

Safe rural drinking water - a Canadian challenge
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When the drinking water in a major city has even the slightest taste and odour residents will often phone and complain despite the fact that these incidences are typically controlled rapidly by the water treatment plant. In addition to taste and odour removal, cities also monitor and treat for what we cannot taste and smell: microbes and chemicals in the drinking water.

What else have city treatment plants in common? Most cities in North America have access to good water sources, which are highly suitable for the production of drinking water. These water sources are commonly from large lakes or rivers, which frequently drain non-contaminated watersheds, such as the Rocky Mountains from which many cities in Alberta, B.C., and Saskatchewan get their water.

In addition to having good quality water to treat, major cities have biologists, microbiologists and engineers who test and evaluate the treatment processes on a daily basis. Experiments are run and treatment optimized. Indeed, Calgary (Alberta) has 18 people in its water quality laboratory ensuring that the water distributed to people in Calgary is safe. Cities frequently treat their water to far higher standards than provincial or federal guidelines.

The combination of good quality source waters and effective treatment offer protection against disease-causing microbes that are very difficult to remove and kill with chlorine, especially the two parasites *Giardia* and *Cryptosporidium* (no Canadian guidelines exist for these parasites). The *Cryptosporidium* parasite was distributed in the City of Milwaukee's drinking water in 1993. Half of Milwaukee's population (400,000 people) became ill and more than one hundred people died. The U.S. National Research Council in a 1999 book (*Setting Priorities for Drinking Water Contaminants*) claims that the accumulated costs for this incidence has now reached \$25 billion U.S. But, the traditional indicators for microbially unsafe drinking water, total coliforms, were absent in Milwaukee's water. The cost of waterborne diseases to a society can therefore be staggering. The World Health Organization estimated in 1996 that the annual cost for waterborne illnesses in the United States was \$23 billion U.S.

The Milwaukee incidence is so significant that there is likely not one large water treatment plant anywhere in the world that does not know what potential costs can be associated with distributing unsafe drinking water. Some of the toughest drinking water quality standards in the world are enforced the U.S. Environmental Protection Agency. Indeed, cities around the world that use surface water (rivers, reservoirs, lakes) frequently try to produce water that meets the U.S. Environmental Protection Agency's Surface Water Treatment Rule. To meet this rule microbes (including parasites) in the water need to be removed at least a thousand-fold by the treatment system before the water can be distributed to consumers. Large water treatment plants in Canada

implement this rule, not because of government guidelines, but because they don't want people to get sick from drinking their water.

Even when the Surface Water Treatment Rule is met some disease-causing microorganisms can slip through. This happened in Milwaukee where the water treatment plant found itself inundated with lawsuits and the U.S. Environmental Protection Agency was not able to prevent the lawsuits. For the first time the water industry's lobby group, the American Water Works Association, started to complain that the U.S. Environmental Protection Agency was not strict enough (they always used to complain that they were too strict). The U.S. Environmental Protection Agency is therefore planning on regulating more than 10 microbes in finished drinking water in an attempt to ensure that people will not get sick if these new water quality regulations are met.

Spreading disease through contaminated water is far more effective than any other means of distribution. Virtually all people on piped water supplies can be reached within hours. The fear of becoming "a disease distributor" has produced an unprecedented improvement in treated water quality for many cities around the world. This is one of the reasons that you will find scientists and engineers working in the laboratories of city water treatment plants. Improving the quality of water to levels that are far better than what government agencies dictate actually makes economic sense.

It is now recognized in the scientific literature that in addition to gastrointestinal diseases, other diseases including cardiovascular, respiratory, liver, central nervous system, and chronic skin infections can all be caused by waterborne microorganisms. Some people exposed to disease-causing organisms may not have any symptoms, while others may suffer mild to severe effects. Health Canada estimates that the costs for waterborne illnesses are around \$200 million per year in Canada. If we then add to those numbers new microbes that are added just about every month to the list of known waterborne transmissions, such as Hepatitis A virus, Coxsackie B virus, which can cause heart disease and insulin dependent diabetes, these costs are quite conservative.

In contrast to cities, rural communities and individual users typically obtain water that is collected from rain and snow from mainly agricultural fields, and this water feeds small reservoirs and shallow wells. The quality of the water originating from this type of drainage is quite poor. The quality of a water source is frequently determined by the dissolved organic carbon (DOC) content in the water and while source waters for cities commonly have low DOC levels, the water originating in rural areas commonly have high DOC. For example, Calgary's source water has a DOC content which is 10 times lower than the average rural reservoir on the prairies. High DOC water typically has a brownish tinge, it will sometimes smell, and the DOC reacts with chlorine forming disinfection by-products. These by-products can be carcinogenic and also make it more difficult to kill the microorganisms in the water.

Despite the poor quality of water available for treatment by rural users there are no laboratories set up to deal with these source waters. Not only is this water much more difficult to treat, but in addition the research and development carried out by most cities to provide safe drinking water simply does not exist for rural water supplies. To make matters worse, when the provinces get together with federal agencies to discuss the Canadian Drinking Water Quality Guidelines (about every six months), rural drinking water has never reached the table. These guidelines were designed to protect city dwellers from the ill-effects of unsafe drinking water.

If the efforts carried out by cities were to be matched for rural Canada, research and development laboratories with several hundred people would be required to solve the much tougher and diverse quality problems affecting rural areas. Small communities and individual rural water users are generally using inadequate treatment equipment to deal with these large challenges.

Canada has taken a highly unusual route in dealing with drinking water quality problems. Drinking water is a provincial mandate with the federal government only providing guidance. Many provinces, instead of shouldering the task, have moved the responsibility further down the line to municipalities. This is fine if we are dealing with Toronto, Ottawa or Calgary. But, how does small rural towns and individual users even begin to deal with such water challenges? The federal government through its devolution of powers to the provinces now plays a minuscule role in the provision of safe drinking water in Canada. In contrast, consider the United States with strong federal drinking water regulations and consider Europe where individual countries are not even able to set their own regulations, but instead, transnational drinking water regulations are set by the European Union. There is a lot more power trying to solve rural water quality problems with a backing of 310 million people (European Union) or 270 million people (the United States) compared with a couple of hundred people or even less for our small rural villages.

The end result has been to leave rural people with the poorest water in Canada and few options to deal with it. Even university and government researchers have shied away from doing research on rural water because in addition to core funds these researchers also need to come up with some external funding, which simply is not available from rural communities. Instead, these researchers will typically be funded by a city water treatment plant, which can afford to support different types of research on its water supply.

Maybe the rural water situation has been addressed by agencies other than Health Canada and provincial environment and health departments? One possibility was clearly dispelled by Agriculture and Agri-Food Canada in a letter to the Safe Drinking Water Foundation (Policy Branch, Ottawa, April 2000, content abbreviated):

"The mandate of Agriculture and Agri-Food Canada is focused on the agriculture and agri-food sector and issues related to human health are not within Agriculture and Agri-Food Canada's scope including safe drinking water for rural citizens".

It is, however, clear that this same department has supported the construction of 150,000 surface water reservoirs and more than 12,000 km of water pipelines to rural areas on the Canadian prairies in addition to dams, thousands of wells etc. While hundreds of millions have been spent on these activities, it is not in the mandate of Agriculture and Agri-Food Canada to be concerned about the health of rural people that use the water. This is not dissimilar to a car manufacturer producing cars without brakes and then claiming that any problems associated with the actual use of the car is somebody else's responsibility.

A car that is manufactured with a top speed of 25 km/h will be less dangerous to drive without brakes than a car that has been built to run at top speeds of 150 km/h. Equally, poor quality water in small reservoirs or wells will affect a limited number of people, but when 12,000 km of pipelines are laid, large numbers of people will be affected by the same water. Most of the pipelines are designated "raw water pipelines" whether the water has been treated or not. The "raw" designation is a convenient way to never have to do any testing on the water to ensure it is safe (as nobody is supposed to drink the water); it is also a convenient way to forget about regular maintenance. Yet, many people will drink this water.

Maybe most of those pipelines are safe, but the odds of having quality water in long distribution lines with little maintenance and no monitoring are not good. The odds of having good quality water (without extensive treatment) from surface water reservoirs that have drained manure piles, plowed, fertilized and crop-protected (application of pesticides) fields are not good either. Even livestock are affected by poor quality water.

Doing very little to ensure that difficult to treat rural water is safe is the most expensive approach available. No city can afford it. But, rural people are expected to put up with it. This is an area where knowledge generated within lower levels of government (mainly cities) needs to be combined with provincial and federal knowledge, as well as knowledge generated by scientists from around the world. There is no reason why we should not be able to find appropriate solutions to the water quality problems facing people in rural Canada so that we can truly say that every Canadian citizen can have access to safe drinking water.

The Safe Drinking Water Foundation is dedicated to finding solutions to rural water quality problems both in developed and developing countries. We are an international charitable organization headquartered in Saskatoon (<http://safewater.org>). We have started to examine microbial problems in rural drinking water supplies across Canada. We are able to do this because of local, national and international scientific and financial support. We work on technical rather than political merit.