both the watershed and local water supplies."

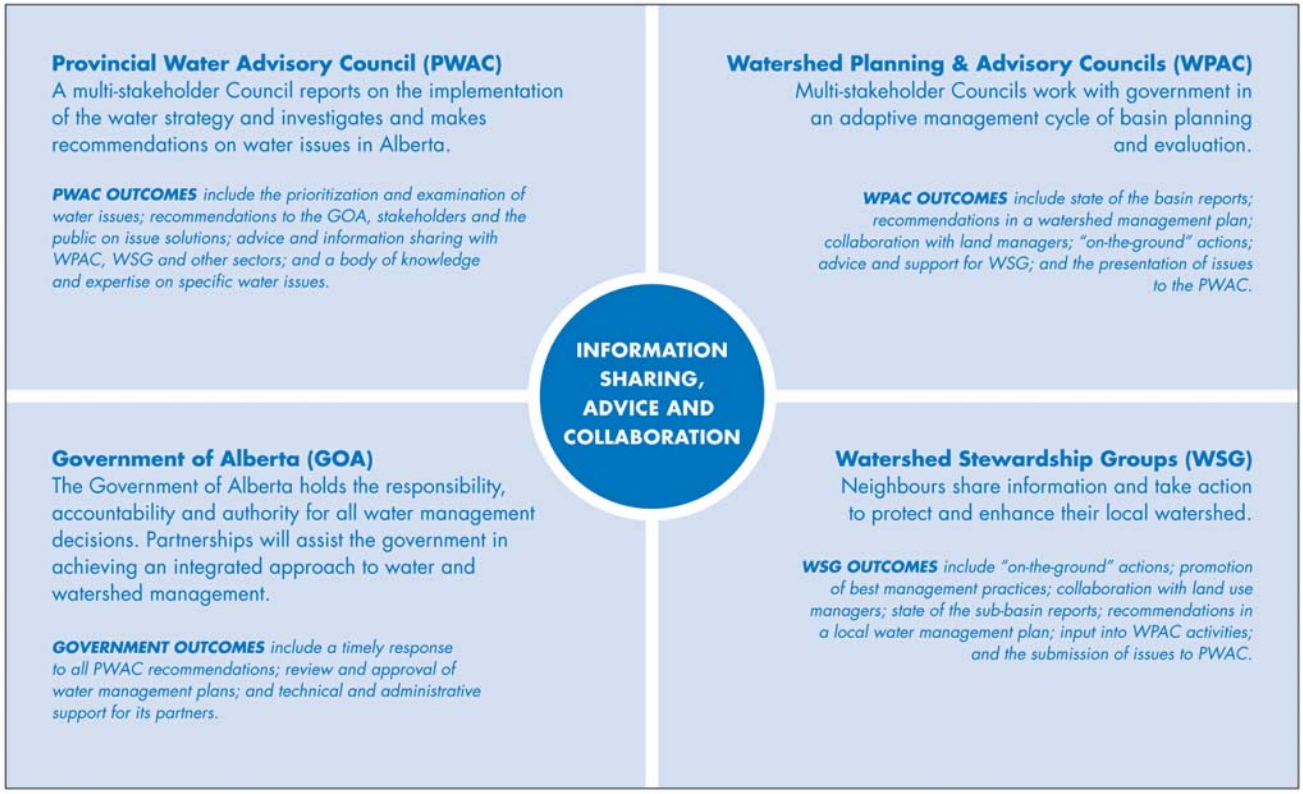
The White Paper on Watershed-based Source Protection Planning outlines potential changes to the legislative and regulatory framework governing water takings in Ontario; it also provides a preliminary exploration of a framework for how Ontario could charge for water takings.

Alberta

In November 2003, the Government of Alberta released its new water management strategy, entitled *Water for Life: Alberta's Strategy for Sustainability*. The strategy outlines a number of key recommendations, one of which is to implement a watershed management and source protection framework. Also recommended is a shift to shared governance through a network of partnerships, with Alberta Environment as the lead ministry. As part of the strategy, a provincial Water Advisory Council has been established to investigate water use issues and to develop policy recommendations that will improve the long-term management and protection

Figure 13: **Shared Governance of Water in Alberta**

Source: www.waterforlife.gov.ab.ca/docs/strategyNov03.pdf



of Alberta's water resources. The council will work with watershed advisory councils to enable stakeholder involvement at the watershed level. Community-based watershed protection groups will also be supported (see Figure 13).

For more information on *Water for Life: Alberta's Strategy for Sustainability*, see www.waterforlife.gov.ab.ca.

Other Provincial Initiatives

For more information on recent strategies and policy instruments related to source protection in your province, as well as a list of some of the key governmental agencies that play a part in source protection issues, see the section entitled Government in Chapter Seven.

Studying the successes of others in source water protection, and understanding the reasons for their success, can help move us toward improved management of surface water and groundwater sources. Highlights of effective strategies that some municipalities, associations and local organizations are using to protect source water quality and quantity are profiled below.

Municipal Initiatives

In North America, source protection is often undertaken at the local level by municipalities and watershed-based organizations. Municipalities are responsible for ensuring that water of adequate quality is delivered to the public. In addition, land-use regulations are typically administered by municipalities under provincial policy guidance.

Fraser Basin Council, British Columbia

The Fraser Basin is the geographical area drained by the 1,370 kilometre-long Fraser River (see Figure 14). The Fraser Basin Council is a non-profit charitable organization formed to ensure the sustainability of the Fraser River Basin in British Columbia. The council includes area residents, non-government organizations, and four levels of government – federal, provincial, municipal and First Nations.

Figure 14: **Map of the Fraser Basin**

Source: www.fraserbasin.bc.ca

The council addresses important issues of sustainability at a watershed level. As of 2003, the council had organized and facilitated more than 25 projects and programs to study the complex problems threatening the sustainability of the basin.

One example is the community-based, community-driven, Business Environmental Pledge Program, implemented in Abbotsford, British Columbia.

The goal of the program is to encourage businesses to change their management practices so that they benefit ecosystems, but also make economic sense. Practices that improve water quality, air quality and solid waste management techniques, and/or promote water conservation, are considered to benefit the ecosystem. Pledged businesses are recognized in a number of ways, including regular exposure in local media. More than 600 businesses are expected to take the pledge.

For more information on the Fraser Basin Council, see www.fraserbasin.bc.ca.

Regional Municipality of Waterloo, Ontario

To ensure a safe supply of water, the Regional Municipality of Waterloo has developed a 10-year Water Resources Protection Strategy to preserve and protect water supplies in the area. Approximately 450,000 people currently live in the region, and 80 per cent of the region's water supply is provided by groundwater.

The work on the strategy involved four major steps:

- understanding the flow of groundwater and identifying recharge areas that contribute water to municipal wells;
- identifying potential sources of contamination, particularly those in recharge areas that contribute water to municipal wells;

- developing and putting in place policies to manage land-uses that may harm sources of water; and,
- developing education programs to raise the public's awareness of the need to protect sources of water.

One aspect of the strategy involved establishing "Well Head Protection Areas" around each municipal groundwater supply well, thus encompassing the recharge area. The region then identified the degree to which these areas were sensitive to groundwater contamination. The Regional Municipality of Waterloo uses this information to guide its land-use development policies and decisions. Land uses that may pose a threat to the region's water supply are directed to other locations.

The Water Resources Protection Strategy also includes a number of other initiatives. The Rural Water Quality Program is a municipally funded incentive program designed to encourage farmers to protect surface and groundwater quality. Measures, such as fencing cattle from creeks, creating buffers beside creeks, and building manure storage facilities, are cost-shared with farmers. A parallel program for businesses, called the Business Water Quality Program, has also been established. Costs are shared for providing spill containment structures, as well as training employees to improve chemical handling and reduce spills to groundwater, surface water and sewers.

The Regional Municipality of Waterloo has also initiated steps to reduce the impact of road salt on its supply wells. All of the above programs are designed with extensive input from stakeholders participating in a number of advisory committees established for the strategy.

For more information on the Regional Municipality of Waterloo's Water Resources Protection Strategy, see www.region.waterloo.on.ca.

TEXT BOX 16

What is a Well Head Protection Area?

Well head protection is one component of source water protection that focuses on managing activities around municipal groundwater supply wells. Land areas where groundwater recharge takes place are identified, and land-use activities in those areas managed, so that the groundwater source is protected from contamination. These well head protection areas are especially important for people that rely on groundwater as a source of drinking water.

TEXT BOX 17

Where is my Watershed?

Conservation Ontario has created an inventory of watershed management projects being undertaken in Ontario. Citizens and watershed practitioners are encouraged to visit the website to find out about projects in their watershed and learn from ongoing watershed studies.

For more information on the Inventory of Watershed Management Projects in Ontario, see www.conservation-ontario.on.ca/projects/iwmpo.

City of Ottawa, Ontario

Canada's capital is home to more than 80,000 rural residents, most of whom rely on groundwater for their homes and businesses. To ensure a safe source of drinking water for its residents, Ottawa is implementing a Groundwater Management Strategy. The strategy includes public consultation and awareness raising, identification of potential contaminant sources, groundwater use assessments, monitoring programs, data management, emergency preparedness and best management practices. The strategy will provide a methodology to determine priorities that will ensure best value for both the effort and money committed to groundwater management activities. Ottawa is also active in watershed planning to identify appropriate management approaches that can deal with the impacts of current and future land-use decisions.

For more information on Ottawa's Groundwater Management Strategy, see www.ottawa.ca/city_services/water/27_0_en.shtml.

Conservation Authorities

In Ontario, conservation authorities were created in 1946 by an Act of the Provincial Legislature. They are local, community-based environmental organizations that work to ensure the conservation, restoration and responsible management of Ontario's water, land and natural habitats through programs that balance human, environmental and economic needs. Conservation Ontario is a non-government organization that represents a network of 36 conservation authorities in Ontario, which together encompass most of Southern Ontario and

the more populated areas in Northern Ontario (i.e., 90 per cent of Ontario's population).

Conservation Ontario recognizes that source protection plans should be developed as part of overall watershed management plans. Conservation authorities work with volunteers, schools and local municipalities, as well area environmental, agricultural and business associations, to protect and rehabilitate the waters and lands within their watersheds and to develop watershed management plans.

Typically, watershed management plans cover several areas, such as woodlands, wetlands and wildlife habitat, flooding, erosion, septic systems, sewer systems and plans for development. Not surprisingly, watershed management plans often take years to develop and involve many studies to gather data and map resources.

For more information on Conservation Authorities in Ontario, see www.conservation-ontario.on.ca.

Community Initiatives

Restoring the Boyer River, Québec

The Boyer River is located near Québec City on the south shore of the St. Lawrence River. It drains a watershed of 21,700 hectares. About 60 per cent of the area is farmland, much in high-density livestock production. Runoff of excess nutrients in the watershed has polluted the Boyer River.

A group of concerned citizens representing the farming community, municipalities and the provincial ministries of agriculture and environment united to form a committee to restore the water quality of the river. The Groupe d'intervention pour la restauration de la Boyer (GIRB) has a mandate to educate the public on the nature and extent of the water quality problem, its significance from ecosystem and economic perspectives, and ways the community can help renew the river.

The committee has obtained assistance from provincial and federal governments, as well as the private sector, to access specific programs for water clean-up. These programs have enabled farmers to develop best management practices, build appropriate manure storage structures and manage animal watering places.

The project has created a feeling of identity, membership and cooperation among community members as they together work to protect their watershed.

For more information on Boyer River restoration, see http://res2.agr.ca/publications/hw/08d_ e.htm.

Figure 15: **Boyer River**

Source: www.girboyer.gc.ca

Nova Scotia Eastern Habitat Joint Venture

Since 1997, the Nova Scotia Eastern Habitat Joint Venture has been working in partnership with several government and non-government associations and farmers on a Riparian Fencing Stewardship Project. The aim of the three-year project was to "fence out" or control livestock access to riparian zones, wetlands and waterways (riparian areas are transitional zones bordering lakes, rivers, streams, ponds and wetlands).

The stewardship project worked with farmers throughout the province to help them fence off sensitive areas and develop alternative watering systems on their properties. Restricting livestock access to these areas creates wildlife habitat, improves water quality and provides for healthier livestock.

The project was so successful that it was extended to the end of 2003. Between 1997 and 2002, the Riparian Fencing Stewardship Project resulted in partnerships with livestock producers on 78 project sites and protected approximately 1,850 acres of wetland/riparian edge.

The Nova Scotia Eastern Habitat Joint Venture is a partnership of government and non-government organizations, including the Nova Scotia Department of Natural Resources, Canadian Wildlife Service, Wildlife Habitat Canada, Ducks Unlimited Canada, the Nature Conservancy of Canada and the Nova Scotia Department of Agriculture and Fisheries.

For more information, see www.gov.ns.ca.

Figure 16: **Livestock Fencing**

Source: www.gov.ns.ca

The choices Canadians make every day — at home, at the cottage, on the farm and at work — can help to protect water at its source. Those choices range from individual actions, such as taking used engine oil and other household hazardous waste to a local hazardous waste site, to collective efforts of Canadians working together to develop watershed-based source protection plans.

At Home

There are many things Canadians can do at home to prevent source water contamination.

Waste

- Minimize the waste you produce – reduce, reuse, recycle and compost.
- Avoid using the toilet as a wastebasket.
- Properly dispose of products, such as cleaners that contain toxic chemicals, pesticides, paints, solvents, gasoline, and flammable liquids. Read the labels to find out how to use and dispose of the product safely. Do not dump these products into sewers, on the ground, in the toilet, or in the garbage can. Take these products to your local household hazardous waste depot.
- Properly dispose of pharmaceutical products. Some municipalities and pharmacies have established programs for the proper disposal of syringes and expired medications. For example, in Ontario, Shoppers Drug Mart has a Sharps Disposal Program and a Medication Cabinet Clean-Up Program designed for the disposal of medical syringes and unused medications. It is planning to expand these programs across Canada. Ask your local health department or pharmacy if such a program is available in your community.
- Use non-toxic cleaning products:

  Look for the EcoLogo (see Figure 17), a registered trademark of Environment Canada, which helps consumers identify products and services that are third-party verified and certified environmentally responsible. For more information, see www.environmentalchoice.com.

  Purchase products from businesses that produce environmentally safe products (not all of them are registered with the EcoLogo program). Check company websites to learn about their environmental practices and products.

Figure 17: **The EcoLogo**

Source: www.environmentalchoice.com

Vehicles

- Take your car to commercial car washes designed to prevent pollutant runoff from entering storm sewers.
- If you do wash your vehicle at home, be sure to use appropriate cleansing agents, such as phosphate-free, biodegradable detergents. Make sure that soaps, dirt and oil do not enter storm sewers. Collect the wastewater using containment pads and pails. For more information on car washing best practices, visit the RiverSafe Carwash Campaign website at www.riversides.org/riversafe.
- Wash your car over a surface that will allow water to soak into the Earth and groundwater, rather than running off into the street.
- Take used motor oil to the recycling center.
- To reduce air pollution emissions, use public transit, carpool, cycle or walk.

Outdoors

- Pick up after pets.
- Minimize the amount of road salts you use in the wintertime.
- Reduce urban runoff by replacing impervious surfaces, such as a paved driveway, with materials that are more porous. Sweep rather than hose down your driveway or sidewalk.
- Disconnect your eaves trough downspout from the sewer. Catch the stormwater in a rain barrel and use it to water your lawn and garden, or redirect the flow to a spot where it can soak into the soil and replenish the groundwater.
- Become energy efficient, and practice energy conservation.

TEXT BOX 18

Is it Illegal to Wash your Car in the Driveway?

The City of Toronto has designed a Sewer Use By-law to prevent and reduce harmful pollutants discharged by residents, industries and businesses from entering sewer systems. The by-law also covers driveway car washes that allow runoff of potentially hazardous substances to enter storm sewers. Residents are encouraged to report any car washing and illegal dumping of material into storm sewers (416-392-9940; after hours 416-392-8280). Municipal field staff will visit the reported site and conduct an assessment to determine whether the runoff is entering storm sewers and whether the pollutants in the runoff exceed the discharge limits established in the by-law. City staff may provide a warning and advise the resident on ways to eliminate car washing-related pollutants. Repeat offences could mean a fine for washing your car in your driveway.

For more information, see www.city.toronto.on.ca/water/protecting_quality/pollution_prevention/iwcu.htm.

TEXT BOX 19

Pesticide By-laws

On May 22, 2003, the City of Toronto passed a by-law prohibiting the outdoor use of pesticides for cosmetic purposes, effective April 2004. Toronto's by-law contains a list of products that can be used, as well as exceptions for pesticide use, either as potentially essential uses or as uses that are not a significant public health concern. The Toronto by-law parallels ones implemented in Halifax, Nova Scotia, (which came into effect in April 2003) and Hudson, Québec, as well as other Québec municipalities.

In the Yard

- Mow high to promote growth and to prevent weeds and pests.
- Use your lawn compost and grass clippings as fertilizer. Use "natural organic," "slow release" or "composted" fertilizers and avoid using "weed and feed" products. Always follow instructions.
- Tolerate a few weeds, hand pull, or spot spray. Overseed lawn areas to crowd out and prevent the growth of weeds.
- Aerate compacted soil in the fall to help oxygen, water and nutrients reach the roots.
- Explore the use of non-chemical pest controls. For tips, see *Twelve Easy Steps to Get Your Lawn Off Drugs* (www.atl.ec.gc.ca/epb/factsheets/12_steps.html) and *Non-Pesticidal Control of Insects* (www.atl.ec.gc.ca/epb/factsheets/pesticides/non_pest.html).

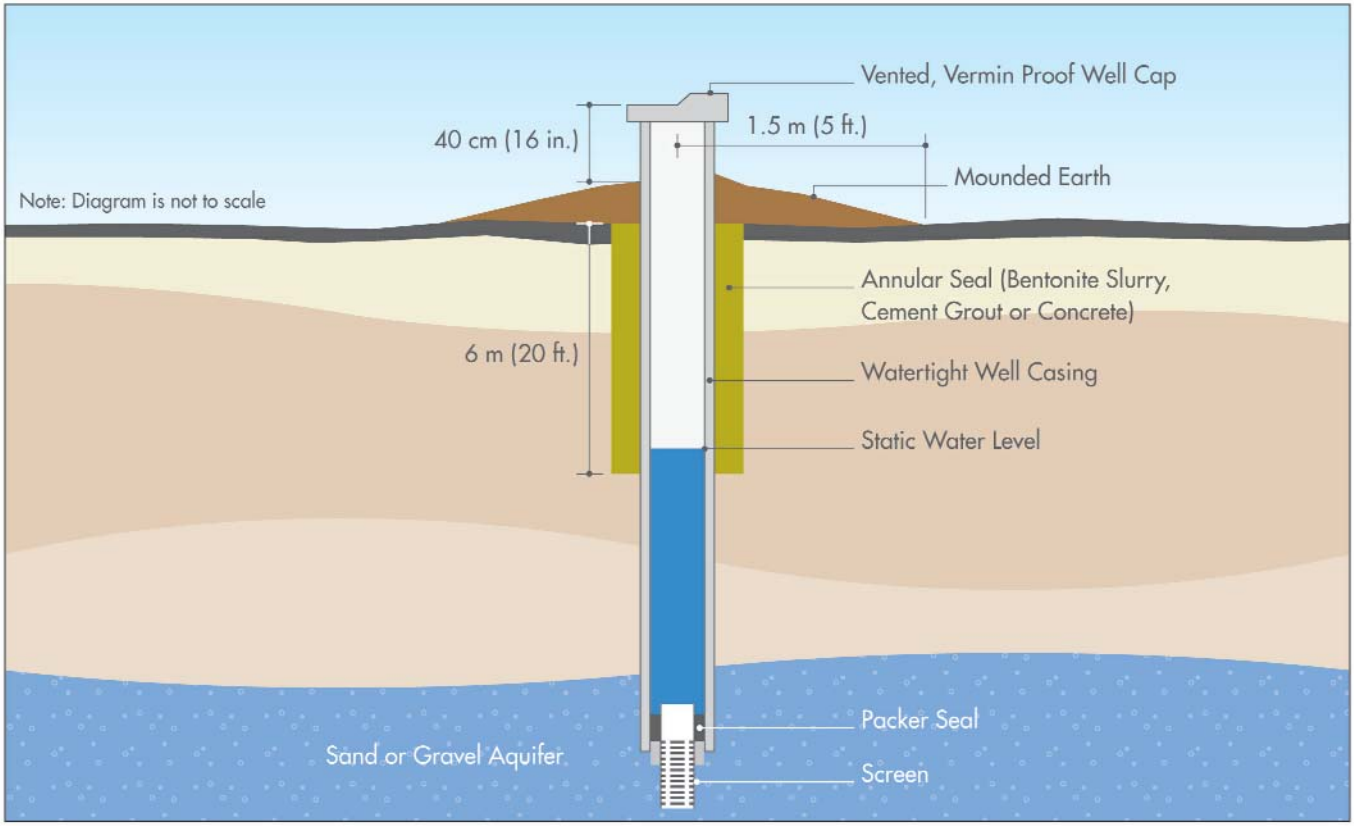
Wells

If you have a private well, it is your responsibility to protect and maintain the well. Water wells should be sampled and tested regularly to help ensure that the water is safe for consumption.

Good well management includes designating an appropriate well location and practicing good housekeeping around the well. Keep an adequate distance between your well and potential contaminant sources, including septic systems, pesticides, fertilizers and other sources of nutrients and hazardous materials. In general, the potential for well water to become contaminated decreases as the distance between the well and the sources of contamination increases.

Figure 18: Sealing Requirements of a Well

Source: Government of Ontario. *Keeping Your Well Water Safe to Drink.*



The quality of well water also depends, in part, on the condition of the well. Sediments and natural chemicals in the groundwater can accumulate and reduce a well's ability to supply water. In 1998, the Ontario Ministry of the Environment found that the occurrence of well water quality degradation in Ontario was directly related to the type, depth and age of the well. Dug wells, shallow wells, and older wells (over 60 years) were more impacted by human activities than were drilled wells, deeper wells and newer wells. To help ensure a good supply of safe drinking water, employ a licensed professional to inspect your well.

Loose caps and leaking well casings are pathways for contaminants to enter groundwater (see Figure 18). For this reason, it is important to take preventative measures:

- Make sure caps are securely in place and are vermin-proof (to prevent other potential sources of contamination, such as insects and small animals).
- If a well casing has any holes or cracks, have a licensed contractor repair it.
- Ensure that there is an impermeable sealant filling the gap between the outside of the well casing and the edge of the surrounding hole in the ground. Lack of sealant, improper selection of sealant, improper placement of the sealant, and accidental collision with the casing (a common occurrence) can all result in contaminated surface water running freely down the outside of the casing to the bottom of the well.

There are other steps that private well owners can take to protect wells:

- Keep cars, trucks and other heavy machinery away from the wellhead because they can damage the well casing.
- Make sure that proper venting techniques are in place to prevent the build-up of noxious gases in the wells.
- Install backflow devices on all taps with hose connections to prevent water from siphoning back into the well.
- Ensure that water does not pond around the well. Make sure the ground around the well is mounded and that surface water in the area is directed away from the well.
- Keep records on the location and status of all wells (and septic systems) on the property.

The property owner is also responsible for all unused and abandoned wells. Abandoned or unused wells that are not maintained properly can cause water problems in other nearby wells and affect entire aquifers. Hire a licensed contractor to properly plug and seal the well, and keep records of any work done.

Provinces across Canada have well construction regulations that must be met. Contact your provincial environmental ministry before you dig.

They can also help you with any concerns you may have for constructing, modifying, maintaining or abandoning your well. It is highly recommended that you test well water regularly for bacteria, including total coliforms and *E.coli*. Call your local health unit – in some provinces tests are provided free of charge; others provide a list of accredited laboratories.

Refer to Wells in Chapter Seven for more information on maintaining water wells.

Septic Systems

Regularly maintaining a properly sized septic system, using water moderately, and taking care about what you dispose, can help keep a septic system healthy and adequately protect water sources. Signs of a malfunctioning septic system include toilets, showers and sinks that take a long time to drain, occasional sewage odours, and grass over the system that is unusually green or spongy. If you notice these signs, contact a licensed contractor.

Some examples of what should not be flushed or poured down the drain include medications, diapers, some feminine hygiene products and other refuse, grease, and chemicals, such as paints, solvents, thinners and other household compounds not intended for down-the-drain use. If a product does not break down naturally, do not flush it into your septic tank. If you question whether the septic system can handle it, do not put it in the toilet or down the drain either, but dispose of it appropriately.

Septic tanks accumulate solid material that must be pumped out. Have a licensed contractor inspect your septic system every two years, pumping out the solids when required. Properly size your septic system. If you install additional water uses, such as toilets or showers, the septic system may need to be upgraded.

Other tips:

- Keep a good cover of grass over the tile bed to take up excess nutrients and water.
- Divert storm and drainage water away from the septic system.
- Do not allow cars, trucks or any other equipment around the tile bed as the wheels may crush it and ruts may alter the drainage patterns.

Septic system owners are required by law to locate their septic systems a specific distance away (called a setback distance) from water sources. For example, in New Brunswick, septic tanks must be installed a minimum of 1.5 metres away from any building, 15 metres away from a drilled drinking water well, 30 metres away from a dug well, 90 metres away from a lake or stream used for drinking water, and 30 metres away from a recreational lake or stream. It is imperative that you contact your provincial agency to determine the regulated septic system requirements. Inform yourself before you dig.

Refer to Septic Systems in Chapter Seven for more information.

At the Cottage

Waterfront cottage residences have an impact on lakes and rivers, and development along many waterfronts continues to be heavy. Waterfront property owners have a special responsibility to care of lakes and rivers, which are current or potential drinking water sources. Protecting water quality will also help protect fish habitat.

To lessen the impact on a lake or river, follow the suggestions made above in the "At Home" section. You can also do the following:

- Maintain a natural shoreline. A buffer zone covered thickly with native vegetation between your cottage and the water will substantially reduce the amount of pollution that enters the lake. It is also aesthetically pleasing and has low maintenance. The wider the buffer zone the better.
- Confine your water access or beach to ten per cent of total frontage.
- Avoid bringing sand from an outside source to create an artificial beach. This can spoil fish habitat, damage water quality, and introduce unwanted species to the lake. Use low-impact docks or offshore swimming platforms instead.
- Give your dishwasher a break. Use only low-phosphate, lake-friendly soaps.
- Do not wash yourself or your boat in the lake.

- Work with your cottage association, local land trust and municipality to protect sensitive areas, educate property owners and develop a lake plan to guide responsible development.

Boats

- Use non-toxic cleaning products to wash your boat, and clean it away from the river or lake. Pick up loose paint chips and other chemical substances.
- Carefully fuel your boat engine, using proper containers and equipment.
- Keep your boat well tuned.

- Properly maintain your boat and use a four-stroke engine. Better yet, minimize use by paddling or rowing.
- Attempt to achieve zero discharge of all sewage from your boat into the water – purchase a marine sanitation device.
- Encourage marinas to implement pollution prevention strategies.

For further information on all aspects of cottaging, including water quality maintenance and monitoring, contact The Federation of Ontario Cottagers' Associations (FOCA) at www.foca.on.ca.

On the Farm

Farmers that run small farms or large agricultural industries can implement Best Management Practices to ensure profitable production while protecting water sources. Best Management Practices are industrial and good housekeeping techniques and practices that are determined to be the most effective and practical means of preventing or reducing non-point source pollution. Learn about agricultural Best Management Practices and put them to work on your farm. Below are a few examples:

- Maintain a wide, native vegetative cover along streams, ditches and runoff channels to prevent erosion and filter nutrients and sediment.
- Manage livestock grazing, as overgrazing exposes soil and increases erosion. Keep livestock out of sensitive areas.
- Discourage or prevent livestock from entering watercourses and provide livestock with an alternative water supply.
- Implement a Nutrient Management Plan, which manages the use of commercial fertilizers and manure to maintain high yields with minimal environmental and societal impacts. This may include, for example, determining crop needs before applying chemical fertilizers or manure to ensure that all nutrients are used and do not run off when rain falls.

- Manage confined animal facilities and manure storage sites. Implement appropriate waste management systems to prevent runoff from major sources of animal wastes.
- Implement Integrated Pest Management techniques, which help limit pesticide use, and manage necessary applications to minimize pesticide movement from the field.
- Keep pesticides away from surface water and wells, and store pesticides in a dry, properly ventilated and secure area.
- Properly install and operate fuel storage tanks to prevent spills.
- Become involved in watershed source protection plans in your community.

Farmers are also encouraged to participate in programs established by government agencies and other organizations, which are designed to help farm owners protect water sources and address other environmental goals. The programs help identify practical solutions to address environmental and land stewardship issues. A few of these programs are described below.

Environmental Farm Plans

Across Canada, farming communities have taken the lead in developing Environmental Farm Plans that serve as guides for farmers, encouraging and enabling them to incorporate sound environmental practices into their operations.

Environmental Farm Plans are documents voluntarily prepared by farm families to increase awareness of the environment on their farms. Farmers assess the current level of environmental concern related to different aspects of their operation, including water wells, soil and site evaluation, manure use and management, milking centre and wash water, and field crop management. Using this information, the farmers identify the environmental strengths and weaknesses on their farms. They develop action plans, with realistic goals and timetables, to improve environmental conditions. Farmers then submit their plans for peer review. Some provinces, such as Ontario, have fully operational Environmental Farm Plan Programs. Currently, one-third of the farmers in Ontario participate in the program, and it has been adopted in other parts of Canada and internationally.

For more information on Environmental Farm Plans, see www.gov.on.ca/OMAFRA/english/environment/efp/efp.htm.

Rural Water Development Program

Agriculture and Agri-Food Canada has developed the Rural Water Development Program (RWDP) to promote and support sustainable development and protection of water resources in the Prairies. The program provides technical and financial assistance to rural residents, such as producers, agricultural and conservation groups, agri-businesses and others who address water development or protection issues. Water protection issues include activities that protect or improve the quality or quantity of surface and groundwater resources.

For more information on the Rural Water Development Program, see www.agr.gc.ca/pfra/water/intro_e/htm.

The Eastern Canada Soil and Water Conservation Centre

The Eastern Canada Soil and Water Conservation Centre, based in New Brunswick, works in cooperation with private and public stakeholders to promote sustainable resource management in agriculture. One of its objectives is to promote production systems and technologies that protect water quality. It also focuses on promoting Best Management Practices that can be adopted by agricultural producers to preserve soil and water, and that can serve as a reference tool for producers who are preparing and implementing Environmental Farm Plans.

For more information on the Eastern Canada Soil and Water Conservation Centre, see www.ccse-swcc.nb.ca.

At Work

As already stated, the most effective way to protect sources of water is to anticipate and prevent pollution from entering the environment in the first place. This makes sense for industry and business for two reasons: First, the volume and toxicity of chemicals used in many industrial and some commercial processes have the potential to contaminate large amounts of surface and groundwater for many years. Second, many businesses in Canada have already experienced substantial financial savings by changing their processes to reduce the quantity of potentially polluting chemicals used, created or disposed of as waste.

Today, federal and provincial governments promote regulatory and voluntary pollution prevention programs. These programs invite

TEXT BOX 20

A Greener Dry Cleaner

The Canadian Centre for Pollution Prevention website provides links to businesses that practice pollution prevention. Visit their site and click on "Affiliated Websites." This will take you to a list of organizations, including green dry cleaners. Green dry cleaners collect and reuse wire hangers, recycle plastic bags, work to phase out the use of toxic perchloroethylene in their processes, and offer customers environmentally preferable cleaning processes. From here, with just a click of a button, you can find a green dry cleaner that is close to where you live.

For more information on green businesses, see www.c2p2online.com.

Canadian businesses of all sizes, from multinational automobile companies to family-run stores, to re-think their operations to reduce the volume and toxicity of pollutants they produce by modifying processes, reformulating products and developing new technologies.

For example, one company, Maratek Environmental Technologies Inc., a North American supplier of recycling technologies and services for the graphic arts, printing, photofinishing and diagnostic imaging industries, has developed a technology that deals with the problem of waste, water, and solvent and chemical streams in the printing industry. The company developed a range of waste recycling and discharge systems that almost eliminate any negative effect that printing plants might have on the environment.

The Canadian Centre for Pollution Prevention (C2P2), a non-profit, non-government organization supported by its members and sponsors, helps companies and organizations determine their pollution prevention information needs and services. C2P2 shares knowledge with others so that they can include pollution prevention strategies in their decision making everyday. It also helps individual Canadians by providing links to sources of information needed to choose businesses and services that practice pollution prevention.

In some cases, financial support is provided to companies that carry out pollution prevention programs. In Toronto, the Ontario Centre for Environmental Technology Advancement (OCETA) is a not-for-profit agency that runs a program offering financial support to small- and medium-sized companies that put pollution prevention programs in place. The agency's Toronto Region Sustainability Program offers manufacturing companies with fewer than 500 employees a pollution prevention assessment. These assessments identify pollutants and wastes

in manufacturing processes and recommend technologies, processes and improvements to reduce the amount of contaminants used or generated. For more information on OCETA, see www.oceta.on.ca.

In Halifax, Nova Scotia, the Eco-Efficiency Centre is a non-profit centre supported by a team of public and private partners who share a commitment to improve the ecological effectiveness and economic efficiency of businesses in the region. The mandate of the centre is to move the environmental agenda forward by demonstrating that sound environmental choices can help businesses reduce costs and/or generate new revenues. The goals of the Eco-Efficiency Centre include directing new attention to areas of energy and water conservation and focusing renewed attention on pollution prevention and source reduction issues. For more information on the Eco-Efficiency Centre, see www.mgmt.dal.ca/sres/eco-burnside.

In the Community

By working together, citizens, industry, municipalities, and provincial and federal governments can implement source protection plans. To learn about and help create and implement watershed management practices and related source protection plans, contact your local government, as well as community-based organizations and environmental agencies in your area. These groups often have information about ways citizens can become involved in the following types of source protection planning:

- **Volunteer Monitoring –** Local groups organize volunteers of all skill levels to gather water quality data. This information can help government agencies understand the nature and magnitude of non-point source pollution.

- **Ecological Restoration –** Ecological restoration provides opportunities for the public to help with a wide variety of projects, such as tree planting and bank stabilization, in both urban and rural areas. Restoration efforts focus on degraded waters or habitats that have significant economic or ecological values.

- **Educational Activities –** Teachers can integrate the importance of source protection curricula into classroom activities. Talk to neighbours and

others in your community about the importance of source protection.

- **Public Meetings and Hearings –** Decisions made during public hearings on storm water permitting and town planning can determine a community's capability to manage water pollution over the long term. Laws or regulations may require federal, provincial or municipal governments to hold public hearings when permits are issued or when town plans are formed. Notices about hearings often appear in newspapers or in government office buildings. Participate in public meetings and hearings and support initiatives that enhance source protection.

- **Participate in Local Politics –** Help shape political decisions concerning land use that affects water quality by talking to local politicians and keeping them informed about the ecological and economic importance of clean water. Contact elected officials to find out what has been done to ensure that local waterways are adequately protected. Keep informed about legislative action that is being taken at provincial and federal levels.

- **Community Organizations –** Many communities have formed groups to protect local natural resources. These community-based groups provide citizens with information about upcoming environmental events in their watersheds, such as ecological restoration, volunteer monitoring and public meetings.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If you are interested in learning more about protecting water sources in your area or would like to know who to contact if you are concerned about potential contamination, help is available.

General

CELA – The Canadian Environment Law Association (CELA) provides many reports and references to source water protection on their website at www.cela.ca.

Pollution Probe – To keep up-to-date on Pollution Probe's water program, visit www.pollutionprobe.org.

Contaminants

Hazardous Waste Disposal – You may be able to take hazardous waste products to a permanent household toxic waste depot set up by your provincial or municipal government, or to a temporary collection facility on a Special Waste Collection Day. For information on hazardous waste disposal facilities in your area, contact your local municipal or provincial governments.

Road Salts – For information on road salts, including which provincial or territorial government departments are responsible for the use of road salts in your province or territory, contact Environment Canada at 1-800-O-CANADA, or visit their website at www.ec.gc.ca/nopp/roadsalt.

Pollutants in Your Area – The Canadian Environmental Protection Act requires emitters to report on the types and amounts of contaminants that they release into air, water or landfill sites. For information about the types of pollution that are released in your area, visit the National Pollutant Release Inventory Program website at www.ec.gc.ca/pdb/npri. You can also visit the PollutionWatch website at www.pollutionwatch.org, which allows you to access the same data simply by entering your postal code.

Environmental Emergencies – Many provincial and territorial governments have numbers to call for environmental emergencies. Contact the

provincial environment ministry directly. In Ontario, for example, the Spills Action Centre has a 24-hour toll free number for reporting spills: 1-800-268-6060. The Ontario Ministry of the Environment also offers a Pollution Hotline (1-866-663-8477) for reporting acts of pollution.

The federal government's National Environmental Emergency Centre, in partnership with Regional Environmental Emergencies Coordinators, provides technical and scientific advice for national incidents involving spills of hazardous substances that may affect human health and the environment. To report a spill, call the centre collect, 24-hours a day, at 819-997-3742, or visit their website at www.ec.gc.ca/ee-ue.

Water Quality

Wells

Well Aware – Well Aware at www.wellaware.ca provides well owners with information on ways to protect wells and groundwater sources. One particularly useful reference you'll find here is a booklet entitled *A Guide to Caring for Your Well and Protecting Your Family's Health.* This website is offered by the Green Communities Association in partnership with the Ontario Ground Water Association.

Ontario Federation of Agriculture – For Ontario private well owners, the Ontario Federation of Agriculture (OFA) administers two programs:

- the first helps owners upgrade wells, and helps defray the cost of installing proper well caps, repairing well casings, and retrofitting well and well pits to extend the casings above the ground.
- the second program assists with decommissioning wells.

The programs are administered on behalf of the Healthy Futures for Ontario Agriculture Program, operated by the Province of Ontario.

A third program offered by OFA is the Rural Water Quality Testing Program, which provides five water-testing kits for bacteria, pesticides, metals and minerals, oils and diesel, and gasoline and solvents.

For more information call toll-free 1-800-668-3276 or visit www.ofa.on.ca.

Canadian Ground Water Association – The Canadian Ground Water Association also has information about wells and septic systems. See their website at www.cgwa.org.

Federal and Provincial Governments – Information and publications on wells and septic systems can be found on federal and provincial government agency websites. For example, you can obtain the following publications:

- *A Guide to Well Water Treatment and Maintenance*
  Available from Health Canada at www.hc-sc.gc.ca/hecs-sesc/water/factsheets/treatment_guide.htm
- *Before You Construct a Water Well: Facts a Homeowner Should Know*
  Available from the Government of Nova Scotia at www.gov.ns.ca/enla/pubs/#env
- *Before you Construct an On-site Sewage System: Facts a Homeowner Should Know*
  Available from the Government of Nova Scotia at www.gov.ns.ca/enla/pubs/#env

Become informed and make sure that you adhere to the regulations on wells and septic systems in your province.

Water Quality Testing – Contact your local Public Health Unit (or equivalent) to find out about contaminants that are typically found in wells in your area. Some provinces offer free water quality testing services.

Beach Water Quality – Environmental Defence Canada is the national operator of the "Blue Flag Program." A blue flag is raised at beaches that comply with 27 standards related to water quality, environmental education, information and management. When the standards have been met, the beach is considered clean and the water safe for swimming. The program was established in Europe and was initiated in Canada in 2003. For more information, see www.torontobeach.ca.

Septic Systems – The Federation of Ontario Cottagers' Association has information about septic systems, including what to do and who to call when a system is not functioning properly. For more information, visit www.foca.on.ca. Check for provincial publications:

- *A Guide to Operating and Maintaining Your Septic System* from Ontario Ministry of Municipal Affairs and Housing: www.obc.mah.gov.on.ca/userfiles/page_attachments/library/4/10431_2790940_new_sept.pdf
- *All About Your Septic System* from New Brunswick Environment Industry Association: www.nbeia.nb.ca/project.htm

If you need a Septic System Inspector, check the Yellow Pages of your telephone directory, ask your local Public Health Unit, or check with your provincial environmental government agency.

The Walkerton Inquiry – The Walkerton Inquiry website is a useful information resource for references and information on water source protection. See www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton.

Land Issues

Land-use Planning – Contact your local municipality to learn about land-use planning and development in your community and to find out what your municipality is doing to protect source water.

Agriculture and Water – For more information about water and agriculture, visit the National Agricultural Library, Water Quality Information Center website produced by the Agricultural Research Service, US Department of Agriculture, at www.nal.usda.gov/wqic.

Legal Information

If you require legal information about environmental concerns, there are several organizations you can contact:

Canadian Environmental Law Association – CELA is a non-profit public interest organization that uses existing laws to protect the environment and advocates for environmental law reforms. This Toronto-based organization also has a free legal advisory clinic. For more information, call 416-960-2284, or visit their website at www.cela.ca.

Environmental Defence Canada – Environmental Defence Canada is a national charitable organization committed to providing Canadians with the tools and knowledge they need to protect the environment. For more information, call 416-323-9521, e-mail info@environmentaldefence.ca, or visit www.environmentaldefence.ca.

Environmental Law Centre, Alberta – This national charitable organization is dedicated to ensuring that laws and policies provide the public with an effective role in environmental regulatory and law-making processes. For more information call 780-424-5099, e-mail elc@elc.ab.ca, or visit www.elc.ab.ca.

Sierra Legal Defence Fund – Sierra Legal Defence Fund is a non-profit charitable organization that provides free legal services to concerned citizens and environmental groups. In Vancouver, call 604-685-5618, or e-mail sldf@sierralegal.org. In Toronto, call 416-368-7533, or e-mail sldfon@sierralegal.org. Their website is www.sierralegal.org.

The Environmental Bureau of Investigation – A donor-based project of the Energy Probe Research Foundation, this organization is dedicated to protecting public resources through the application and enforcement of environmental laws. For more information call 416-964-9223, e-mail EBI@nextcity.com, or visit www.e-b-i.net.

West Coast Environmental Law Association – This Vancouver-based association supports the public's right to participate in the formation of environmental policy and law. The association also provides free legal advice, advocacy, research and law reform services. For more information, call 604-684-7378, or toll free in British Columbia at 1-800-330-WCEL; e-mail admin@wcel.org. Their website is www.wcel.org.

Government

Visit your federal, provincial and municipal government websites to learn what they are doing regarding source water protection. Encourage governments to take action on source protection issues.

Federal

The Oceans Act and the Fisheries Act
www.dfo-mpo.gc.ca/communic/policy/dnload_e.htm

Canadian Environmental Protection Act and Canadian Environmental Assessment Act
www.ec.gc.ca/EnviroRegs/ENG

Provincial

For more information on recent strategies and policy instruments related to source protection in your province, visit the following websites (adapted from Environment Canada. 2003. *Water and Canada: Preserving a Legacy for People and the Environment*):

British Columbia Action Plan for Safe Drinking Water
www.healthservices.gov.bc.ca/protect/water.html

Alberta Water for Life, Alberta's Strategy for Sustainability (draft version)
www.waterforlife.gov.ab.ca

Saskatchewan Water Management Framework
www.se.gov.sk.ca/ecosystem/water/framework

Manitoba Water Strategy
www.gov.mb.ca/conservation/watres/water_strategy_index.html

Ontario Water
www.ene.gov.on.ca/water.htm

Québec Water Policy
www.menv.gouv.qc.ca/eau/politique/index-en.htm

New Brunswick Watershed Protection Program
www.gnb.ca/0009/0371/0004

Nova Scotia Drinking Water Strategy
www.gov.ns.ca/enla/water

Prince Edward Island Drinking Water Strategy
www.gov.pe.ca/infopei/onelisting.php3?number=50234

Newfoundland and Labrador Multi-barrier Strategic Action Plan
http://sourcetotap.ccme.ca/eng/map_eng.php?view_id=1&jurisdiction_id=6

Yukon, Northwest Territories and Nunavut, Framework for the Management of Drinking Water Quality – Source water management is shared with Indian and Northern Affairs Canada and other co-management agencies.

Useful Websites

Federal Agencies

Agriculture and Agri-Food Canada – www.agr.gc.ca/index_e.phtml

Canadian Council of Ministers of the Environment – www.ccme.ca

Environment Canada, National Water Issues Branch – www.ec.gc.ca/water_e.html

Fisheries and Oceans Canada – www.dfo-mpo.gc.ca/canwaters-eauxcan

Health Canada – www.hc-sc.gc.ca/waterquality

National Water Research Institute – www.nwri.ca

Natural Resources Canada – www.nrcan-rncan.gc.ca/inter/index.html

United States Environmental Protection Agency (US EPA) – www.epa.gov/safewater/protect.html

Provincial/Territorial Agencies

British Columbia Ministry of Water, Land and Air Protection – www.gov.bc.ca/wlap
British Columbia Ministry of Agriculture, Food and Fisheries – www.gov.bc.ca/agf

Alberta Environment – www3.gov.ab.ca/env/water/index.cfm
Alberta Agriculture, Food and Rural Development – www1.agric.gov.ab.ca/app21/rtw/index.jsp

Saskatchewan Environment Ministry – www.se.gov.sk.ca
North Battleford Water Inquiry – www.northbattlefordwaterinquiry.ca

Manitoba Conservation, Programs Division, Water Branch – www.gov.mb.ca/natres/watres/index.html
Manitoba Agriculture and Food – www.gov.mb.ca/agriculture/index.shtml

Ontario Ministry of the Environment – www.ene.gov.on.ca
Ontario Ministry of Agriculture and Food – www.gov.on.ca/OMAFRA
Ontario Ministry of Natural Resources – www.mnr.gov.on.ca/MNR

Walkerton Inquiry –
www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton

Québec Ministry of the Environment –
www.menv.gouv.qc.ca/ministere/inter_en.htm
Québec Ministère de l'Agriculture, des Pêcheries et de l'Alimentation –
www.agr.gouv.qc.ca

New Brunswick Department of Environment and Local Government –
www.gnb.ca/0009/0003-e.asp
New Brunswick Department of Agriculture, Fisheries and Aquaculture –
www.gnb.ca/0173/01730003-e.asp

Nova Scotia, Environment and Labour –
www.gov.ns.ca/enla/water/index.htm
Nova Scotia Agriculture and Fisheries –
www.gov.ns.ca/nsaf/department

Prince Edward Island Environment and Energy – www.gov.pe.ca/enveng/index.php3
Prince Edward Island Agriculture, Fisheries, Aquaculture and Forestry –
www.gov.pe.ca/af/index.php3

Newfoundland and Labrador Department of Environment, Water Resources Division –
www.gov.nf.ca/env/env/water_resources.asp
Newfoundland and Labrador Department of Fisheries and Aquaculture –
www.gov.nf.ca/fishaq

Northwest Territories Land and Environment –
www.gov.nt.ca/agendas/land/index.html

Nunavut Department of Sustainable Development – www.gov.nu.ca/sd.htm

Yukon Environment –
www.environmentyukon.gov.yk.ca/main/index.shtml

Non-governmental Organizations

Canada Centre for Pollution Prevention –
http://c2p2online.com

Canadian Ground Water Association –
www.cgwa.org

Canadian Water and Wastewater Association –
www.cwwa.ca

Conservation Ontario –
www.conservation-ontario.on.ca

Federation of Ontario Cottagers Association –
www.foca.on.ca

Ontario Farm Environmental Coalition, Environmental Farm Plans –
www.gov.on.ca/OMAFRA/english/environment/efp/efp.htm

Ontario Federation of Agriculture –
www.ofa.on.ca

Watershed Science Centre – www.trentu.ca/wsc

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Pollution Probe. 2000. *The Acid Rain Primer*. Toronto: Pollution Probe.

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