WATERPROOF

Canada's Drinking Water Report Card

Sierra Legal Defence Fund

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I Waterproofing Canada:

Executive Summary

A waterborne disease outbreak that caused thousands of residents in an Ontario town to fall violently ill in the spring of 2000 was well suited to capture news headlines. Not only was the outbreak fraught with early allegations of negligence or wrongdoing, the speed at which it made people ill and, in a few tragic cases, killed them, was frightening.

The rapid expansion of media coverage quickly turned Walkerton into a household word, forcing the Ontario government to call an independent inquiry into the causes of the disease outbreak. Launched in the fall of 2000 and likely to carry on well into 2001, the inquiry is expected to shed light on how and why so many people became seriously ill from drinking the water coming out of their household taps.

But many people hope the inquiry will do more than that. Environmental and public health advocates have long maintained that Canada's drinking water is not as safe as we may think. While it is true that the nation's drinking water is safer than most, significant problems continue to crop up across Canada. And there is growing concern that as human developments further deplete and degrade drinking water sources like streams, rivers, lakes and wells, problems may worsen.

At the same time, Canada's aging water and wastewater infrastructure is in need of renewal and upgrading. But the current federal infrastructure program falls short of the funding required to ensure that the systems that treat and deliver water to Canadians are up-to-date and functioning well. This funding shortfall is especially problematic in light of new service responsibilities downloaded to cash-strapped municipalities. Mounting pressure may force some municipalities to turn to the private sector to own and operate water systems, further muddying the waters of accountability.

In the absence of a comprehensive, cross-country approach to protecting drinking water, more tragedies almost certainly await us. While Walkerton stands as the worst modern-day waterborne disease outbreak in Canada, many other communities across the country have had their water supplies contaminated.

The potentially lethal single-cell parasite *cryptosporidium* has surfaced in water supplies in Collingwood and Kitchener, Ontario, as well as the British Columbia communities of Cranbrook and Kelowna. Faecal coliforms, including *E. coli*, have been detected in Moncton, New Brunswick's drinking water. Cancer-causing trihalomethanes (THMs) have been found in Newfoundland waters. And in several Ontario communities traces of trichloroethylene—the waterborne chemical whose debilitating health effects are chronicled in the popular non-fiction book and movie, *A Civil Action*—have also turned up. This list is by no means exhaustive.

In the absence of a comprehensive, cross-country approach to protecting drinking water, more tragedies almost certainly await us.

As the severity of the Walkerton disease outbreak became apparent, Sierra Legal Defence Fund launched a national survey of drinking water protection in Canada. A report card and comparative tables accompanying this report bring together for the first time an analysis of how each province fares in a number of important areas, including:

- Protecting drinking water at its source.
- Water treatment and testing.
- Informing the public.

In conducting the survey and arriving at its grades, Sierra Legal contacted relevant government personnel in each province and territory. Each was asked to provide information on a range of issues. (For details about sources please refer to Endnotes and Bibliography.)

For example, they were asked whether or not their governments require testing *before* a water source is approved. Similarly, they were asked whether their government had the legal means to protect the lands around water supplies from potentially harmful human activities. Other issues included:

- Whether the province or territory had a single agency dedicated to protecting all aspects of drinking water quality.
- What they tested for and how that compared to the *Guidelines for Canadian Drinking Water Quality*.
- Whether or not they used accredited labs to test water quality.
- Methods of water treatment.
- Public reporting requirements.

All provinces and territories responded to the initial survey. They were then given an opportunity to comment in writing on the summaries reprinted in this report. Most did so, and where it was warranted minor changes or clarifications to the report were made.

Some significant standouts emerged from the survey. For example, Alberta, Nova Scotia and Quebec are alone among Canadian provinces and territories in nearly or completely adopting the *Guidelines for Canadian Drinking Water Quality* as the standard by which their drinking water is assessed. The *Guidelines* set fairly stringent limits on a number of potentially harmful microbiological, chemical and radiological contaminants that may be found in community drinking water supplies.

New Brunswick and Nova Scotia also receive high marks for the work that they have done to bring some limited legislated protection to watershed lands. And Ontario receives recognition for its decision (post-Walkerton) requiring that the results of drinking water tests be publicly available.

But no single province is found to be doing an outstanding job across the broad range of issues examined. In fact the top three provinces—Alberta, Ontario, and Quebec—receive just a B grade. And Ontario is only awarded that score based on recent changes to its regulatory regime, changes that won't be fully implemented until 2002. If Ontario is judged pre-Walkerton it receives a D, the same grade assigned British Columbia and Newfoundland. The Yukon fares worse with a D minus while the Northwest Territories and Nunavut both do marginally better with a C.

All the remaining provinces with the exception of Prince Edward Island receive grades ranging from B minus in the case of Nova Scotia—which introduced revised regulations last fall—down to C minus for New Brunswick. Canada's smallest province is awarded an F, the lowest grade in this inaugural report card. (For a complete list of grades see the accompanying map and further explanation in Chapters IV and V.)

While some provinces do better than others, no single jurisdiction does an exemplary job. Furthermore, the overall approach to safeguarding drinking water in Canada lags far behind the United States, where a much higher emphasis is placed on the protection of water at its source and on ensuring that citizens have ready access to current information on the quality of their drinking water.

By protecting watersheds from potentially harmful land-uses such as factory farming, logging or urban sprawl, water suppliers can go a significant way toward safeguarding drinking water quality.

However, most Canadian jurisdictions have failed to seriously address legislated watershed protection. Not one Canadian province or territory has seen fit to appoint a single agency with sole responsibility for all aspects of drinking water quality—an idea that has been proposed by at least one provincial government's Auditor General (British Columbia's). And few insist on certified labs doing water quality testing.

Differences between provinces are not the only thing standing in the way of better drinking water protection and treatment in Canada. Overall, Canada's drinking water protection is not as strong as that of the United States.

The Safe Drinking Water Act, administered by the U.S. Environmental Protection Agency, lists a large number of contaminants that are not allowed, or permitted at only very low concentrations in public water supplies. Among the compounds listed in the U.S. act that are not even included in the *Guidelines for Canadian Drinking Water Quality* are asbestos (which causes intestinal problems), beryllium (intestinal lesions), thalium (linked to kidney, liver and intestinal problems, among other ailments) and a number of pesticides. As well, the U.S. places more stringent limits on certain contaminants than does Canada. For example, Canada's limit on trichloroethylene is ten times higher than the U.S. standard. (For more information on the U.S., see accompanying story in Chapter IV, *The United States of Safe Water*.)

During the course of its survey, Sierra Legal identified several serious deficiencies in how the Canadian government, individual provinces, and territories approach the protection of public water supplies. To avoid future disease outbreaks, these deficiencies must be remedied.

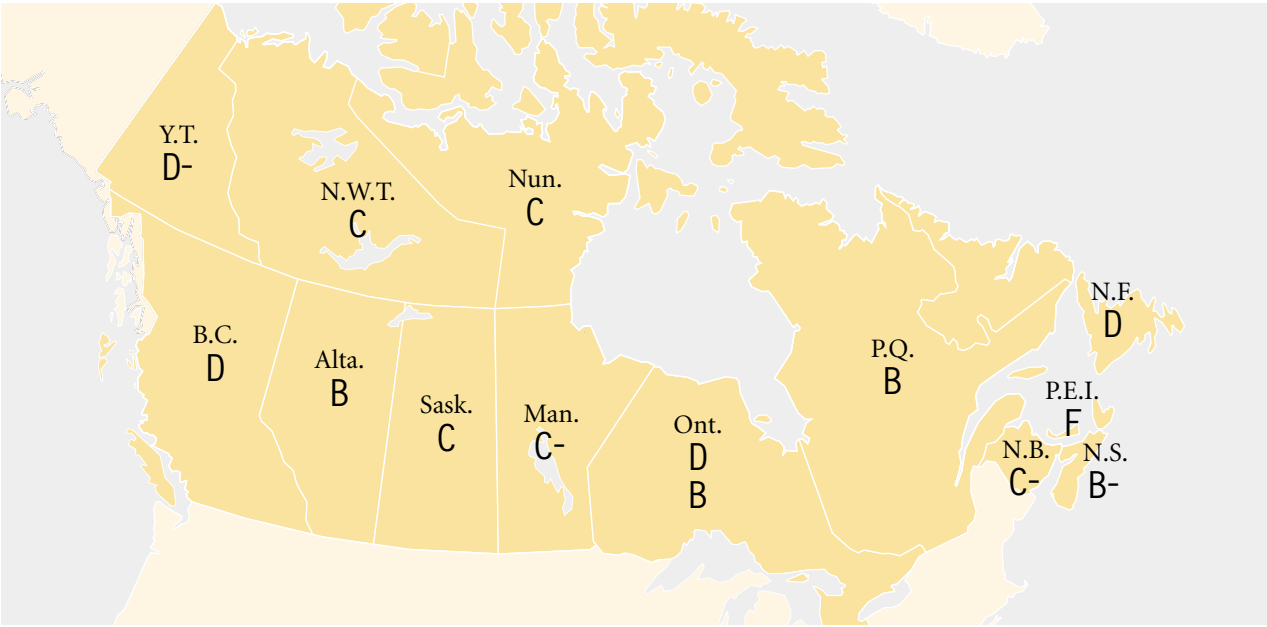
The survey results contained in this report point toward the need for some basic changes in the way we protect and treat drinking water in Canada. In Chapters IV and V we elaborate on these key recommendations:

Key Recommendations:

- **Make drinking water protection mandatory.**
- **Enact comprehensive watershed and wellfield protection.**
- **Make the *Guidelines for Canadian Drinking Water Quality* binding across Canada.**
- **Require training and certification for the operators of public water systems.**
- **Enact stringent reporting requirements and establish right-to-know provisions for water consumers.**
- **Give citizens the right to sue jurisdictions that fail to meet water standards, as is allowed in all U.S. states and territories.**
- **Increase federal funding for the construction and renewal of water treatment and delivery infrastructures, making the funding contingent on meeting water protection requirements.**

We believe that if these recommendations are adopted by all provincial and territorial governments, Canada will have moved a significant step forward in preventing waterborne disease outbreaks.

Later we explain in detail what we asked each jurisdiction and how we ranked them. But before presenting the results of our national survey, we turn briefly to a discussion of common threats to drinking water and what constitutes proper water treatment.



II Water Hazards:

Threats to Our Drinking Water

It didn't take public health officials long to realize that something was terribly wrong in Walkerton, a town of 5,000 people in southwestern Ontario. Disturbing numbers of people began arriving at hospitals and doctors offices in May 2000, complaining of bloody diarrhea and severe cramps. A potentially deadly strain of *E. coli* bacteria had contaminated the municipal drinking water supply and was soon identified as the cause of the disease outbreak.

There are many forms of bacteria that people require in order to live healthy lives. But the strain of *E. coli* that contaminated Walkerton's water made people violently ill, and in seven tragic cases it killed them. Young people and the elderly were at particularly high risk.

E. coli belongs to a much larger group of common bacteria called coliforms, many of which are perfectly harmless to humans. Within this group is a subset called faecal coliforms. Faecal coliforms commonly originate in the digestive tracts of warm-blooded animals, and if they find their way into drinking water can make people sick.

"While tap water that meets federal and state standards generally is safe to drink, threats to drinking water quality and quantity are increasing," the U.S. Environmental Protection Agency reported in 1997.

In *Water on Tap: A Consumers Guide to the Nation's Drinking Water*, the EPA went on to say:

"Microbiological and chemical contaminants can enter water supplies. These materials can be the result of human activity or can be found in nature. For instance, chemicals can migrate from disposal sites and contaminate sources of drinking water. Animal wastes and pesticides may be carried to lakes and streams by rainfall runoff or snow melt. Human wastes may be discharged to receiving waters that ultimately flow to water bodies used for drinking water. Coliform bacteria from human and animal wastes may be found in drinking water if the water is not properly treated or disinfected. These bacteria are used as indicators that other harmful organisms may be in the water."

As the EPA suggests, water providers have their work cut out for them when it comes to protecting water

There is a growing awareness in Canada and the United States that water supplies are at risk.

E. coli is just one of many contaminants that pose public health risks which can be transmitted through drinking water. While North American drinking water is generally among the safest in the world, there is a growing awareness in Canada and the United States that water supplies are at risk.

supplies. To assist in doing this, officials in Canada, the United States and Europe generally set limits for levels of three broad categories of contaminants — micro-organisms, chemicals, and radionuclides. From there, it is common for maximum levels that limit the amount of any one contaminant present in the water to be set.

Micro-organisms

Pathogenic or disease-causing micro-organisms that contaminate drinking water include protozoa (single-cell parasites) such as *cryptosporidium*, bacteria and intestinal viruses.

Each type of micro-organism may be present in surface water and groundwater, although protozoa are more commonly found in surface water supplies such as lakes, rivers and streams.

A common disease attributable to waterborne micro-organisms is gastrointestinal illness or diarrhea. In the developing world where access to safe water supplies is less common, gastrointestinal illness kills an estimated 11,000 children daily. But in developed countries like Canada, the incidence of waterborne disease outbreaks is low because governments have invested more in locating, treating and distributing safe drinking water.

Nevertheless, waterborne disease outbreaks have occurred numerous times in Canada and the United States. The worst modern-day waterborne disease outbreak in North America occurred in 1993, when as many as 100 people died and 400,000 fell ill after drinking water contaminated with the *cryptosporidium* parasite in Milwaukee, Wisconsin.

That same year, residents in the Kitchener-Waterloo area of Ontario were ordered to boil their water after local residents became ill and it was discovered that *cryptosporidium* was in their water. Cases of *cryptosporidium* contamination have occurred in other Canadian water supplies, including those of Collingwood, Ontario, and Cranbrook and Kelowna, British Columbia.

Another protozoa that triggers waterborne disease outbreaks is *giardia*. The illness resulting from water contaminated with *giardia* is commonly called 'beaver fever', because a strain of *giardia* is often present in beaver excrement.

Identifying micro-organisms in water is no easy task. *Cryptosporidium*, for example, is transported in water in microscopic cysts. Identifying these cysts in water samples takes a great deal of time. Once identified, it is very difficult to tell if the cysts contain living parasites that could actually cause a person to become sick.

In 1996, Health Canada published the sixth edition of it *Guidelines for Canadian Drinking Water*. The *Guidelines*, which are not legally enforceable, state that it is "not practical or technically feasible to monitor for all pathogens in drinking water."

Consequently, the microbiological guidelines Canada has developed are based on so-called 'indicator organisms' that, if present in water, may indicate contamination by harmful disease-causing bacteria, protozoa, or viruses.

Among the most commonly looked for indicator organisms are coliforms. Trace amounts of coliforms may be considered acceptable if they occur infrequently in tests, the *Guidelines* say. But if they show up more often, health officials become concerned. Of greater worry is the presence of faecal coliforms. When these turn up, it is considered strong evidence that a water supply may be contaminated.

"Total coliforms are not necessarily an indication of the presence of faecal contamination," the *Guidelines* state. "Faecal coliforms in drinking water may, however, indicate the presence of faecal contamination. The presence of *Escherichia coli*, one species in the faecal coliform group, is a definite indicator of the presence of faeces."

Most strains of *Escherichia coli* are relatively harmless. But the strain that contaminated Walkerton's water supply — *E. coli* O157:H7 has been associated with numerous disease outbreaks. It produces a powerful toxin in humans that causes severe bloody diarrhea and abdominal cramps. In the worst cases involving children under the age of five and the elderly, *E. coli* 0157:H7 can destroy red blood cells and cause kidney failure. It takes the ingestion of as few as 10 to 100 of these microscopic organisms — each about a tenth the size of a human red blood cell — to make people sick.

For these and other reasons, the *Guidelines* set stringent limits on the amount of coliforms allowed in drinking water supplies (no more than 10 total coliforms per 100 ml of water) and insist on zero tolerance of faecal coliforms. They close with a recommendation that, had it been followed promptly, may have prevented the Walkerton tragedy: "The confirmed presence of *E. coli* in drinking water should trigger an immediate boil water advisory."

The *Guidelines* do not set any maximum levels for viruses or protozoa. But they do say, "it is desirable" not to have any present in a drinking water supply. Given the health effects associated with protozoa such as giardia, this is a sound recommendation. The *Guidelines* also describe how water supplies can be protected to guard against their contamination by micro-organisms, a topic addressed in the next part of this report.

A final word on micro-organisms: Things like the deadly strain of *E. coli* that contaminated Walkerton's water, or the *cryptosporidium* parasite, are much more prevalent in the environment than we may like to think. Moreover, *giardia* and *cryptosporidium* are not effectively killed by chlorination, the conventional water treatment method. Carried by the billions in the faeces of cattle and other warm-blooded animals, these contaminants can easily be transported to surface water or groundwater after heavy rainstorms and rapid melting of snow.

Effective protection against them is less a matter of water treatment than prevention. In other words, the focus should be on keeping them out of the water supply in the first place. Because once they are in, they are not easily gotten rid of.

Soil, silt and organic matter

In 1997, a team of U.S. scientists from the Harvard Medical School and the U.S. Environmental Protection Agency published groundbreaking findings in the journal *Epidemiology*. Their study showed that humans have much more to worry about than just the unpleasant look and taste of water clouded with suspended particles of sediment.

Combing through five years of data supplied by Philadelphia's water department and Children's Hospital, the scientists found that when turbidity levels in drinking water rose there was a corresponding 13.1 percent increase in the hospitalization of children complaining of gastrointestinal illnesses.

A recent Health Canada study found a statistically significant relationship between cloudy drinking water in Greater Vancouver between 1992 and 1998 and 7,500 visits to physicians, 85 hospital admissions for adults, and 138 pediatric hospital emergency room visits for patients complaining of diarrhea and vomiting. Like other cities with surface water supplies, Greater Vancouver's water periodically turns cloudy or turbid. Often this follows heavy rains that wash soil and debris into streams that feed the city's reservoirs.

Lands surrounding surface water bodies are commonly referred to as watersheds. Watersheds may vary from a few hectares in size to tens of thousands of hectares. *Protecting Drinking-Water Sources*, a report released in 1999 by British Columbia's Auditor General, describes watersheds as: "The entire area drained by a waterway, or that drains into a lake or reservoir." Watersheds may also be called catchment basins or catchment areas.

During periods of high runoff, sediment may be washed into surface waters. Depending on the severity of runoff and the water-treatment equipment in place, drinking water may not be affected at all, or it may be rendered cloudy for days, weeks, or months.

Numerous studies demonstrate that when watersheds are developed for agricultural, forestry, mining or other land uses there is an increased chance of sediment entering surface water. That is partly because natural filters such as trees are no longer present in their pre-development abundance, leaving organic soils exposed to the forces of erosion. Consequently, water in the form of rain or snow makes direct contact with the ground where it carries away sediment to nearby receiving waters. (See accompanying story — *From Land (and Air) to Water*).

From Land (and Air) to Water

The following list of possible sources of water contamination is drawn from *Protecting Drinking-Water Sources*, a 1999 report by B.C.'s Auditor General.

Farms

- *Animal-raising operations (pigs, chickens, cattle) can be a major source of nutrient overload in water, particularly when large quantities of manure are mixed with water and sprayed on land and some of this material leaches into groundwater or runs off into streams.*
- *Cattle grazing on steep slopes can increase runoff and sedimentation of streams.*
- *Feedlots and factory farms can contaminate water with faecal matter that may carry bacteria such as E. coli or pathogens such as cryptosporidium.*
- *Runoff triggered by rain or melting snow on cleared farmlands may wash sediment into water.*
- *Pesticides and herbicides can leach into groundwater or wash into streams or storm sewers (urban lawns, golf courses, parks and gardens are also common sources).*

Gravel pits and mines

- *Gravel pits or other digging operations can disturb soils, causing sediment to wash into nearby water bodies, or expose groundwater and surface water to other contaminants such as acid-generating waste rock.*

Urban developments

- *Cleared land for urban developments may leave soil exposed for months at a time, leading to significant amounts of sediment washing into streams.*

Poorly constructed or uncapped wells

- *These are a common source of groundwater contamination.*

Pavement

- *Roads, parking lots, airports and other paved surfaces can accelerate runoff into nearby waters. The faster and heavier the runoff, the more debris, including sediment and pollutants, is carried into the water.*

Logging

- *Logging and associated road-building can increase erosion and turbidity and, in some cases, cause algal blooms. Forest fires, like prairie grass fires, can burn off ground cover, leading to increased erosion.*

Air pollutants

- *From cars to factories, pollutants pumped into the air can mix with rainwater or snow or be carried by wind into water bodies.*

Sewage treatment plants and factories

- *A variety of chemical and other contaminants found in sewage and industrial effluents can enter water bodies that also serve as drinking-water sources.*

Cloudy water poses three significant dangers.

First, pathogens such as *E. coli* are commonly found in cattle faeces. If cattle are in a watershed, rain can easily wash contaminated faecal matter into surface water. If the surface water is inadequately filtered, the pathogen may then pass into the water delivery system itself.

Second, pathogens are much harder to kill when they are 'masked' by turbidity.

Third, when cloudy water is treated with chlorine, further health risks may arise.

While chlorine's use as a water disinfectant is widely credited with dramatically reducing waterborne disease outbreaks in many parts of the world, health officials now know that it is not without its own risks. When chlorine comes into contact with organic sediment in water, it can bind to it and form carcinogenic byproducts known as trihalomethanes or THMs.

In 1999, Health Canada reported that THMs are linked to increased bladder and colon cancer in long-time drinkers of chlorinated water. Adverse pregnancy outcomes including miscarriages, birth defects and low birth weights are also associated with THMs.

Some surface water supplies may be chronically more cloudy than others, thanks to the topography of the lands adjoining the water supply or as a result of runoff from surrounding watershed lands. The cloudier a chlorinated water supply, the more likely it is to be contaminated with THMs. THM levels can also increase depending on the time of season, water temperature (which plays a role in where sediments settle in a water column), the amount of chlorine used, and the point at which chlorine is used in the water distribution system itself.

To control the presence of THMs in drinking water, Health Canada advises "removing the organic matter from the source water before disinfection so that it cannot react with chlorine or other disinfectants to form byproducts."

If unwanted organic particles are filtered out of water in advance of disinfection, then the water can be treated with small amounts of chlorine or some other product if there are concerns that the distribution system itself may become contaminated with unwanted bacteria, viruses or other pathogens. When this is done, chances are slim that the chlorine will bind with sediment, unless a pipe breaks in the distribution system itself.

But even the best water filters can be rendered ineffective when water supplies become too cloudy. If watershed lands are developed for agricultural, urban, logging, mining, or other human uses, they are more likely than undeveloped lands to cause sediment to flow into nearby water bodies following periods of precipitation. To guard against that happening, watershed lands should be carefully managed to ensure that potentially damaging land-uses do not occur.

When the *cryptosporidium* parasite made 400,000 Milwaukee residents sick in 1993, it did so in cloudy water where filtration and chlorine treatment was in place. Protecting watersheds places one more barrier — some would say the most critical barrier — in the path of potentially deadly bugs.

Chemicals and metals

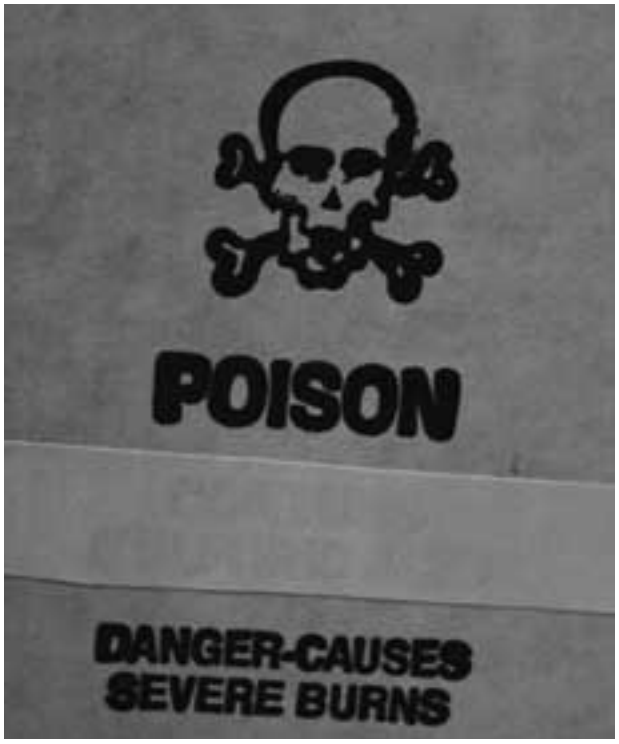
Thousands of herbicides, pesticides and chemicals are used daily in agricultural and industrial enterprises. Some are carcinogenic. Many more are not, but are associated with adverse health effects of varying severity.

When chemicals are mixed with water and applied as herbicides or pesticides, they can seep into the ground and contaminate groundwater supplies. They may also be carried off agricultural land into surface water supplies in periods of high runoff.

Aware of this danger, the *Guidelines for Canadian Drinking Water Quality* notes that Agriculture Canada has ranked pesticides based on their potential to contaminate groundwater supplies. One is the chemical atrazine which is used extensively on Canadian farms to control weeds in corn and rapeseed crops, as well as for control of unwanted plants in non-cropland or industrial settings.

Atrazine does not easily absorb into the soil, so it often leaches out into groundwater sources. For this reason, the *Guidelines* note that Agriculture Canada has ranked atrazine as the number one threat to groundwater out of a list of 83 potential pesticide contaminants. The *Guidelines* go on to note that several epidemiological studies have suggested that exposure to atrazine may increase risks of ovarian cancer and lymphomas. Though the evidence remains inconclusive, they recommend an interim maximum acceptable concentration (IMAC) of atrazine in drinking water of .005 mg per litre.

Another troublesome herbicide that can contaminate groundwater is bromoxynil, traces of which have been found in municipal and private water supplies in Canada. Used for controlling broad-leaved weeds in



grain crops, bromoxynil is listed in the *Guidelines* as having a "moderately high acute toxicity" that principally attacks the liver.

These are but two of nearly three dozen chemicals associated with various agricultural applications that the *Guidelines* say pose a risk to humans if found in high enough concentrations in drinking water. To deal with these and other harmful chemicals and metals, the *Guidelines* set IMACs or Maximum Acceptable Concentrations (MACs) and then recommend regular sampling and testing of water supplies to ensure that the chemicals are not present in high concentrations.

"If there is reason to suspect the presence of certain substances in a water supply, these substances should be sampled more frequently to ensure that their concentrations are below the acceptable limits. Also, where public water supplies are derived from frequently polluted raw water sources, the sampling frequency should be increased from once every six months to once every three months or as determined by the control agency," the *Guidelines* say.

The *Guidelines* also point out that for pesticides and herbicides, which are applied seasonally, water sampling and testing should take place at those times of the year when chemicals are most likely to make their way into groundwater or surface water supplies.

A wide array of chemicals used in various industrial applications may also contaminate drinking water, posing a risk to humans.

For example, the U.S. EPA characterizes cyanide, with its multiple applications in electroplating, steel, plastics, mining and fertilizers, as an extremely fast-acting and toxic poison that can damage the thyroid and central nervous system. Cyanide use has threatened some Canadian communities and yet has been kept out of the listed items in federal regulations aimed at curbing water pollution from mining operations.

Cyanide is often used in mining operations to separate gold from excavated rock. The *Guidelines* describe it as an "extremely toxic and fast-acting poison." Rules governing pollution from Canadian mines are covered in the federal Metal Mining Liquid Effluent Regulation. The MMLER does not include cyanide as a regulated substance, because when it was drafted it was not thought economically feasible to remove cyanide from mine waste. Recently proposed changes to the MMLER include cyanide as a listed substance. However, other potentially troublesome waterborne contaminants that environmental activists hoped to see covered in the revised regulation — such as mercury and cadmium — are not included.

Beckwith's Toxic Water Woes

Eastern Ontario residents struggling to rid their community drinking water of a lethal toxin say the Guidelines for Canadian Drinking Water Quality *are out of step with the times.*

The toxin in question is trichloroethylene or TCE. The Guidelines *set a non-enforceable objective to limit TCE to no more than .05 mg per litre of drinking water. But that*

level is ten times higher than that established by the U.S. Environmental Protection Agency.

In October 2000 the Beckwith Water Contamination Committee formally petitioned Canada's Auditor General to take strong action to control the release of TCE into the environment and to immediately amend the Guidelines to meet the U.S. standards.

TCE has gained recent prominence as a result of an award-winning non-fiction book, A Civil Action *(later a popular Hollywood movie), which chronicled the story of a small community in Massachusetts where contaminated drinking water was blamed for a cancer cluster and the deaths of 12 children.*

Commonly used in metal degreasing operations, TCE is listed by the U.S. Environmental Protection Agency as a 'probable' human carcinogen. It has been detected in the water supplied to 237 homes in Beckwith Township. Beckwith residents draw their water from private groundwater wells. A plume of TCE-contaminated water, estimated at nine kilometres long, runs through the aquifer feeding the wells. An abandoned landfill and scrap yard is the suspected source of contamination.

In addition to the threats posed by drinking contaminated water, Beckwith residents may be at even greater risk when they shower or bathe, because the skin readily absorbs TCE. Easily evaporated from contaminated water, TCE can also be breathed in. There is a strong association between TCE and cancer of the kidney and liver.

In 1993, Environment Canada and Health Canada assessed TCE as one of the 30 most toxic substances in Canada under the Canadian Environmental Protection Act. Seven years after that decision, however, the federal government had not taken any action to limit the release of TCE into the environment.

Since 1987, TCE has been listed in the Guidelines for Canadian Drinking Water Quality. *But the guidelines are not enforceable and only two Canadian provinces — Alberta, Nova Scotia and Quebec — have nearly or completely adopted the guidelines in their drinking water regulations. The U.S. sets much more stringent standards for TCE. It also sets limits for a number of other contaminants that are not even included in the Canadian list.*

(For more information on Beckwith, please contact Sierra Legal Defence Fund for a copy of a Petition under the Auditor General Act [R.S.C. c.A-17] filed on behalf of the Beckwith Water Contamination Committee and its individual members by Sierra Legal.)

Poison in the Pic

For people living in aboriginal communities in Canada's most populous province, the Walkerton inquiry's broader mandate came as welcome news.

For years, many of them have lived with inadequately treated or otherwise unsafe drinking water. But because their communities tended to be small and isolated, their water woes barely registered with the outside world.

A case in point is the community of Pic River, near the banks of the Pic and the shore of northern Lake Superior, a three-hour drive east of Thunder Bay, Ontario.

Five years ago the Pic River was poisoned following a cyanide spill at a mining operation upriver at the Hemlo gold field. The spill contaminated the community's drinking water system, which had been installed in the late 1970s at a cost of $1.3 million, and which drew water from the Black and Pic Rivers.

For three years following the spill, the Department of Indian and Northern Affairs trucked potable drinking water to the community at a total cost of $300,000. After extensive negotiations, DIAND spent an additional $2.8 million to provide a new water supply for the community. The water now comes from five deep wells near the lakeshore.

Pic River First Nation chief Roy Michano says the unexpected expenditure on a new water supply meant that Pic River's residents were forced to postpone other much-needed infrastructure improvements. "There have been delays in subdivision developments, sanitation, and sewage treatment. It [the spill] impacted negatively on our capacity," Michano says.

Across Canada, other aboriginal communities have suffered a spate of drinking-water-related setbacks. A 1995 report prepared by Health Canada's Medical Services Branch for DIAND notes that of 863 First Nations community water systems surveyed, 20 percent or 171 of them "have the potential to affect the health and safety of the community."

Similarly, of the 425 sewage treatment systems examined in aboriginal communities, nine percent or 39 of them experience problems that "could potentially affect the health and safety of the community."

The report goes on to note that the 171 communities with poor drinking water exceeded important health parameters laid out in the Guidelines for Canadian Drinking Water

Quality, *in some cases for multiple violations. Of the 171 communities, 78 were cited for failing total coliform guidelines. Another 52 were cited for failing faecal coliform guidelines, and 60 for failing turbidity guidelines. Guidelines limiting trihalomethanes, fluoride, nitrate, sodium, lead, and arsenic were also exceeded.*

Despite spending $500 million on First Nations water and infrastructure between 1991 and 1995, the report estimated that it would cost at least another $214 million for priority drinking water projects in First Nations communities. That cost didn't include improvements at some 76 communities where engineering studies had yet to be done.

When Walkerton's water crisis became the subject of daily newscasts, Phil Fontaine, former national chief of the Assembly of First Nations, was quick to note the irony. On the one hand, Canadians seemed shocked to learn that a public water system could be so unsafe. Yet they remained unaware of the ongoing conditions on many reserves.

"You have to remember that for the last seven years, Canada has been ranked the No. 1 country in the world to [live in] by the United Nations, but if you isolate the conditions of aboriginal peoples, we rank sixty-third," Fontaine said.

A wide array of other chemicals used in industrial applications, including monochlorobenzenes (used as solvents for adhesives), dichloroethanes (used in the preparation of vinyl chloride), chlorophenols (used in some pesticides and wood preservatives), are possibly carcinogenic and have the potential to be transported in drinking water.

In addition to harmful chemicals and byproducts, naturally occurring metals can also contaminate water supplies. Arsenic, for example, has many different industrial applications. But, as the *Guidelines* note, it is also "widely distributed in the earth's crust and is present in trace amounts in all living matter." A carcinogen, arsenic has been linked to the modern-day poisoning of millions of water users in Bangladesh, India, Chile and Taiwan after they unknowingly drilled into groundwater sources contaminated with naturally-occurring arsenic to avoid using water from polluted surface water sources.

Only through thorough and frequent monitoring of water supplies for arsenic and other potentially harmful metals and chemicals can the risk of potentially life-threatening illnesses be avoided.

Radionuclides

Radioactive substances known as radionuclides are another family of potential waterborne contaminants of concern to health officials. Exposure to radioactive material may come from natural sources, nuclear reactors, mining operations, or from nuclear weapons test explosions.

Once they enter the body (commonly through air, food, or water), radionuclides can remain there for extended periods of time, in the worst cases several months or years. Some radionuclides are carcinogenic, and some have much longer half-lives than others.

"The relationship between radiation exposure and the probability of causing a cancer depends on the type of radiation and the tissue or organ exposed," the *Guidelines* say.

The *Guidelines* go on to note that "different types of radiation have different effectiveness at causing biological damage, and different organs and tissues in the body have different sensitivities to radiation . . . . Radionuclides taken into the body by inhalation or ingestion may persist for extended periods of time."

In most cases, the *Guidelines* say, the levels of radionuclides normally encountered in drinking water are far below the threshold for acute effects of radiation.

Among the radionuclides of most concern to public health officials are:

- Cesium-137, which can concentrate in the food chain, has a radioactive half-life of more than 30 years, and is released during normal reactor operations and in the fallout from nuclear explosions.
- Iodine-131, which can be released during nuclear explosions, from reactors and fuel reprocessing facilities.
- Radium-226, which occurs naturally in soils, is commonly transmitted through foods, and can be found in groundwater when an aquifer comes into contact with radium-bearing materials such as rocks, soil and ore deposits.
- Tritium, which commonly exists in the environment in water, and is produced naturally in the upper atmosphere and artificially in nuclear detonations and during nuclear reactor operations. Tritium has been detected in drinking water samples in Port Elgin near the Bruce Nuclear Facility on Lake Huron.

III Four Safety Barriers:

Water Treatment and Delivery

Providing clean drinking water is more than just a matter of treating it with powerful chemical disinfectants such as chlorine. Increasingly, water providers, public health officials, and environmental agencies agree that water protection requires 'multiple barriers' against possible contamination.

In 1999, B.C.'s Auditor General George Morfitt issued a report entitled *Protecting Drinking Water Sources*. The document succinctly captured the central elements of a treatment chain that begins with the water source itself and carries through the distribution system to the water coming out of household and business taps. (See accompanying story, *Watershed Protection in Saint John*.)

Watershed Protection in Saint John

Saint John, New Brunswick, has the oldest and one of the best protected public water supplies in Canada. According to Peter Hanlon, manager of Saint John's water and sewerage services, the city has been purchasing lands since the mid-1800s in one of two major watersheds, which now supplies 65,000 residents and a host of industries. The other watershed, Spruce Lake, is all Crown land, meaning no purchase is necessary.

That purchase program means that the City of Saint John owns more than one third of the land in the Loch Lomond watershed, with further land being purchased as it becomes available.

"We're prepared to buy any land in the watershed," Hanlon says. "But we're concentrating on the water edge. The more that we can control access to the water and control the use of the land surrounding the water, the more we can control activities that impact on water."

Like other professionals involved in providing and managing public water supplies, Hanlon favors a 'multi-barrier' approach: looking after water from the source right through to the household tap.

To a certain degree, protecting water sources is also a priority of the Province. One regulation under New Brunswick's Clean Water Act—a unique regulation not found in other Canadian provinces—allows the Minister of Environment to designate as protected, lands within 75 metres of the banks of watercourses located within watersheds. Twenty-five New Brunswick municipalities have had their watershed lands so designated.

In the case of Saint John, Hanlon says the designation applies to the lakes themselves and all feeder rivers or creeks running into the larger water bodies.

The Province has also initiated a process that could result in further protection of watershed lands, asking interested cities to submit proposals — something Saint John has done.

Saint John's water and sewerage system services 65,000 of the 72,000 residents within the city's boundaries. Hanlon says the water treatment includes coarse screening, chlorination, and fluoridation. The water is also 're-chlorinated' at one point.

Protecting water sources from possible contamination is the first and most important aspect of a safe drinking water strategy.

The current water system delivers 38.5 million gallons of water per day to residents and industry, according to Hanlon.

To better provide safe drinking water to area households, the City is embarking on an ambitious program to separate industrial water from potable water. Once complete, the potable water will be further treated by installing coagulation, floculation, and sedimentation equipment. Sand filters will also be used prior to chlorine treatment. The estimated cost for the new work is $63 million. The projected completion date of 2011 will coincide with a new wastewater and sewage treatment plant estimated to cost $110 million.

Saint John is required to test its drinking water weekly—although in practice it averages twice weekly—for bacterial contaminants, including coliforms, faecal coliforms and heterotrophic plates. It also tests semi-annually for 19 inorganics, and quarterly for 18 organic contaminants. Beyond these tests required by the Province, it has added a number of other tests to its list. Testing is done to the standards set out in the Guidelines for Canadian Drinking Water Quality, *Hanlon says.*

Test results, compiled by a private lab, are sent simultaneously to the City and the local Department of Health.

Saint John last had a boil-water advisory in 1973. Of short duration, it applied only to a small section of the city where bacterial regrowth occurred in part of a water distribution line.

The B.C. Auditor General's report noted that multiple-barrier water treatment programs are the most likely to "cost-effectively maintain a high quality tap water." It went on to say that "There are four primary means for maintaining good drinking-water quality:

- The first line of defence is a protected water source.
- The second line of defence is water treatment, which always includes disinfection.
- The next line of defence is a well-designed and operated water distribution system with a continuous flow and pressurized pipes and the presence of residual disinfectant to counter bacterial regrowth.
- The final line of defence is comprehensive testing of drinking water."

As is abundantly clear in the wake of the Walkerton disaster, the town's defence system suffered a catastrophic collapse in mid-May 2000. Large amounts of the *E. coli* bacteria in the town's well water caused the disease outbreak, and remained present in the well water for months after the outbreak began.

The First Barrier: Protected Water Sources

Whether the water source is a well from which groundwater is drawn or a surface water body such as a lake, reservoir, river or stream, protecting water sources from possible contamination is the first and most important aspect of a safe drinking water strategy.

Once this concept is embraced, potentially destructive land-uses must be limited or eliminated in those areas where the chance of groundwater or surface water contamination is high. Agriculture, forestry, gravel and mining operations, sewage disposal, urban developments, roads, air pollution and forestry can all contribute to potentially harmful contaminants entering drinking water supplies.

Farming activities, in particular, have become a flashpoint in this regard. First, there is some evidence that the source of the *E. coli* contamination in Walkerton may have been a farming operation. Second, modern-day farming operations are often industrial in scale, producing massive volumes of

potentially contaminated animal waste. Third, farming operations enjoy lax regulations and legislated protection from anyone — citizen or government — interfering with their operations. So there is little control over activities that could put water sources at risk, including the disposal of animal waste as well as the use of pesticides and fertilizers. (See accompanying story—*Bigger Farms — Bigger Problems*.)

If effective management of land use occurs in watersheds, the chances of dirt and pathogens being transported in runoff to surface waters or percolating through subsurface soils to groundwater are greatly reduced.

Bigger Farms — Bigger Problems

Just how a deadly strain of E. coli *bacteria came to be in Walkerton's drinking water may never be known. But the speculation from the beginning was that an unusually heavy rain saturated a nearby livestock operation carrying contaminated runoff into the town's wells.*

This is no surprise. Pig and cattle operations are growing in size. Industrial amounts of manure are produced in some of these modern-day farms. Getting rid of it in a way that does not degrade the environment or endanger human health is often difficult.

Despite the ecological and public health risks associated with such operations, the agricultural industry continues to evolve toward bigger farms. "There's no question we've had a dramatic escalation of factory farming in this country," federal Environment Minister David Anderson said in 2000. "The factory farm is happening and with that, we'd better make sure we don't wake up to a problem later."

Any farming operation, large or small, can pose health and environmental risks. But the scale of factory farms means that when problems arise, they are that much greater and more difficult to contend with.

A major challenge related to cattle, poultry, and swine operations, is the disposal of manure. A single cow produces 22 times more waste than a person does. Pigs fattened for pork also generate large amounts of waste. A pig farm with 3,600 animals, for example, produces as much excrement as a city of 15,000 residents, three times bigger than Walkerton.

Containing and disposing of such large volumes of animal waste is a constant challenge, and one that is not well regulated.

In December 1998, the Washington, D.C.-based Natural Resources Defense Council released America's Animal Factories: How States Fail to Prevent Pollution from Livestock Waste. *The report documented a number of problems with factory farms, including:*

- *A North Carolina pig farm whose 'manure lagoon' burst in 1995, creating the worst hog-waste spill on record — killing as many as 10 million fish and closing 145,600 hectares of coastal wetlands to shell-fishing.*
- *Elevated levels of toxic hydrogen sulfide gas (up to 50 times higher than the state standard) near factory farms in Minnesota, resulting in area residents complaining of nausea, vomiting and other flu-like symptoms.*
- *Elevated nitrate levels in more than a third of wells located next to poultry and hog-farming operations in North Carolina.*

Canada has had its share of problems too. For example:

- *A study by the Upper Thames River Conservation Authority in London, Ont., found that on average 2 percent of liquid manure sprayed on lands adjacent to farms flowed directly into local streams, or 80 gallons of runoff for every acre sprayed.*
- *The owner of a giant pig farm near Napanee, Ont., was charged in March 1999 with 11 counts of violating the Fisheries Act, after federal investigators found that manure-laced effluent pumped off the farm into the Bay of Quinte's receiving waters killed fish.*
- *A 1991 study by the University of Guelph found that half the wells used for drinking water contained some bacterial contamination and a third were contaminated with* E. Coli *– contamination was greatest where farming operations spread manure.*

In Quebec roughly two-thirds of small pig farms have gone out of business since 1986, but the average number of pigs per farm has increased six-fold in the 20 years ending 1996.

Rising public concern about the health and environmental implications of huge concentrations of pigs has prompted a group of hog producers in Quebec to announce they will build an animal waste treatment plant, the first of its kind in Canada.

Often, waste from hog-farming and cattle-farming operations is mixed with water and stored in lagoons. Sometimes this mixture is sprayed on adjacent lands, or pumped off into nearby streams.

To dilute and then spray manure requires large volumes of water. For example, Hay Bay Genetics Inc., the Napanee factory farm charged under the Federal Fisheries Act, has two water-use permits from Ontario's Environment Ministry. The permits allow diversion of 2.16 million gallons of water per day out of adjacent Hay Bay and a further 1,440 gallons per day out of a nearby well.

If the ground becomes too saturated with liquefied manure, underground water sources can become contaminated. Similarly, if effluent from farms runs off into streams or is pumped into water bodies, chances are high that surface water bodies will become contaminated.

Ranging cattle are also a known threat to surface water sources and have been linked to serious waterborne disease outbreaks. In the summer of 1996, an estimated 10,000 to 15,000 residents in the B.C. communities of Kelowna and Cranbrook became sick when local drinking water supplies were contaminated with the cryptosporidium parasite. It is believed that the parasite came from ranging cattle.

In Cranbrook's case, health officials found evidence of ranging cattle defecating directly into surface water bodies feeding the city's reservoir. One or more residents in 2,000-plus Cranbrook households were estimated to have fallen ill, suffering diarrhea, nausea, cramps and weight loss. The suspected source of contamination was cows defecating into a stream supplying the city's reservoir.

Cows, particularly calves, are capable of 'shedding' billions of potentially infective cryptosporidium *cysts each day. It takes as few as 10 cysts to make a human sick. Similarly, the strain of* E. Coli *that caused at least seven deaths in Walkerton and more than 2,000 residents to become sick is commonly found in cows. Only tiny amounts of the bacteria are required to cause a person to become ill.*

At the same time that factory farms are growing in size, laws governing the agricultural industry have not changed to reflect the new reality. As a Globe and Mail *article on the subject noted a week after the Walkerton disaster became national news:*

"Ontario's so-called right-to-farm laws make it very hard for folks . . . to make a fuss. Those laws were passed to protect family farmers from city slickers or anyone else who complains about odour, dust and other noxious animal byproducts. The laws were not designed for the modern hog factory. Meantime, the province's Environment Ministry has been gutted. And federal environment cops can only intervene if farm runoff starts killing fish."

The Second Barrier: Water Treatment

The second line of defence, water treatment, is itself multi-layered and usually includes disinfection.

Perhaps the most important factor in treating water is to ensure that the water itself is free of sediment. Surface waters are much more likely than groundwater to experience periodic or chronic turbidity problems. The authors of the *Guidelines for Canadian Drinking Water* emphasize control of sediment and organic material in water as part of an integrated water-treatment program.

The *Guidelines* note that cloudy or turbid water "can serve as a source of nutrients for waterborne bacteria, viruses and protozoa, which can be embedded in or adhere to particles in the raw water." This can make it very difficult to determine what micro-organisms are actually in the water, because they are attached to, or obscured by, the particles. Cloudy water can also undermine the ability of disinfectants to neutralize pathogens in the water both before and after they enter distribution systems.

To deal with cloudy water, water providers frequently use filters of some kind. Filters can remove solid particles by forcing water to pass through various mediums including sand, anthracite or other fine mediums. If water is particularly cloudy, water providers use one or two other processes in advance of filtration to allow sediments to settle out of the water or to be bound together or coagulated so that they are easier to remove.

Given the effectiveness of many filters, it is possible to remove virtually all sediments and tiny waterborne pathogens such as *giardia* and *cryptosporidium*. If this occurs prior to the water entering the distribution system, it is possible to reduce or eliminate the use of chemical disinfectants and still provide healthy water.

However, most water providers and public health officials maintain that some kind of disinfectant should be used once and possibly twice in the treatment chain. Disinfectants such as chlorine will kill many micro-organisms. The potential for bacteria to re-grow in pipes carrying water to households is itself regarded by many water providers and health officials as a possible (if remote) source of disease outbreaks. Consequently, water officials advocate putting enough disinfectant into the water as it enters the pipes so that a tiny amount of it is present in the drinking water itself. They sometimes refer to this as "maintaining a residual."

As reported elsewhere, chlorinated water has its own health risks. The greatest risk involves chlorine binding with organic particles in the water to form carcinogenic trihalomethanes. By using filters, water providers can eliminate most if not all of the organic material and virtually eliminate THMs. And they can get rid of protozoa such as *cryptosporidium* that are highly resistant to chlorine.

Beyond filtration, several different options are open to water providers to further disinfect water. These include chlorine, chlorine dioxide, chloramine, ozone, ultraviolet light, and activated carbon and ozone. Various human health risks are associated with each of these disinfection options. Briefly, here is what each disinfectant does:

Chlorine

Since the first chlorinating plant opened in Belgium in 1902, chlorine has become one of the most commonly used water-disinfectants in the world. It took only 40 years, for example, for chlorine to become the predominant disinfectant of choice in the United States, where it was used by 85 percent of all of that country's water treatment plants by 1941.

Chlorine is very effective in preventing many waterborne diseases, and can kill most, but not all, waterborne micro-organisms. It is cheap, readily available in many parts of the world, and does not require the infrastructure that some other disinfectants do.

Chlorine dioxide

Along with ozone, chlorine dioxide is considered an effective agent in killing problematic 'encysted' parasites such as *cryptosporidium*. It has another advantage over chlorine in that it does not react with other elements in the water to form THMs.

Chlorine dioxide is several times more expensive than chlorine and it cannot be transported; therefore it must be manufactured on site. It is also associated with certain adverse health effects.

Chloramine

In the early 1980s water providers began using this disinfectant, a mixture of chlorine and ammonia, with increasing frequency because of concerns over unwanted by-products associated with chlorine in the

water. It is a powerful disinfectant that, like chlorine, kills most micro-organisms.

But chloramine is highly toxic to fish and has been associated with documented fish-kills following leaks or spills. It also has associated health risks for people.

Ozone

Compared to chlorine, ozone requires a much shorter contact time with drinking water. This reduces the need for pipe infrastructure and land acquisition at the primary water-treatment site. It is effective in killing bacteria, viruses and protozoa such as *giardia*, *cryptosporidium* and *toxoplasmosis*.

Ozone's drawback is that it oxidizes quickly after use. Consequently, it has little residual disinfecting power. Often water providers introduce another chemical to water following ozone use, generally chlorine. The chlorine is usually introduced as or after the water has entered the distribution system. Ozone can be used in conjunction with activated carbon to treat drinking water, but it also has health risks.

Ultraviolet light

Ultraviolet light can destroy some bacteria, viruses and fungi. Lamps containing mercury vapour are used to generate electromagnetic radiation, which acts as the disinfectant. UV light is commonly used as a disinfectant by the beverage industry and is also used in, among other facilities, fish hatcheries to avoid the use of fish-killing chemicals such as chlorine.

It does not kill *giardia* or *cryptosporidium*, and is ineffective if there is sediment in the water that can shield contaminants from the light rays. Like ozone, it has little or no residual disinfecting power.

The Third Barrier: A Clean Distribution System

On October 12, 1999, the Federation of Canadian Municipalities (FCM) submitted a report to federal finance minister Paul Martin. The federation noted the pressing demands on municipal governments to invest in various infrastructure programs, including water treatment, water distribution, and sewage treatment.

The FCM estimated that an investment of approximately $13 billion annually over a 10-year period, or $130 billion in total, is "required to address the deficit in Canada's environmental, social and transportation infrastructure."

A significant component of the money needed is for water-related infrastructure costs. "There is an investment shortfall of $16.5 billion in water facilities (mains, [distribution], storage tanks and treatment plants) and $36.8 billion in wastewater facilities (sewers, combined sewer and separations and treatment plants)," the federation informed Martin.

From the perspective of municipal governments, demands for infrastructure spending are on the rise. Only through concerted efforts by the federal, provincial and municipal governments can those demands be met.

Clearly, when it comes to designing, building and operating effective water-distribution systems, money must be spent to upgrade existing water treatment systems or to replace them altogether. Further money must also be spent to replace existing pipes that can break and potentially cause harmful bacteria to enter water lines.

Unpopular as it is, this may require increases in federal and provincial spending and municipal tax hikes, depending on the urgency and scale of infrastructure program requirements.

The 2000-2001 federal budget creates a new infrastructure fund that commits $2.65 billion over the next six years to various infrastructure programs. The funding is contingent upon matching funds by municipal governments and relevant provincial governments. Up to $600 million, or 22 percent of the total infrastructure fund, will be made available to highway improvements, leaving slightly more than $2 billion for other infrastructure programs.

If previous cost-shared programs are an indication, demand will exceed supply and all levels of government will spend $2.65 billion, meaning a total expenditure of nearly $8 billion over the next six years. Impressive as it sounds, this is less than 62 percent of what the federation says is needed *each year* for the next 10 years.

At a time when the federal government and some provincial governments are spending more of their growing surpluses on tax cuts rather than meeting social needs, it is not surprising that the private sector is now offering to step in and help cash-strapped municipalities by investing in public infrastructure for profit. Often this takes the form of offering to design, build, and finance infrastructure in return for long-term public-private partnerships of up to 30 years.

Another related development that threatens to expose public water and wastewater services to privatization is the downloading of service delivery and responsibilities from upper tiers of government to the municipal level. In recent years the federal government has reduced transfers and grants to the provinces. The provinces, in an uneven fashion, have responded by downloading services and responsibilities to municipalities.

As municipalities are forced to deliver more services and rely further on revenue from property taxes, many find it difficult to deal with infrastructure needs. For instance, the Ontario government reduced funding and downloaded many services to municipalities in 1996/1997, including water and wastewater services for small municipalities that had relied on the Ministry of the Environment and the Ontario Clean Water Agency. Such downloading made municipal water and wastewater services more vulnerable to privatization.

In British Columbia, the Greater Vancouver area offers a case in point of the huge costs that confront municipal and regional governments as they seek to upgrade water treatment and delivery systems.

This year, new ozone-treatment and corrosion-control equipment began operating at one of the region's three large reservoirs. The cost of installing the new equipment was $40 million. Similar equipment is to be installed at a second reservoir at an estimated $90 million, with the job going out to tender later this year. Beyond that, a fine water filter that will use anthracite to screen out potentially harmful organic compounds, sediment, and protozoa among other things, is to be built at a third reservoir at a projected cost of $135 million. Once that equipment is installed, an estimated $5-million to $6-million will be spent every year to operate the new filtration plant.

Periodic declines in water quality due to runoff from surrounding mountains (which many people attribute to past logging and road-building activities) may necessitate construction of filter plants at two other reservoirs. Beyond these costs, the regional government has recently installed or upgraded eight 're-chlorination' plants. Located at various points in the water-distribution system, the plants add additional chlorine as insurance against breaks in the water lines that might re-introduce potentially harmful bacteria to the drinking water.

The Final Barrier: Comprehensive Testing

No matter how safe a water system may seem, there are always chances for it to become contaminated. Only through frequent and rigorous testing can early detection of waterborne contaminants be made and potentially disastrous disease outbreaks averted.

In the U.S. and Europe water providers must test for virtually every contaminant for which a health standard is set. That is not the case across Canada. The frequency with which U.S. water providers test for contaminants is set out in law. The frequency changes based on population and the specific contaminants tested for. (Testing for micro-organisms is required more often than is the case for certain chemicals, for example.)

In Canada the approach to testing is provincially or territorially based. Consequently, we have a patchwork of vastly different testing requirements. In the aftermath of the Walkerton tragedy, Ontario instituted the most stringent and comprehensive testing requirements of any Canadian province or territory. But they are still behind testing requirements in the U.S., and have no mandatory testing requirements for radiological contaminants.

Alberta represents a sort of muddy middle. Generally it requires fairly stringent testing requirements, but the requirements are set out on a municipality-by-municipality basis, and the required frequency of testing is low compared to the U.S. and other jurisdictions.

And there are many jurisdictions — Prince Edward Island, Newfoundland and Manitoba to name three — that require little or no testing.

In the coming months, we can expect to hear a lot about what went wrong in Walkerton in terms of water-testing and reporting requirements. During a public inquiry into the disaster, much is likely to be made about who knew what when. Moreover, once people in the local Public Utilities Commission, private water-testing laboratories, and Ontario's Ministry of Environment knew of *E. Coli's* presence in Walkerton's water supply, what were their responsibilities to inform the public?

In the next chapter we examine how the various Canadian provinces fare when it comes to protecting water sources as well as what their testing and reporting regimes are. We also examine the *Guidelines* (which are not legally binding but have been adopted by the provinces of Alberta, Nova Scotia and Quebec) and compare them to those in the United States and the European Economic Community.

IV Waterproof:

A Comparison of Drinking Water Regulations

Canadians view their country as blessed with an abundance of clean water. But in many places, Canadians cannot safely drink the water that comes directly from their lakes, streams and wells. Urban, industrial, and agricultural developments are just a few of the reasons why many water supplies once considered safe are no longer.

Providing good tap water is a challenging task. It requires identifying and protecting appropriate water sources, treating and testing water, and safely distributing that water to homes. Any change to the proper functioning of the system that poses health risks must be promptly reported and publicized. As well, provincial regulators must have adequate powers to prevent and correct problems when they occur.

This report identifies a number of standards and protections for drinking water, as well as evaluating provincial and territorial performance in meeting those standards. Specifically, it looks at protecting drinking water sources, water testing and treatment, construction and operation of water-delivery systems, reporting water testing results, and the ability (legally speaking) of provincial regulators to ensure that water providers do a good job.

In most provinces and territories, the level of drinking water protection offered is at the discretion of a government official. Making public safety protections discretionary allows for potential human error, something that became apparent during the Walkerton tragedy. Prior to the Walkerton case, Ontario's protections and standards, including contaminant standards and water testing, were either discretionary or enacted in the form of non-binding guidelines. To its credit, Ontario responded to the Walkerton tragedy by revising and strengthening its regulations.

It seems indisputable that the best regulatory approach to safe drinking water is to make drinking water protections and standards binding and enforceable. If it is thought that certain protections may not be needed in all cases, the best approach is to enact a binding standard, with exemptions available under certain conditions.

Fortunately, discretionary or inadequate provincial regulation does not always translate into poor water quality. During our research, we were impressed with the number of municipalities that provide drinking water protection and treatment far in excess of what is required by the respective provincial governments. For example, although British Columbia receives a D in this report, Vancouver and Victoria, if ranked separately, would receive higher grades because of the mechanisms they have in place to protect water supplies. Strong drinking water regulations may not dramatically improve water quality in those municipalities already doing a good job, but they may prevent tragedies elsewhere.

> Providing good tap water requires identifying and protecting appropriate water sources, treating and testing water, and safely distributing that water.

1. Protection of Drinking Water Sources

Water providers are in a much better position to control the quality of drinking water if they already have or select a water supply that is generally free of chemical, microbiological and radiological contaminants. Once such a source is found it should be protected at all costs, because that lessens the chance of waterborne disease outbreaks. Secondly, protection of such a source decreases the need for unnecessary and costly water treatment.

Unfortunately, this logical, up-front approach to providing safe drinking water is not always followed. Sometimes, Canadian regulators approve waterworks or allow the taps to be turned on without a complete picture of the water quality at its source. Our research has found that no provincial or territorial legislation requires that all parameters in the *Guidelines for Canadian Drinking Water Quality* be analyzed as part of the permitting or approval process. Some jurisdictions require testing of a smaller number of contaminants (N.W.T. and Nunavut require testing of 25 contaminants, which is the highest mandatory pre-approval testing requirement we found), while most jurisdictions require water quality analysis on a case-by-case basis. Imposing public health requirements or determining criteria for approving drinking water sources on a case-by-case basis is problematic. For this type of system to function properly, provincial agencies must be adequately staffed and agency officials must be properly trained. Agency staff must also have intimate knowledge of natural formations around water supplies and a good understanding of past and present land use activities that could affect water quality. Comprehensive testing at the approval stage would eliminate the risks posed by inadequate information or oversight.

Equally important to selecting a high quality water source is preventing future contamination of that source. Obviously, one mechanism that may be available in many jurisdictions is for municipalities to purchase watershed lands or areas surrounding wells. In some cases such as Saint John, New Brunswick, an ongoing program is in place to do just that.

But what other legal means may be open to protect water supplies? The Northwest Territories and Nunavut have potentially the most significant regulation in Canada for the protection of surface water. Their Chief Medical Health Officer is empowered to stop any activity or proposed activity that "may adversely affect the quality of the raw water." Only Manitoba, New Brunswick, Newfoundland and Nova Scotia have enacted legislation allowing for the creation of protected watersheds or wellfields. A legally recognized watershed or wellfield designation can ensure that potentially harmful land use activities are controlled in situations where the municipality does not own the land. Newfoundland, according to our count, has identified 265 such areas that can harm drinking water. Other jurisdictions, such as Quebec, place limits on the activities that may be conducted within a certain distance from a well.

Furthermore, no provincial or territorial government has a stand-alone, designated agency responsible for protecting all aspects of drinking water. Recently, British Columbia's Auditor General identified the lack of such an agency as a serious impediment to the protection of drinking water supplies.

Recommendations:

- **Testing for all parameters in the Guidelines for Canadian Drinking Water Quality should be part of the approval process.**
- **All jurisdictions should have mandatory protection for watersheds and wellfields that supply drinking water. This protection should include a mandatory designation of the land areas that influence water quality as well as an assessment of all existing and potential risks to drinking water quality. Further, watershed or wellfield representatives should have authority to fully participate in government decisions about land-use activities that may affect the watershed.**

2. Water Quality Testing

Health Canada has identified more than 80 harmful substances that are commonly found in drinking water. By no means comprehensive, this list includes items such as micro-organisms and bacteria, pesticides, heavy metals, petroleum by-products and radioactive materials. Gastrointestinal illnesses are commonly associated with waterborne microbiological contaminants such as *giardia*, and usually surface within a few days of a person drinking unsafe water. Other serious illnesses are associated with the long-term ingestion of waterborne chemicals and other contaminants. These illnesses include some types of cancer, liver and kidney disorders, birth defects, and others. Many of the illnesses triggered

by long-term exposure to unsafe drinking water involve contaminants that are colourless, odourless and tasteless.

Frequent and stringent testing is the only way to determine whether these agents are present in water, making it unsafe to drink. Yet sampling for chemical contaminants is only required for all public water systems in four of the provinces.

Drinking water protections may be created through laws (enacted by the provincial legislature), regulations (generally created by an agency or the provincial cabinet and approved by the provincial cabinet), permit or approval requirements, and guidelines (sometimes called objectives or protocols, which are created by an agency). There are important distinctions between laws, regulations, permit standards and guidelines. Laws, regulations and permit standards may create legally binding and enforceable standards and requirements, meaning that if your water provider is not meeting the relevant standards, enforcement action can be taken. Guidelines, on the other hand, are not generally binding. If your province or territory has established guidelines only, your water provider does not have to meet those guidelines.

Table I below sets out the most relevant laws, regulations or guidelines, and the binding water testing requirements for each province or territory. As with many of the categories we survey, an individual municipality's standards may be higher or lower than the province or territory-wide standard because of permit or approval conditions. Also, the testing standards listed below may not apply to systems falling below a certain size threshold.

Ten of the provinces and territories we surveyed have mandatory sampling requirements related to microbiological contaminants. They are B.C., Manitoba, the Northwest Territories, Nova Scotia, Nunavut, Ontario (post-Walkerton), Quebec, Saskatchewan and the Yukon. Two provinces, Alberta and New Brunswick, have no mandatory sampling, but may impose sampling requirements on a discretionary basis. Five provinces or territories (the Northwest Territories, Nova Scotia, Nunavut, Ontario-post-Walkerton, Quebec and Yukon.) require some form of testing for physical and chemical contaminants, while the Yukon requires testing for chemical contaminants. Two other provinces, Newfoundland and PEI, do not impose sampling requirements on either a mandatory or discretionary basis. On the basis of mandatory sampling requirements (for both contaminants and frequency of testing) Ontario has the strongest regulation, followed by Quebec.

Table I: Testing Requirements

Jurisdiction	Standards and Testing Requirements
Alberta: Environmental Protection and Enhancement Act; Potable Water Regulation. (Sources cited in endnotes)	Water quality must meet the microbiological, chemical and radiological characteristics in the Canadian Guidelines. The director of Alberta Environment determines the parameters that must be analyzed for each municipality. Surface waters are monitored twice per year and groundwater monitored once per year.
British Columbia: Health Act; Safe Drinking Water Regulation.	Water quality must meet a coliform standard. Other standards may be imposed on a case-by-case basis. The frequency of sampling is discretionary.
Manitoba: Health Act; Water Supplies Regulation; Water Works Regulation; Protection of Drinking Water Supplies Regulation.	Testing for chlorine residuals and microbiological sampling is required and the frequency is mandated; all other testing is discretionary.
Newfoundland: Environment Act; Health Act; Sanitation Regulation.	No testing required. The provincial government may undertake some testing.
New Brunswick: Clean Water Act; Health Act; Potable Water Regulation; Water Quality Regulation; Water Well Regulation.	Water quality standards and sampling frequency is discretionary. Public water suppliers must have an approved sampling plan.
NW Territories: Health Act; Public Water Supplies Regulation.	Operators are required to ensure tests are performed monthly for coliforms and annually for 25 chemical and physical parameters.

Table I: Testing Requirements (cont)

Jurisdiction	Standards and Testing Requirements
Nova Scotia: Environment Act; Water and Wastewater Facility Regulations; Guidelines for Monitoring Public Drinking Water Supplies.	Disinfection residual testing, turbidity sampling and fluoride level sampling (if used) is required daily. Microbiological sampling must meet Canadian Guidelines (population based). Thirty chemical and physical parameters must be sampled, once a year for surface water, and once every two years for groundwater. Water providers have an obligation to provide water which meets the microbiological, chemical and physical contaminant standards of the Guidelines for Canadian Drinking Water Quality.
Nunavut: uses N.W.T. regulation: Health Act; Public Water Supplies Regulation.	Operators are required to ensure tests are performed monthly for coliforms and annually for 25 chemical and physical parameters.
Ontario (pre-Walkerton): Ontario Water Resources Act; Water Works Regulation; Ont. Drinking Water Standards; Ont. Water Quality Objectives	Testing is discretionary. Non-binding objectives have been developed by the government, but these standards are only applicable if required by an individual permit.
Ontario (post-Walkerton, effective 2002): Ontario Water Resources Act; Water Works Regulation; Drinking Water Protection Regulation; Ont. Drinking Water Standards; Ont. Water Quality Objectives.	Ontario's new Drinking Water Protection Regulation, which will become effective in January of 2002, sets out new testing requirements. Binding testing requirements will be in effect (except in the case of small systems, for example, serving less than five residences) for microbiological characteristics, chlorine residuals, volatile organic compounds, inorganic chemicals, nitrates, and pesticides. Radiological contaminant testing is not mandatory, but may be required on a case-by-case basis. The frequency of testing varies by type of contaminant and the population served by the water system, but the frequency of testing is rigorous compared to other Canadian jurisdictions.
PEI: Environmental Protection Act; Health Act.	Sampling not required.
Quebec: Reglement sur l'eau potable.	There is mandatory testing for 46 contaminant standards. The frequency of testing varies by type of contaminant and the population served by the water systems. Water providers are legally obligated to provide water that meets Quebec's contaminant standards. (Proposed legislation will raise the number of contaminant standards to 77 and implement mandatory controls for turbidity, trihalomethanes and E.coli.)
Saskatchewan: Environmental Management and Protection Act; Water Pollution Control and Waterworks Regulations.	Bacteriological testing after water system construction or alteration required. Daily chlorine residual testing required. All other testing is discretionary. Saskatchewan has created Municipal Drinking Water Quality Objectives, but these are not binding unless an approval or operating permit specifies.
Yukon: Public Health and Safety Act; Yukon Waters Act.	Coliform testing required and frequency is based upon population. Chlorine residual testing is required. Some monitoring of physical characteristics is required. Chemical and radiological testing is discretionary.
United States:	Testing for over 80 parameters (microbiological, chemical and radiological) is required. The frequency for testing is population based.
European Union, starting 2003:	Testing for over 45 parameters (microbiological, chemical and radiological) is required. The frequency for testing is population based

Recommendations:

- **Provinces and territories should require testing, at appropriate frequencies, for all contaminants listed in the *Guidelines for Canadian Drinking Water Quality.***
- **Exemptions from testing for certain contaminants should be granted only where there is a history of clean tests and there are no ongoing human activities which could affect drinking water quality.**

Regulation of testing laboratories

Certification or accreditation of water sampling labs ensures that the labs selected to analyze critical health threats have trained staff, proper equipment and the appropriate procedures that will produce accurate results. Accreditation of labs may be accomplished through government or private sector programs.

According to our survey, five jurisdictions require the use of accredited labs: British Columbia, New Brunswick, Ontario (effective early 2001), Quebec and the Yukon. Six other jurisdictions attempt to ensure accuracy by testing drinking water at provincial labs or at labs suitable to the relevant agency. These jurisdictions include: Alberta, Manitoba, Newfoundland, Nova Scotia, Nunavut and Saskatchewan. The Northwest Territories does not require certified labs or select water testing labs.

Alberta: Microbiological samples must be tested at the provincial lab (water providers are not charged for these tests). Other types of testing must be performed at a lab approved by the Director (as named under the *Potable Water Regulation*) or by an approved analytical method. There is currently no lab accreditation program.

British Columbia: Testing must be performed at accredited labs.

Manitoba: The provincial government selects (by contract) the labs where testing is performed. There is no requirement that the labs themselves be accredited.

Newfoundland: The use of accredited labs is not required, but testing performed by the province is done at the provincial lab or another accredited lab. (Generally, however, Newfoundland does not require testing, although it undertakes some testing itself.)

New Brunswick: Testing must be performed at accredited labs.

Ontario: Currently, the use of accredited labs is not required. Effective Feb. 28, 2001, testing must be performed at an accredited lab.

Northwest Territories: The use of accredited labs is not required.

Nova Scotia: Labs need not be accredited, but water suppliers must conduct testing at labs acceptable to the Department of Environment. The province's lab accreditation policy is being drafted.

Nunavut: Testing must be performed at labs run by the territory.

PEI: The use of accredited labs is not required.

Quebec: The use of accredited labs is required.

Saskatchewan: The use of accredited labs is not required; however, testing is generally done at the provincial lab or a lab acceptable to the province.

Yukon: Testing must be performed at an accredited lab.

Recommendation:

- **Provinces should require that all water testing is performed at accredited labs, or when testing is performed by the water supplier, by accredited personnel.**

3. Water Treatment

Effective water treatment ensures that any contaminated water is purified and made potable. From a general regulatory standpoint, water treatment can be approached in two ways. First, water providers may be required to treat water with specific methods. For example, introducing chlorine and maintaining a chlorine residual throughout the water distribution system is required in some jurisdictions. Second, regulations may establish certain standards (for example, no faecal coliforms), but leave the choice of how to meet them up to the water provider. (See Table I, Testing Requirements.)

Table II below sets out the province or territory-wide water treatment requirements found in Canada. All provinces and territories except Newfoundland, New Brunswick and Prince Edward Island require disinfection of water supplies. Only two provinces, Alberta and Ontario (effective 2002), require filtration. (The benefits of filtration are discussed in Chapter III.)

Table II: Treatment Requirements

Jurisdiction	Water Treatment Requirements
Alberta	Disinfection is required for both groundwater and surface water. Chemically-assisted filtration or slow-sand filtration is required for surface water. The province regulates treatment techniques.
British Columbia	Disinfection (chlorination or other approved disinfection) is required.
Manitoba	Chlorination is required.
Newfoundland	There is no mandatory treatment requirement.
New Brunswick	There are no mandatory requirements for treatment, although treatment may be required through the approval process for individual municipal water systems.
NW Territories	Chlorination is required.
Nova Scotia	Chlorination is required.
Nunavut	Chlorination is required.
Ontario (pre- Walkerton)	No treatment required.
Ontario (post- Walkerton)	Groundwater must be chlorinated. Surface water must be chlorinated and subjected to chemically assisted filtration.
P.E.I.	No treatment required.
Quebec	There are no specific treatment requirements, but water quality must meet specified parameters (there are currently 46 parameters and there is a proposal to increase that number to 77).
Saskatchewan	Chlorination is required.
Yukon	No treatment required.

Recommendations:

- **Disinfection should be required for all water supplies, and provinces and territories should explore using disinfection methods other than chlorine where applicable.**
- **Filtration should be required for surface water supplies and groundwater supplies subject to the influence of surface waters.**

4. Construction and Operation of Water Delivery Systems

Regulatory control over construction and operation of water supply systems

It may seem obvious to state that the purpose of water treatment and supply facilities is to ensure the delivery of safe, clean water. What is less obvious is that the facilities themselves can be health hazards. An example of this occurs when municipalities try to economize on infrastructure costs by placing sewer pipes and drinking water pipes in the same trench. Under the right circumstances a broken sewer line can contaminate a drinking water line. Additionally, a poorly designed, constructed or maintained plant may not actually protect drinking water.

The potential for harm from drinking water treatment materials is serious enough that the federal government has proposed the Drinking Water Materials Safety Act which would prescribe national, health-based standards for drinking water materials, (which include water system components, water treatment devices and chemical additives). The Act would require third-party certification of all drinking water materials before they are imported to or sold in Canada. Unfortunately, guaranteeing the safety of drinking water materials does not seem to be a priority for the federal government, and the proposed Drinking Water Materials Safety Act has languished since it was introduced in 1997.

According to the Alberta Law Centre, the U.S. Environmental Protection Agency previously provided to the provinces information on what kinds of additives and materials may be used to achieve safe drinking water standards. However, the EPA's advice program ended in 1998. Only a few of the provinces and territories now regulate or approve drinking water materials.

Table III below lists the requirements that provinces and territories have enacted for water treatment system design, construction and materials standards.

Table III: Regulation of Water System Design and Construction

Jurisdiction	Design, Construction and Materials Standards
Alberta	Alberta requires an approval as a prerequisite to operating a drinking water system. Pursuant to the Potable Water Regulation, all water treatment systems must be designed, constructed and operated in accordance with standards issued by Alberta. Additionally, either the Environment Ministry or the independent, U.S.-based, National Sanitation Foundation must approve all chemicals used for water treatment.
British Columbia	B.C. requires both a construction permit and an operating permit. Provincial regulators review construction plans prior to issuing a construction permit. However, there are no binding standards related to design, construction, materials, or treatment methods or additives.
Manitoba	The Minister of Health must approve plans and specifications before a public water system can be constructed, operated or altered. However, there are no binding standards related to design, construction, materials, or treatment methods or additives.
Newfoundland	The Minister of Environment must approve plans and specifications before a public water system can be constructed, operated or altered. However, there are no binding standards related to design, construction, materials, or treatment methods or additives.
New Brunswick	New Brunswick regulates water system design and construction. There are construction and materials standards for wells, but not for water treatment systems.
NW Territories	Approval to construct a drinking water treatment system is required and there are binding requirements with respect to construction standards and materials.
Nova Scotia	Public water systems must be classified (based on population served) and registered with the province. There are no binding standards regarding design, construction, or materials used.
Nunavut	Approval is required. There are binding requirements with respect to construction standards and materials.
Ontario (pre- Walkerton)	The establishment, alteration, extension or repair of water works requires an approval issued by the Environment Ministry. Plans and specifications for water works may be reviewed during the approval process. There are no binding standards for design, construction or materials.
Ontario (post- Walkerton)	The establishment, alteration, extension or repair of waterworks requires an approval issued by the Environment Ministry. Plans and specifications for water works may be reviewed during the approval process. There are no binding standards for design, construction or materials.
P.E.I.	Approvals are not required and there are no binding standards for design, construction or materials.
Quebec	The construction or operation of public waterworks requires approval and there are binding standards regarding design, construction and materials.
Saskatchewan	The construction or operation of public waterworks requires approval and there are binding standards regarding design, construction and materials.
Yukon	Approvals are not required and there are no binding standards for design, construction or materials.

Recommendations:

- **Provinces and territories should enact binding standards for the design, construction and operation of drinking water treatment facilities and distribution systems.**
- **The federal government should enact binding standards or approval processes for materials used in drinking water treatment and distribution.**
- **The federal government should evaluate and approve drinking water testing and treatment methods.**

Certification of operators

The best designed water treatment and delivery facility is of little benefit if the people running the system are not properly trained and certified. Operator training and certification is considered such an important issue in the United States that individual states must establish mandatory training and certification programs in order to be eligible for certain infrastructure grants.

In Canada, only Alberta, Nova Scotia and Ontario require the use of certified operators. However, Ontario exempted some operators from training and certification requirements because they were already employed. In Quebec an operator certification program is proposed, while Saskatchewan's recent regulatory changes will require that all municipal water facilities come under the direction of a certified operator within five years.

Recommendation:

- **Provinces and territories should require that drinking water treatment and distribution facilities are operated by adequately trained and certified personnel.**

5. Reporting Requirements

As became evident after the Walkerton tragedy, prompt reporting of water testing results can go a long way toward avoiding waterborne disease outbreaks. Yet in most provinces and territories, there is no requirement for the public to be promptly notified when water contamination occurs. Some provinces require that certain government officials are notified in the event of poor test results. But not all provinces and territories require government officials to automatically notify the public and public notification (including boil-water alerts) is only issued if the relevant agency feels it is necessary.

Such discretion is not allowed in the United States or European Union, where direct notification of the public is required. Some provinces have also adopted mandatory public notification of health threats. Ontario's new *Drinking Water Protection Regulation* requires warning notices to be posted if the sampling, analysis or corrective actions related to microbiological contamination have not occurred. Nova Scotia has developed guidelines which state when boil-water alerts are required, a communication plan, suggested wording for the alert and follow-up activities. However, these guidelines are not legally binding.

The requirement that only government officials be notified, without notification being given to the public, may have led to tragic consequences in the Walkerton *E. coli* outbreak. Even prior to the outbreak, water samples sent to a private lab between January and April tested positive for E. coli bacteria. Government regulators had been notified of those results. However, this potentially crucial information was given to the public only after people became very ill or died, prompting the local public health unit to conduct and announce the results of its own testing.

The need to report goes beyond informing consumers of immediate health threats. It is also important that consumers be informed of the overall quality of their drinking water. Both the U.S. and European Union require water suppliers to provide 'right-to-know' reports, which summarize water quality testing results and compare the quality of their water with the relevant standards. In the U.S., these reports are required annually, while in the European Union, such reports must be delivered every three years, starting in 2003. Some Canadian cities, such as Victoria, Vancouver, and Edmonton, are now preparing right-to-know reports. Ontario's new Drinking Water Protection Regulation requires right-to-know reports to be issued quarterly.

New Brunswick is unusual in having something that could be described as an 'no-right-to-know' provision. Under Section 6 of the New Brunswick Potable Water Regulation, health and environment officials are specifically prohibited from disclosing the results of a sample of well water to anyone but the well owner, unless the owner consents. There is no exception in the regulation for public water supplies that serve persons other than the owners of the well. This could be particularly problematic in instances where the public may drink from a privately-owned well at a gas station or campground, for example, or when a municipality's water system is privatized.

Table IV below lists provincial and territorial standards for reporting of testing results, water quality threats, and the provision of right-to-know reports. Almost all jurisdictions, with the exception of P.E.I. and the Yukon, require the reporting of test results to the provincial government. Newfoundland performs testing itself, and Manitoba receives test results from a private lab which has a contract to undertake water-quality testing. However, only British Columbia, Ontario (post-Walkerton), Quebec, and Saskatchewan have any legally binding requirements that water-quality concerns be brought to the attention of consumers. Ontario is the only Canadian jurisdiction that requires the preparation of right-to-know reports. Ontario also requires that water suppliers make testing reports and approvals available for inspection by the public.

Table IV: Reporting Requirements

Jurisdiction	Mandatory reporting of test results to government officials? Mandatory consumer notification of health threats? Right-to-know report required?
Alberta	Routine water testing results must be reported to the provincial government. Any malfunction of the plant must be reported to government officials. There is no requirement that water contamination or equipment malfunctions be reported to consumers. There is no requirement for the preparation of a public right-to-know report.
British Columbia	Routine water testing results must be reported to the provincial government where testing is required. Public notification of potential health threats must be provided. Equipment malfunctions must be reported to government, but there is no corresponding requirement for public notification. There is no requirement for the preparation of a public right-to-know report.
Manitoba	The province contracts with labs for microbiological testing and these results are reported to the provincial government. There is no requirement that water contamination or equipment malfunctions be reported to consumers. There is no requirement for the preparation of a public right-to-know report.
Newfoundland	There is no requirement that routine test results be reported to government, however, the province does most testing. There is no requirement that water contamination or equipment malfunctions be reported to consumers. There is no requirement for the preparation of a public right-to-know report. Newfoundland has made the results of testing for trihalomethanes available on the Internet.
New Brunswick	Routine water testing results must be reported to the provincial government. There is no requirement that water contamination or equipment malfunctions be reported to consumers. There is no requirement for the preparation of a public right-to-know report.
NW Territories	Routine water testing results must be reported to the territorial government. There is no requirement that water contamination or equipment malfunctions be reported to consumers. There is no requirement for the preparation of a public right-to-know report.
Nova Scotia	Routine water testing results must be reported to the provincial government, as do specific water quality concerns. Nova Scotia's guidelines also contain directions for issuing boil water alerts, but these are not legally binding. There is no requirement for the preparation of a public right-to-know report.
Nunavut	Routine water testing results must be reported to the province. There is no requirement that water contamination or equipment malfunctions be reported to consumers. There is no requirement for the preparation of a public right-to-know report.
Ontario (pre- Walkerton)	No required reporting of testing results or water quality threats. Public notification is not required.
Ontario (post-Walkerton)	Routine water testing results must be reported to the provincial government, as do cases of suspected contamination. Public notification of microbiological threats is required. Water treatment facilities must make available for inspection by the public all testing results and approvals. Right-to-know reports must be prepared on a quarterly basis.
P.E.I.	None
Quebec	Water suppliers must report violations of contaminant standards. Boil water alerts are required in certain circumstances, and the procedure and public notification requirements are legally binding. There is no requirement for the preparation of a public right-to-know report.
Saskatchewan	Routine water test results are reported at the request of the provincial government. Water suppliers must also report violations of contaminant standards to government. Results must be reported on request or upon violation of contaminant standards. Water suppliers must notify the public when contaminant standards are exceeded three times in 30 days. There is no requirement for the preparation of a right-to-know report.
Yukon	Routine testing results and violations of water quality standards must be reported to territorial officials. There is no requirement for the preparation of a right-to-know report.

Recommendations:

- **Provinces and territories should require that water suppliers report test results, missed sampling and equipment failures to provincial or territorial agencies.**
- **Provinces and territories should require that water suppliers make system approvals and testing results readily available to the public, and that suppliers prepare right-to-know reports.**

6. Regulatory Supervision

Routine inspection and water sampling by provincial agencies is essential for monitoring potential problems. These inspections cannot replace the regular system of monitoring that must be in place at the water supply facility, but they are an important addition to a good water protection regime. Other mechanisms, such as the power of provincial regulators to order corrective measures or perform the work themselves, offer another essential level of protection. Such orders may extend to requiring water suppliers to have back-up water treatment equipment on hand in the event of a breakdown in the main system. Government inspections will only be useful if the information is sent to the appropriate people and immediate, effective measures are taken to correct any problems.

Virtually all provinces that we surveyed gave provincial or territorial agencies the right to conduct sampling or inspections and allowed government officials to require corrective actions to protect drinking water safety. The adequacy of provincial and territorial efforts depends upon the vigilance with which officials approach their jobs, an issue beyond the scope of our survey. For example, any province or territory could issue boil water alerts, but the number of boil water alerts per year ranges from zero in some jurisdictions to several hundred per year in others. It is unlikely that this range could be completely explained by a lack of water quality problems in some jurisdictions and low quality water in others.

We surveyed whether or not a government requires the development of plans to deal with drinking water quality emergencies, and whether water suppliers are required to keep back-up parts or entire treatment works on hand to address equipment failures varies with the province or territory. Two jurisdictions, B.C. and Nova Scotia, require the preparation of emergency plans. Six jurisdictions, Alberta, Manitoba, New Brunswick, N.W.T., Nova Scotia and Nunavut require at least some back-up parts to be kept on hand for water treatment facilities.

Recommendations:

- **Provinces and territories should develop programs for random sampling and inspection, with clear follow-up actions required in cases of non-compliance.**
- **Provinces and territories should require the preparation of plans to deal with water quality emergencies and should require water suppliers to keep back-up treatment parts on hand where appropriate.**

The United States of Safe Water

The United States sets the standard for regulated protection of drinking water, surpassing Canada in several important respects.

It is a world leader in establishing strong and comprehensive requirements for

- *restrictions on contaminants;*
- *water-treatment techniques;*
- *water testing and reporting.*

The U.S. also provides water consumers with the right to bring legal actions against water providers that fail to enforce drinking water standards: a right denied to Canadian consumers.

Minimum standards for U.S. drinking water safety are established under the federal Safe Drinking Water Act, administered by the Environmental Protection Agency. Individual states may apply to receive federal approval to implement a drinking water program only if they do three things:

- *adopt standards that meet or exceed federal standards;*
- *have adequate enforcement and record-keeping mechanisms;*
- *provide clean drinking water in an emergency situation.*

With the exception of Wyoming and the District of Columbia, all 56 states, commonwealths and territories have received this federal approval.

U.S. water regulations cover a wide range of issues from source water protection, to specified water treatments for contaminants such as giardia, Legionella and certain viruses, to building and operating water delivery systems, to monitoring and testing drinking water, to reporting requirements.

Under the Safe Drinking Act, states must establish operator-training and certification programs and they can only employ trained and certified operators. Otherwise, they risk losing federal funding.

The Act also requires states to establish "wellhead protection" programs that prevent the entry of contaminants into wells. All sources of potential contamination in a wellhead area must be identified. Similarly, the Act requires each state to look at sources of surface water and determine how susceptible these water bodies are to possible contamination.

Such provisions reflect a commitment to protect drinking water sources rather than simply treating the end product.

The Federal Government's Role in Drinking Water Protection

Drinking water regulations are almost always enacted at the provincial or territorial levels. However, federal, provincial or territorial and local governments all have a role to play in ensuring drinking water safety. Federally, Health Canada has issued guidelines establishing contaminant standards and locally, individual municipalities own and operate water treatment facilities. And, all three levels of government have powers concerning land uses that may affect local water bodies.

Under Canada's division of powers, provincial and territorial governments clearly have jurisdiction to undertake regulation of drinking water. However, it is arguable that the federal government could regulate some aspects of drinking water provision pursuant to its jurisdiction over food and drug standards (part of the 'criminal law' power). Some would argue that, given the disparate performance of the provinces and territories, the federal government should be regulating drinking water providers.

While it seems unlikely that the federal government will take drinking water regulation away from the provinces, there are at least two steps that the federal government could take to improve drinking water. First, it could set minimum standards and requirements related to drinking water which provinces or territories must meet. Second, the federal government could make funding designated for drinking water infrastructure (which, as described in Chapter III, is desperately needed) contingent upon the creation or implementation of drinking water protection, including such things as operator training programs.

Recommendations:

- **The federal government should enact binding drinking water quality standards.**
- **The federal government should increase federal funding for the construction and renewal of water treatment and delivery infrastructure, and make the funding contingent on meeting water protection requirements.**

V Water Marks:

National Drinking Water Report Card

In the inaugural National Drinking Water Report Card we based our evaluation on the following criteria:

Watershed and Wellfield Protection

Water providers often talk about a 'treatment chain.' When each link in the chain, beginning with the water source itself and extending through to the water flowing from your household tap, is properly maintained, high quality water is almost guaranteed.

The first link in that chain is the water supply itself. If efforts succeed in preventing harmful land-uses from degrading surface or groundwater supplies, treating and delivering clean water is that much easier.

The task of protecting surface and groundwater is often difficult in the absence of legislation allowing for watersheds and wellfields to be designated protected.

Stringency of Testing

No water supply can be considered safe unless it is tested regularly for a broad range of possible contaminants.

Jurisdictions were evaluated both on the frequency of their testing and what they looked for in water samples.

Water Treatment

Proper water treatment involves a range of activities that include but are not limited to protecting water sources, filtering water, chemically or otherwise disinfecting water, re-disinfecting that water as it enters the pipes that deliver it to households and businesses, and maintaining water-distribution lines.

Jurisdictions were evaluated on what they required by way of treatment.

Operator Training and Certification

Jurisdictions were evaluated on whether or not they required the people and agencies charged with delivering water to be trained and certified. They were also evaluated on whether they required certification of laboratories doing water testing.

> The task of protecting surface and groundwater is often difficult in the absence of legislation.

Proper testing looks for microbiological contaminants such as giardia or E. coli, physical contaminants such as tiny organic particles that can mask disease-causing microbiological or chemical contaminants, chemical contaminants that may be present in such things as pesticides and industrial effluents, and naturally occurring or industrially-derived radiological contaminants.

Reporting Requirements and the Public Right to Know

Depending on the jurisdiction, there are many different requirements for when water quality information must be given to health and government officials, and when the public must be informed.

Listed below are the provincial and territorial summaries. Each grade is followed by a list highlighting individual strengths and weaknesses.

In many cases, the grades arrived at are similar. But the reasons for the grades vary. The highest grade awarded in this inaugural report card is a B, as measured against the United States, which under our scale would receive an A. (While the U.S. system still needs refining, its comprehensive approach to water protection remains far stronger than in Canada.)

Alberta — B GRADE

Comment: *With Quebec and Ontario, the best of a bad lot.*

Strengths:

- Water suppliers are required to meet standards set out in the Guidelines for Canadian Drinking Water Quality.
- Testing methods and system designs must be approved.
- Operator training and certification is required.
- Disinfection and filtration are required.
- Alberta is the only jurisdiction to have performance standards for giardia and virus reduction.

Weaknesses:

- There is no mechanism for protecting watersheds or wellfields.
- Alberta does not have clear, legislated standards for public reporting and public notification.

Actual testing requirements are discretionary (however, testing requirements are set after all parameters have been analyzed), and the minimum frequency of testing in the regulations is low.

British Columbia — D GRADE

Comment: *Rich province, poor regulations.*

Strengths:

- Water purveyors are required to disinfect water supplies.
- There is mandatory reporting of test results to health officials and public notification must be given of potential health threats. Health officials must also be informed of equipment failures.

Weaknesses:

- B.C.'s regulation only addresses microbiological contamination (coliforms). Other bacteriological, physical, chemical and radiological contamination is not addressed.
- Testing requirements and frequency are discretionary.
- There are no operator training or certification requirements.

Manitoba — C- GRADE

Comment: *Not bottom of the class, but …*

Strengths:

- Manitoba has enacted some protections for watersheds and wellfields.
- Disinfection, and testing for disinfection residuals, is mandatory.
- Testing results must be reported to the province.

Weaknesses:

- No operator training or certification programs (although this is under consideration).

  There is no requirement that testing be done at accredited labs.

New Brunswick — C- GRADE

Comment: *Strengths outweighed by serious weaknesses.*

Strengths:

- Watershed and wellfield protection is available under the Clean Water Act.
- New Brunswick requires an approved 'sampling plan' (however, the requirements of the sampling plan for each community are at the discretion of government officials).
- New Brunswick requires the use of certified labs.
- Testing results must be reported to government.

Weaknesses:

- No clear standards for public notification of problems or potential problems with drinking water.
- There are no mandatory standards for treatment (treatment requirements may be imposed through the approval process).

Newfoundland — D GRADE

Comment: *Should do more homework.*

Strengths:
- Under provincial legislation, watersheds and wellfields may be protected. Newfoundland has created 250 such areas.
- Testing is done at the provincial lab.
- Newfoundland is posting the results of trihalomethane testing on the Internet.

Weaknesses:
- All testing is discretionary.
- Treatment is discretionary.

Northwest Territories — C GRADE

Comment: *No longer a regulatory deep-freeze.*

Strengths:
- Operators are required to ensure tests are preformed monthly for coliforms and annually for 25 chemical and physical parameters.
- Disinfection (chlorination) is required.
- Provincial government reviews test results.

Weaknesses:
- No watershed/wellfield protection.
- No operator training or use of accredited labs.
- No mandatory provisions for public notification.

Nova Scotia — B- GRADE

Comment: *Has recently pulled up its socks.*

Strengths:
- Protection for watersheds and wellfields is available (but not mandatory).
- Disinfection is required and disinfection residual testing must be performed daily.
- Microbiological sampling frequency must meet population-based Canadian Guidelines.
- Chemical and physical parameters must be testing once a year for surface water, and once every two years for groundwater.
- Water suppliers must meet the Canadian Guidelines standards for 30 chemical and physical parameters.
- Operator certification is required.
- Test results must be reported to provincial officials, and the boil-water procedure has been codified.

Weaknesses:
- There is no lab certification policy (although one is being drafted); however, testing must be conducted at a lab acceptable to government.
- No mandatory testing for the majority of standards in the Canadian Guidelines.

Nunavut — C GRADE

Note: Nunavut uses N.W.T. regulation. See above.

Ontario: Pre-revision — D GRADE

Post-revision (effective 2002) — B GRADE

Comment: *After a hard lesson, showing improvement.*

Pre-revision:

Strengths:
- Testing labs must be certified.
- Operator certification and training is required.

Weaknesses:
- Ontario water quality objectives are not binding or enforceable.
- Mandatory water quality testing is not required.
- There is no statutory provision for watershed or wellfield protection.

Post-revision:

Strengths:
- Testing labs must be certified.
- Results must be routinely reported to environment ministry and in cases of suspected contamination.
- Public notification of water quality problems is required.
- Right-to-know provisions guarantee public access to water-quality reports.
- Mandatory water treatment prescribed: groundwater must be chlorinated and surface water must be chlorinated and filtered.
- Operator certification and training is required.
- Extensive mandatory testing for micro-organisms, turbidity, residual chlorine, volatile organics, metals, pesticides and nitrates, among other elements.

Weaknesses:

- There is no statutory provision for watershed or wellfield protection.
- Mandatory testing does not cover all parameters in the Canadian Guidelines.

PRINCE EDWARD ISLAND — F GRADE

Comment: *Bottom of the class.*

Strengths:

None

Weaknesses:

- No binding standards for testing or treatment.
- Chlorination and other disinfection are rare.
- There is no operator certification or use of certified laboratories.
- There are no binding requirements for notifying the public of water quality problems.

QUEBEC — B GRADE

Comment: *With Alberta and Ontario, top of a lacklustre class.*

Strengths:

- Water quality must meet the Canadian Guidelines.
- There is mandatory testing for 46 contaminant standards. Proposed legislation will raise it to 77 standards and implement mandatory controls for turbidity, trihalomethanes and E. coli.
- Proposed legislation will strengthen reporting standards.
- Proposed legislation will make water quality guidelines applicable to domestic wells.
- Proposed legislation will raise microbiological sampling frequency to eight samples per month, up from two samples per year.

Weaknesses:

- Operator training and certification not required (though proposed).
- Right-to-know reports are not required.

SASKATCHEWAN — C GRADE

Comment: *Middle province with middling to poor water protection.*

Strengths:

- Mandatory testing for chlorine residual and mandatory testing for bacteriological quality after construction.
- Disinfection (chlorine) is required.
- Use of certified labs is required.

Weaknesses:

- No watershed or wellfield protection.
- All testing is discretionary except for chlorine residual testing and bacteriological testing after construction or repair of water systems.
- Operator training/certification is not required.
- Reporting requirements need to be strengthened (although there is a requirement that consumers are to be notified if there have been three contaminant violations in 30 days).

YUKON — D- GRADE

Comment: *Frontier mentality poses threats.*

Strengths:

- Mandatory testing for coliform, chlorine residuals and some physical parameters.

Weaknesses:

- No watershed or wellfield protection.
- Chemical and radiological sampling is discretionary.
- No operator training and certification.
- Reporting requirements need to be strengthened.
- No treatment requirements.

VI Conclusion

After surveying jurisdictions across Canada, it is clear that there is tremendous variation in how different provinces and territories approach the important task of ensuring that public water supplies are safe for human consumption.

A patchwork approach to drinking water poses serious public health risks and it explains why other countries — most notably the United States — have taken serious steps to develop enforceable guidelines that states and districts must comply with to receive federal funding.

As things stand, the safety of drinking water supplies is a serious question in many parts of Canada. Not only are many provinces and territories found lacking when it comes to how frequently they require water to be tested, but the contaminants to be tested for are often narrowly defined and exclude potentially dangerous and, in some cases, carcinogenic substances. Questions also abound about who does the testing, where the test results are sent to and when, and whether or not they are made publicly available.

In the aftermath of the Walkerton tragedy, Ontario made strides toward addressing some of these issues. Nevertheless, it has yet to act on what is arguably the most serious deficiency in its approach to protecting public water supplies. It has not provided the legislated means to protect watersheds and groundwater from potentially damaging human activities. Ontario is not alone in this regard. And yet most people familiar with the provision of clean drinking water say protecting water sources is as important if not more important than how the water is ultimately treated.

Looking at the patchwork of Canadian regulations, the question is not why the Walkerton debacle occurred, but why more disasters of a similar magnitude have not occurred. The inescapable conclusion from this first national drinking water report is that a number of provinces and territories are well behind pre-Walkerton Ontario. Unless things change, it is only a matter of time before circumstances combine to create another serious outbreak of waterborne disease.

Canadians deserve to know that wherever they are in their home country, the same enforceable rules apply when it comes to the water they drink. That implies a strong role for a federal government that sets minimum standards. And it requires a commitment by all levels of government to make the necessary investments in water treatment and water delivery infrastructure.

Water is a precious resource. Let's treat it that way.

Looking at the patchwork of Canadian regulations, the question is not why the Walkerton debacle occurred, but why more disasters have not occurred.

Methodology

To assess how jurisdictions performed in protecting water sources as well as treating and testing drinking water, Sierra Legal contacted relevant ministries in each province or territory. Initially this involved telephone interviews with government officials in the health or environment ministries. A thorough review of relevant documents, including legislation and regulations followed. Provincial and territorial summaries were subsequently prepared and sent back to each jurisdiction for comment. Four — British Columbia, Saskatchewan, Ontario and Quebec — chose not to respond.

Endnotes For Chapter 4

Section 1: Protection of Drinking Water Sources
Alberta: None. **British Columbia:** No general provision for protected watersheds or wellfields. "Reserves" under the *Land Act* and "community watershed" status under the *Forest Practices Code* may be used to create some protections. **Manitoba:** *Public Health Act* ("PHA") – *Protection of Water Sources Regulation* ("PWSR"); *Environment Act – Sensitive Areas Regulation.* **Newfoundland:** *Environment Act* ("EA"), s. 10. **New Brunswick:** *Clean Water Act* ("CWA"), s. 14. **Northwest Territories:** *Public Health Act* ("PHA") – *Public Water Supplies Regulation* ("PWSR"), s. 8. **Nova Scotia:** *Environment Act* ("EA"), s. 106. **Nunavut:** PHA – PWSR, s. 8 (NWT). **Ontario:** None. **Prince Edward Island:** None. **Quebec:** *Reglement sur l'eau potable* ("RSLP"), *Distances à respecter d'une potable par rapport à certains usages ou activités.* **Saskatchewan:** None. **Yukon:** None.

Section 2: Water Quality Testing
Alberta: *Environmental Protection and Enhancement Act* ("EPEA") – *Potable Water Regulation* ("PWR"), s. 19. **British Columbia**: *Health Act* ("HA") - *Safe Drinking Water Regulation* ("SDWR"), s. 5. **Manitoba**: PHA – PWSR, s. 10. **Newfoundland**: none. **New Brunswick**: CWA – *Potable Water Regulation* ("PWR"), s. 10. **NW Territories**: PHA – PWSR, s. 9. **Nova Scotia**: EA — *Water and Wastewater Facility Regulations* ("WWFR"), s. 16, and the *Guidelines for Monitoring Public Drinking Water Supplies*. **Nunavut**: PHA – PWSR, s. 9. (N.W.T.). **Ontario:** *pre-revision: Ontario Water Quality Objectives* (non-binding). **Ontario**: *post-revision: Ontario Water Resources Act* ("OWRA") – *Drinking Water Protection Regulation* ("DWPR"), s. 7. **Prince Edward Island**: none. **Quebec**: RSLP. **Saskatchewan**: *Environmental Management and Protection Act* ("EMPA") – *Water Pollution Control and Waterworks Regulations* (WPCWR"), s. 25. **Yukon**: *Public Health and Safety Act* ("PHSA"); *Yukon Waters Act* ("YWA"); Correspondence of Yukon Environmental Health Services, Sept. 11, 2000 ("Correspondence"). **United States:** *Safe Drinking Water Act – National Primary Drinking Water Regulations, passim.* **European Union:** *(effective 2003) Council directive 98/83/EC of November 3, 1998 on the quality of water intended for human consumption*, Article 7.

Use of Accredited Laboratories:
Alberta: EPEA — PWR, s. 19; Correspondence of Kara Chinniah, Municipal Programs Development Branch – Government of Alberta, Sept. 10, 2000 ("Correspondence"). **British Columbia:** HA — SDWR, ss. 1 (definitions) and 5. **Manitoba:** Correspondence of Morley Smith, Environment Officer, Manitoba Conservation, Sept. 8, 2000 ("Correspondence"). **Newfoundland:** Not required. **New Brunswick:** CWR – PWR, s. 9. **NW Territories:** Not required. **Nova Scotia:** Not required. **Nunavut:** Not required. **Ontario:** Not currently required. Required effective Feb. 28, 2001, OWRA – DWPR, ss. 2 and 7. **Prince Edward Island:** Not required. **Quebec:** RSLP, *Controle Analytique,* s. 1. **Saskatchewan:** Not required. **Yukon:** Correspondence.

Section 3: Water Treatment
Alberta: EPEA – PWR, s. 11; Correspondence. **British Columbia**: HA – SWDR, s. 6. **Manitoba**: HA – WSR, s. 10. **Newfoundland**: Not required. **New Brunswick**: Correspondence with Neil Thomas, Public Health Management Unit, Sept. 7, 2000 ("Correspondence"). **NW Territories**: PHA – PWSR, ss. 15 and 16. **Nova Scotia**: Correspondence of Steve Warburton, Nova Scotia Environment, Sept. 11, 2000 ("Correspondence"). **Nunavut**: PHA – PWSR, ss. 15 and 16. (N.W.T.). **Ontario:** *pre-revision:* Not required. **Ontario**: *post-revision:* OWRA – DWPR, ss. 5 and 6. **PEI**: none. **Quebec**:. Correspondence of Jean Maurice Latulippe, Quebec Ministry of the Environment, November 14, 2000 ("Correspondence").
Saskatchewan: EMPA – WPCWR, s. 23. **Yukon**: Not required.

Section 4: Construction and Operation of Water Delivery Systems:
Alberta: EPER – PWR, ss. 4 and 8. **British Columbia**: HA – SWDR, ss. 2 and 4. **Manitoba**: HA – *Water Works, Sewerage and Sewage Disposal Regulation* ("WWSSDR") – s. 2. **Newfoundland**: EA, s. 6. **New Brunswick**: *Clean Environment Act – Water Quality Regulation,* s. 3. **NW Territories**: PHA – PWSR, ss. 3, 14 - 15, and 18 - 20. **Nova Scotia**: EA – WWFR, ss. 4 and 5. **Nunavut**: PHA – PWSR, ss. 3, 14 – 15, and 18 - 20 (N.W.T.). **Ontario:** *pre-revision:* OWRA, s. 52. **Ontario**: *post-revision:* OWRA, s. 52*OWRA – DWPR*, ss. 4 and 6. **PEI**: Not regulated. **Quebec**: Correspondence. **Saskatchewan**: EMPA — WPCWR, ss. 19 – 22. **Yukon**: Not regulated.

Certification of Operators:
Alberta: EPEA – PWR, s. 16. **British Columbia**: Not required. **Manitoba**: Not required. N**ewfoundland**: Not required. **New Brunswick**: Not required. **NW Territories**: Not required. **Nova Scotia**: EA – WWFR, ss. 6 and 7. **Nunavut**: Not required. **Ontario:** *pre-revision:* OWRA, *Water Works and Sewage Works Regulation* ("WWSWR"), ss. 5 - 14. **Ontario**: *post-revision:* OWRA –WWSWR, ss. 5 - 14. **PEI**: Not required. **Quebec**: Communique, *Cabinet du ministre de l'Environment et ministre responsible de la région de Québec – QUÉBEC RENFORCE CONSIDERABLEMENT SA REGLEMENTATION SUR L'EAU POTABLE*, June 19, 2000. **Saskatchewan**: Not required. **Yukon**: Not required.

Section 5: Reporting Requirements:
Alberta: EPEA – PWR, ss. 13 and 19. **British Columbia**: HA – SDWR, ss. 3 and 5. **Manitoba**: Correspondence. **Newfoundland**: No binding reporting requirements. **New Brunswick**: CWA – PWR, ss. 5 - 10. **NW Territories**: PHA – PWSR, ss. 9, 11 – 13. **Nova Scotia**: EA – WWFR, ss. 16 and 17. **Nunavut**: PHA – PWSR, ss. 9, 11 – 13. **Ontario:** *pre-revision:* No binding reporting requirements.
Ontario: *post-revision:* OWRA – DWPR, ss. 7, 8, 10 – 12. **PEI**: No binding reporting requirements. **Quebec**: Correspondence. **Saskatchewan**: EMPA – WPCWR, ss. 24 and 25. **Yukon:** Correspondence.

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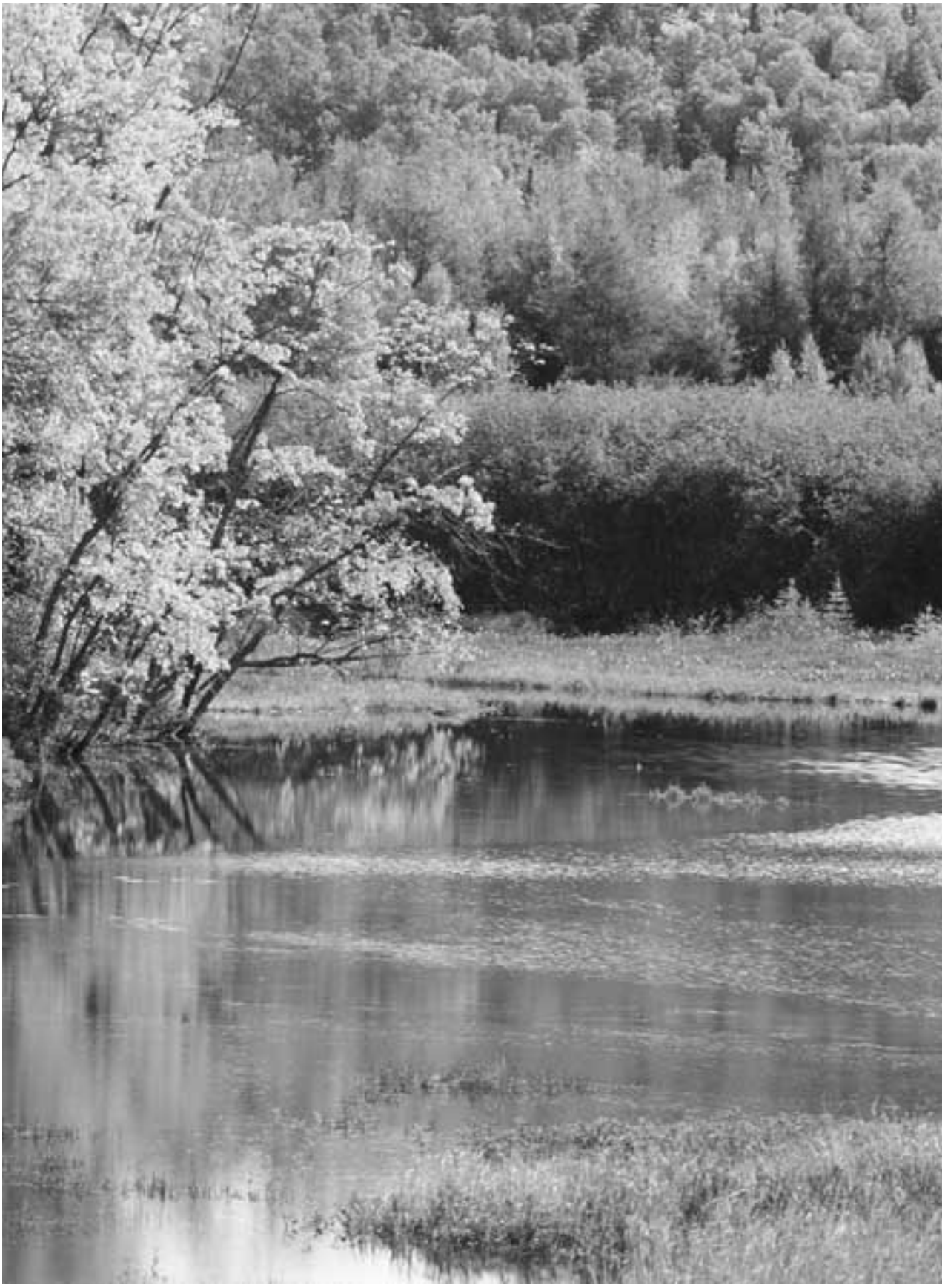

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