Chapter 14 Small Drinking Water Systems

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14.1 Introduction

This chapter discusses some of the problems that confront small drinking water systems. Small systems lack economies of scale, and as a result it may be more expensive, on a per capita basis, for them to meet regulatory requirements. In addition, they may have difficulty attracting, retaining, and affording the expertise they need.[1]

The challenge lies not in making small systems safe; technically, this is rarely difficult. Rather, the challenge lies in doing so affordably. In this chapter, I make recommendations regarding the minimum safe operating requirements for three categories of small systems and point to some ways in which technology and good management can keep costs to a reasonable level. The three categories of small systems are those that come within the purview of Ontario Regulation 459/00, those that do not come within the regulation but provide water to the public, and private systems operated for private use.

14.2 Systems Regulated by Ontario Regulation 459/00

The starting point for determining whether a system is regulated under Ontario Regulation 459/00 is section 52 of the *Ontario Water Resources Act*,[2] which requires all waterworks to have the approval of the Ministry of the Environment (MOE) unless they fall under one of the following exemptions:

- They are used only to supply water for agricultural, commercial, or industrial purposes and not for human consumption.
- They are incapable of supplying more than 50,000 L per day.
- They are privately owned waterworks that supply water to five or fewer private residences.

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[1] See American Water Works Association, 1995, "White paper on building water system viability" in J.A. MacDonald, for the Ontario Water Works Association/Ontario Municipal Water Association, 2001, "Review of issue #8 – Production and distribution of drinking water," Walkerton Inquiry Submission.

[2] R.S.O. 1990, c. O.40.

- They are exempted by the regulations under the Act.

Ontario Regulation 459/00 applies to water systems for which approval is required under section 52, with two additional exemptions:

- They supply 50,000 L of water or less on 88 days in every 90-day period, unless they serve more than five private residences.

- They are not capable of supplying water at a rate greater than 250,000 L per day, unless they serve more than five private residences.

Recommendation 81: Ontario Regulation 459/00 should apply to any system that provides drinking water to more than a prescribed number of private residences.

Using pumping capacity or actual use as criteria for determining the applicability of Ontario Regulation 459/00 is unnecessarily confusing. The important issue is the number of families, households, or private residences (a matter to be defined in the regulation) that should serve as the cut-off point for a communal system falling under the regulation. Currently that number is five. I recognize that a line has to be drawn somewhere, and I have no reason to disagree with this number.

14.3 Variances from Ontario Regulation 459/00

During the Inquiry, I heard from a number of parties that the requirements of Ontario Regulation 459/00 were financially onerous for some small systems. This was said to be true whether the systems were municipally or privately owned, although the private owners who appeared before the Inquiry were rural subdivisions, not the nine industrial owners of communal drinking water systems. The recommendations in this report relating to accreditation would raise costs further for municipally owned systems.

The underlying principle is that communal water systems should be safe, in the sense of the goal I set out in Chapter 1.[3] I would therefore not propose that variances from the requirements of Ontario Regulation 459/00 or the

[3] The overall goal of the recommendations is to ensure that drinking water systems in Ontario deliver water with a level of risk so negligible that a reasonable and informed person would feel safe drinking from the tap.

recommendations of this report be granted simply on the basis of cost. The test should be based solely on an assessment of risk.

Recommendation 82: The Ministry of the Environment should establish a procedure under which owners of communal water systems may apply for a variance from provincial regulations only if a risk analysis and management plan demonstrate that safe drinking water can be provided by means other than those laid down in regulations.

Ontario Regulation 459/00 was created quickly in the wake of the tragic events in Walkerton. The commendable result was that the standards for quality and sampling that had previously been mere guidelines or objectives were made enforceable in law. In so doing, the regulation stiffened some requirements and imposed new costs on municipalities. It may also have made a few matters more rigid and universal than they need to be.

The main changes introduced by Ontario Regulation 459/00 that carried cost implications, for at least some of the smaller systems, are as follows:

- Groundwater must be disinfected – in practice, with chlorine (s. 5).

- Surface water must have chemically assisted filtration and disinfection or, in the view of the MOE director, receive equivalent or better treatment (s. 5).

- An exemption can be made from disinfection and chlorination, but only after a lengthy and expensive process, and only if the equipment and chemicals for disinfection are installed and available for instant use if needed (s. 6).

- A more onerous sampling regime (s. 7) requires, among other things, that testing be done either in a laboratory accredited for the particular test by the Canadian Association of Environmental Analytical Laboratories (CAEAL), operating under the aegis of the Standards Council of Canada (SCC) (s. 2), or by staff certified for the procedure in question (s. 7).

- Notification requirements are formalized, and requirements to take any necessary corrective action and to inform the public are introduced (ss. 8–11).

- Exhaustive quarterly public reports of test results and actions taken must be made available to the public (s. 12).

- Consulting engineers must be retained every 3 years to make a detailed examination of the works and to prepare reports according to an MOE outline.

Small communities are now faced with new requirements for qualified and certificated staff and with the logistics and costs of having regular sampling done. Information management systems must be improved. Some communities must acquire chlorinators and deal with the resulting materials-handling and qualified-labour expenses.

The costs of the new testing and chlorination requirements are most burdensome in some rural subdivisions, villages, and other very small drinking water systems. Many of these systems have never had problems with their water. Thus it seems to me that it is reasonable to relax some requirements of Ontario Regulation 459/00 in cases where the water supply comes from wells of long-established safety or where an assessment of the risks indicates that certain standards are not necessary. The test for granting a variance, however, should be based solely on an assessment of risk, not of cost.

Assessing risks may reduce the burden of costs for some communities, but not for all. With this in mind, I make two further recommendations.

Recommendation 83: The provincial government should not approve water systems that would not be economically viable under the regulatory regime existing at the time of the application.

This recommendation can prevent the creation of further problems. Often, when an applicant seeks approval for a water system, it is faced with making choices about the manner in which the system will be managed and the technology that will be used. To save costs, small communities may involve others in the management and operation of their water systems through consolidation or contracting, build for present rather than distant future requirements, or choose less expensive technologies as a condition of provincial approval. The Province should not, however, after approving a system, be confronted with the dilemma of either reducing regulatory standards to an unacceptable level or facing demands for financial assistance to ensure the

system's compliance. The applicant should confront the economic problems before approval is granted.

Recommendation 84: Approved systems that are not economically viable under the improved regulatory scheme should be required to explore all managerial, operational, and technological options to find the most economical way of providing safe drinking water. If the system is still too expensive, the provincial government should make assistance available to lower the cost per household to a predetermined level.

The difficulty here is that the Province has approved some systems and has imposed or will be imposing, for safety reasons, regulatory requirements that are more costly than those existing at the time of approval. The first step in these situations must be to consider less expensive alternatives for safely managing and operating the system, including making improvements in the use of technology.

A number of avenues exist to upgrade the quality of the small systems' water operations. These systems may move related functions under one administrative roof, thus increasing the scope and skill of management and other specialized services. They may seek cooperative or contractual arrangements with a larger nearby municipality. They may consolidate their operations with those of other municipalities in the region who have similar concerns, or they may gradually upgrade their own staff, through training. In addition, they may contract their operations to a suitably competent operator, such as the Ontario Clean Water Agency (OCWA), or to the private companies that may bid for the business.

When all these options fail to reduce the cost of drinking water to a predetermined level, the Province may determine that the system is not economically viable. In these cases, the Province should provide enough assistance to reduce the cost to the predetermined level. Although I do not have figures to indicate the costs of such assistance, my impression from the somewhat fragmentary evidence given in presentations to the Inquiry is that the aggregate subsidy would not be large. Situations requiring subsidies should be dealt with as the need arises, rather than cause a departure from the high standards of drinking water safety that Ontario residents expect.

14.4 Other Systems Serving the Public

Ontario Regulation 459/00 does not apply:

- to systems that do not have the capacity to supply more than 50,000 L per day (because of the exemption in section 52(8)(b) of the *Ontario Water Resources Act*); or

- to private systems that have a capacity of less than 250,000 L per day and that do not serve more than five private residences; or

- to private systems that actually deliver less than 50,000 L per day for 88 out of any 90 days and do not serve more than five private residences.

Whether or not the volumetric criterion is dropped, as I recommend, there are many types of systems not covered by Ontario Regulation 459/00 that serve water to the public. Here I refer to water providers such as rural schools, hospitals, churches, retirement homes, hospitals, restaurants, gas stations, daycare centers, campgrounds, summer camps, resorts, and golf courses that rely on their own water supply.

Ontario has begun to address this situation with the passage of Ontario Regulation 505/01, which requires designated types of small private water systems to meet certain treatment requirements. This regulation applies only when Ontario Regulation 459/00 does not. The designated systems include those that provide water to at-risk groups, such as the young, the elderly, and the infirm.

Systems regulated under Ontario Regulation 505/01 that use groundwater are required to disinfect the water,[4] and those that use surface water or groundwater that is within 15 m of surface water must either follow the surface water treatment requirements of the Chlorination Procedure or provide equivalent filtration and disinfection.[5] The regulation also contains provisions regarding

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[4] Disinfection must be able to inactive 99% of waterborne viruses and provide *CT* to a prescribed level.

[5] Treatment must be able to achieve 4-log inactivation of waterborne viruses and 3-log inactivation of *Giardia*, and it must be as reliable and as free of disinfection by-products as the systems recommended in the Chlorination Procedure: Ontario, Ministry of the Environment, 2001, "Procedure B13-3 Chlorination of Potable Water Supplies in Ontario" (updated January 2001).

the need for residual disinfection in the distribution system, monitoring and reporting obligations, and responding to adverse test results.

However, Ontario Regulation 505/01 does not apply to many of the types of private systems mentioned above that have a commercial or institutional interest in providing water for human consumption to the public. There is a need, in my view, for additional protection.

Recommendation 85: The application of Ontario Regulation 505/01 should be broadened to include all owners of water systems that serve the public for a commercial or institutional purpose and that do not come within the requirements of Ontario Regulation 459/00.

In my view, where a person has a commercial or institutional interest in supplying water to another, the supplier is bound to ensure that the water being supplied is safe and that the people who put their trust in the supplier are justified in doing so. Such a person should act with the prudence of any reasonable person. The Province has established a standard for this circumstance by enacting Ontario Regulation 505/01, the requirements of which seem to me to cover these situations reasonably.

However, it is not necessary for all such establishments to provide potable water to the public. While I agree that those institutions to which Ontario Regulation 505/01 currently applies must provide potable water and therefore must meet the treatment requirements laid out in the regulation, the newly captured establishments should be given an option of either complying with the current requirements of Ontario Regulation 505/01 or posting notices at every tap that inform water users that the water is not potable. Depending on the circumstances, water suppliers who choose to post non-potable water signs may wish to provide an alternative supply of bottled or bulk drinking water.

14.5 Private Systems

At present, owners of private water systems that do not come within the application of Ontario Regulation 459/00 or Ontario Regulation 505/01 are not required to meet any regulatory standards to ensure the safety of the water. I recommend above that this be changed for those who provide drinking water to the public as part of their institutional or commercial business. I do not recommend, however, that private owners who do not supply water to the

public be required to meet regulatory requirements. I am suggesting that private water system owners not serving the public continue to be responsible for the safety of their own water. I do think, however, that the Province can assist private owners in providing safe water.

Recommendation 86: With regard to private drinking water systems that are not covered by either Ontario Regulation 459/00 or Ontario Regulation 505/01, the provincial government should provide the public with information about how to supply water safely and should ensure that this information is well distributed. It should also maintain the system of licensing well drillers and ensure the easy availability of microbiological testing, including testing for *E. coli*.

Present regulations use five residential units as the cut-off point to distinguish the systems to which Ontario Regulation 459/00 applies from those to which it does not. Ontario Regulation 505/01, even amended as I propose, would apply only to private systems serving the public.

Whatever the number of residences to which Ontario Regulation 459/00 applies, I do not consider it practical to impose the whole regulatory and testing regime of Ontario Regulations 459/00 and 505/01 on private systems that are smaller than a certain size and that do not serve the public. The inspections would be costly and intrusive, and the costs of implementing compliant systems would, for many, be prohibitive. Fortunately, developing technologies such as UV radiation and membrane treatment techniques are becoming economically viable for single houses and small systems. Since owners of private systems do not pay for water from treated communal supplies, they should be able to pay for their own treatment technology.

One important contribution for the provincial government in this area lies in providing information to the public on such topics as wells and their protection, water treatment options, and good sanitation practices. Much of this information exists in some form, but improvements in presentation are required, as are more technical resources to complement simplified consumer information.

Rural households have a corresponding obligation to construct and decommission wells properly and to supply the information necessary for the assessment of common resources. This obligation is laid out in Regulation 903 under the *Ontario Water Resources Act*, which also requires all well drillers and

technicians to be licensed.[6] The proper construction of water wells is best accomplished by thoroughly applying existing licensing systems. Ontario Regulation 903 should be reviewed and updated if necessary to ensure that it requires best construction practices.[7]

The Province can also assist in the area of drinking water testing. The Ministry of Health commendably now offers free bacteriological testing, which should be available to all owners of private wells. Consumers would, of course, be free to test more frequently, or for other parameters, at their own expense.

14.6 Technology

Some recent technical developments may be of use to small communal water systems, private water systems, and small waste treatment systems.

14.6.1 Technology for Small Communal Systems

New technology can play an important role in assisting small systems to provide reliable safe water at a reasonable price. The problem arises with the application of big-system standards – including chemically assisted filtration and chlorination – to small communal water systems.

Small communal systems also have problems that transcend regulations. From a technical point of view, one is the variation in demand over time. Water treatment technologies, with the partial exception of membrane and UV systems, perform best under relatively stable flows and with unchanging source water quality. As a result, water in small systems may have to be treated and stored rather than treated on demand.[8] Another challenge facing small communal systems lies in designing an affordable treatment process capable of responding to changing raw water conditions. The stability of raw water quality should be of particular concern, because the complex treatments for dealing

[6] R.R.O. 1990, Reg. 903.

[7] The government has recently proposed changes to the way it regulates wells. I am not in a position to comment on the proposed changes because they have been introduced only recently. Ontario, Ministry of the Environment, 2002, "Government toughens well construction rules to protect drinking water," press release, April 5 <www.ene.gov.on.ca/envision/news/20021040501.htm> [accessed April 23, 2002].

[8] K. Faller, ed., 1999, *Design and Construction of Small Water Systems*, 2nd ed. (Denver: American Water Works Association), p. 8.

with varying quality can quickly drive costs to unaffordable levels. On the regulatory side, the problem may lie less in designing a system to meet today's standards than in designing the one that will be able to meet future standards.[9]

In general, capital and operating costs can be significantly higher per customer for small systems [10] and the availability of trained staff and management may be a fundamental constraint. There is no getting around the fact that the technical systems needed to ensure safety demand trained specialists, who are in short supply and who may not be needed full-time in smaller places. As drinking water standards become more stringent, small systems will have to develop new strategies.

Appropriate technologies for these systems include traditional filtration and disinfection systems, as well as membrane and UV treatment. All these technologies remove pathogens. Membrane technologies also remove sediment and many contaminants, and the only other treatment required for membrane technologies is a disinfectant residual for the distribution system, if there is one. It is also possible to install ultrafiltration units sized to an individual household.

UV treatment, which requires filtration and a chemical residual, may also require specialized treatment processes such as granular activated carbon (GAC) for taste and odour removal. The advantages of these technologies for small systems include compactness, reasonable capital expenditures, and low maintenance and operating costs. Packaged conventional treatment facilities are another alternative for small systems with good-quality source water. These self-contained units are delivered to a site and hooked up to the source water and distribution systems. They treat the water while requiring little maintenance.

Innovations in management and technology will provide more fruitful avenues for smaller systems than will the relaxation of standards.

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[9] Canada, Department of National Health and Welfare, Health Protection Branch, 1993, *Water Treatment Principles and Applications* (Ottawa: Canadian Water and Wastewater Association), p. 31.

[10] Costs decline dramatically with the scale of operation, typically levelling off in the 40 ML/d range, according to U.S. Environmental Protection Agency work reported in W.B. Dowbiggin, 2001, "Advanced water treatment without advanced treatment costs," proceedings at the AWWA Annual Conference, Washington, June 18, 2001.

14.6.2 Technology for Small Private Systems

Two types of water treatment devices are available for private individual systems: point of entry (POE) and point of use (POU) devices. POE technologies treat water as it enters a house; water flowing to all outlets in the house is therefore treated but not necessarily chlorinated. Both UV and membrane technology devices are POE treatments. POU devices treat water as it leaves the tap. Faucet filters and fridge filters are in this category. According to Statistics Canada, in 1994, 19.5% of Canadians and 24.9% of Ontarians had a filter or purifier system for drinking water in their homes.[11]

Cartridge filters, which are traditional POU devices, can be used for membrane pre-treatment as well. Filter media include membranes, fabrics, string, and porous ceramic filter elements. Viruses and bacteria can pass through most of these filters – a problem exacerbated by the ability of protozoan cysts and oöcysts to deform to a certain extent and pass through smaller pore sizes than might be anticipated. Thus, it may be necessary to use pre-treatment to remove larger sediments and disinfection to prevent microbial growth.[12] Once the system reaches a certain pressure drop or headloss, the cartridge is discarded rather than cleaned. If the cartridge is not replaced at the appropriate time, highly concentrated contaminants may break through, into the filtered water, and lower water quality.

This type of occurrence highlights the greatest problem with the use of POE and POU treatment systems: the user is responsible for their operation and maintenance. If the equipment is not cared for and the filters are not replaced when necessary, the systems can *reduce* water quality. As well as experiencing filter breakthrough, POE and POU systems can provide an attractive host environment for bacterial growth. Thus they require a method of monitoring use or contaminant build-up, as well as foolproof warning systems. For example, one manufacturer has introduced a pressure-sensitive dial that indicates the appropriate time to change the filter.

A further problem with POU devices is the lack of certification for different products. It is difficult to know how effective some of these devices are, if at all, against various water contaminants. The Canadian Standards Association (CSA)

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[11] Statistics Canada, 1995, "Households and the environment survey 1994," Cat. no. 11-526, Table 12, p. 41.

[12] HDR Engineering Inc., 2001, *Handbook of Public Water Systems*, 2nd ed. (New York: John Wiley & Sons), p. 354.

certifies devices by using relevant American National Standards Institute (ANSI) standards, but this certification is not mandatory. Although independent laboratories can assess the validity of claims made, their approval is not mandatory.

An alternative for some small communities and individual homeowners is to have drinking water delivered in bulk. This area of drinking water supply is presently unregulated. Although I have not looked into this issue in detail, I encourage the Province to do so and to develop an appropriate regulatory framework as necessary.

Recommendation 87: The provincial government should review the current practices for the delivery of drinking water in bulk and the need for a regulatory framework in this area.

14.6.3 Waste Treatment Techniques for Small Systems

Small-scale wastewater treatment devices, such as septic tanks, have great potential to pollute source waters. This is primarily because of their large numbers, the lack of certification and monitoring, and a frequent lack of maintenance that leads to the premature release of undigested matter. Although regulated under both the Ontario Building Code and Ontario Regulation 122/98, septic tanks tend to be built and forgotten. As a result, substantial groundwater pollution can occur before it is obvious or visible. The Ministry of Municipal Affairs and Housing has developed a guide to septic tank operation and maintenance.[13] It also provides a list of approved systems to meet the secondary effluent quality criteria of the Ontario Building Code.

Packaged systems for the private treatment of wastewater are increasingly available. They are based on either conventional digestion, composting, or incineration. In general, they are delivered in a self-contained unit and maintained by an authorized contractor, and they may include built-in monitoring devices that draw immediate attention to system failure. Current warning systems for septic tanks use a float system hooked up to a klaxon and light warning panel. Their prices range from $150 to $450.

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[13] See, for example, Ontario, Ministry of Municipal Affairs and Housing, n.d., "A guide to operating and maintaining your septic system" <www.obc.mah.gov.on.ca/septic.htm/new_sept.pdf> [accessed April 7, 2002].

The treatment capacity of self-contained conventional wastewater treatment units ranges from single homes to small municipalities of up to 2,000 people. This capacity can be increased by using multiple units. The units provide settling, biological oxidation, final settling, and sludge storage. Advanced options such as tertiary filtration, denitrification, disinfection, and phosphorus reduction can be integrated into the units.

Composting toilets are an alternative method of treating wastewater. Some composting toilets do not require water or use only small amounts; other designs use foam instead of water. Typically, systems that use water will be part of a total wastewater treatment system. If a home does not have central wastewater services, a composting toilet may be practical. Coupled with a subsurface grey-water irrigation system, a composting toilet can make the installation of a black-water septic system unnecessary. Commercially available composting toilets range in price from $1,000 for simpler units to more than $10,000 for fully integrated wastewater/composting systems.[14]

On-site composting can be done on any scale, to serve either individual users or 10,000 people a day at a beach. Municipalities can use composting as part of their wastewater treatment and may even do so profitably, if the product can be sold as fertilizer, as it is in Austin, Texas. Closer to home, the C.K. Choi Building at the University of British Columbia, a 3,000-m^2 office complex that houses the Institute of Asian Research, is not connected to the city's sewer system. Instead, it composts its sewage and recycles its grey water for on-site irrigation. [15]

[14] See <http://www.greenbuilder.com/sourcebook/CompostToilet.html-Implement> [accessed April 7, 2002].

[15] City Farmer, n.d., "Composting toilets, Urban agricultural notes" <www.cityfarmer.org/comptoilet64.html> [accessed April 16, 2002].