Tapping into Consumers' Perceptions of Drinking Water Quality in Canada: Capturing Customer Demand to Assist in Better Management of Water Resources

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Abstract: Canadian municipal water utilities have had to face many difficulties in the past few years: increasing water treatment and processing costs, tighter fiscal constraints, changing regulations regarding water quality, and aging and rapidly deteriorating infrastructure. Not the least of these problems has been an erosion of consumer confidence in the reliability and safety of publicly-supplied tap water. Many consumers have "voted with their feet" by choosing to install in-home water filtration devices or to purchase bottled water. This paper reviews results from Canadian surveys on perceptions of the quality of municipally supplied tap water. Next, it examines the approach to water management adopted by the United Kingdom (UK) over the last 15 years. This examination provides valuable lessons to Canada's policy makers to encourage them to adopt integrated water resources management (IWRM). In particular, the paper argues that water utility performance can be enhanced by applying one of the most fundamental "economic instruments", namely the use of information about consumer preferences. In so doing, water utilities promote IWRM. This should result in more satisfied customers and a more efficient use of Canada's scarce water resources. The key challenge for regulators will be the design of incentive mechanisms that encourage Canadian water utilities to adopt information gathering practices similar to what is currently done in the UK.

Résumé : Les services publics d'eau des municipalités canadiennes ont dû faire face à de nombreux obstacles au cours des dernières années : la hausse des coûts de l'épuration et du traitement des eaux, des restrictions budgétaires plus serrées, l'évolution de la réglementation sur la qualité de l'eau et le vieillissement et la détérioration rapide de l'infrastructure. L'un des problèmes, et non le moindre, a été l'érosion de la confiance des consommateurs dans la fiabilité et dans la sécurité du système public d'approvisionnement en eau du robinet. De nombreux consommateurs ont décidé de passer à l'action en faisant installer des appareils de filtration de l'eau à domicile ou en se procurant de l'eau embouteillée. Cette communication passe en revue les résultats de sondages menés au Canada quant à la perception de la qualité de l'eau du robinet fournie par les municipalités. Elle se penche ensuite sur l'approche de gestion de l'eau adoptée par le Royaume-Uni au cours des 15 dernières années. Cet examen permet de tirer de précieuses leçons qui devraient inciter les décideurs du Canada à adopter une démarche de gestion intégrée des ressources hydriques (GIRH). En particulier, la communication fait valoir qu'il est possible

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d'accroître le rendement des services publics d'eau en appliquant l'un des « instruments économiques » les plus fondamentaux, à savoir l'utilisation des renseignements sur les préférences des consommateurs. Ce faisant, les services publics d'eau favorisent la GIRH. Cette mesure devrait se traduire par une satisfaction accrue des clients et par une utilisation plus efficace des ressources hydriques limitées du Canada. Le défi clé qui attend les organes de réglementation sera la création de mécanismes d'incitation pour encourager les services publics d'eau du Canada à adopter des pratiques de collecte de renseignements semblables à celles du Royaume-Uni.

Introduction

Over the last decade the operating environment for Canadian regional and municipal water utilities has been challenging. They have dealt with increasing water treatment and processing costs, tighter fiscal constraints, changing regulations regarding water quality, and aging and rapidly deteriorating infrastructure. Moreover, since the events of spring 2000 — when the small agricultural community of Walkerton, Ontario found its water contaminated by the presence of the bacteria, *E. coli O157:H7*, from manure that entered the water system upstream — consumers and government agencies alike have paid much greater attention to the quality of municipally supplied tap water. The widespread illnesses and seven deaths caused by the presence of the bacteria were shocking to Canadians, who, up to that point, had prided themselves on having plenty of good quality water. Many consumers have since "voted with their feet" by choosing tap water substitutes, such as in-home water filtration devices and purchased bottled water.

The events in Walkerton led to a call for better water management practices such as Integrated Water Resources Management (IWRM). IWRM was first discussed at the International Conference on Water and the Environment in Dublin in 1992 (Global Water Partnership, 2000). It is a process that provides directions on ways to develop policies that support the use of scarce water resources in a cost-effective and sustainable manner. There are four principles in IWRM: water is a finite and valuable resource, its use requires a participatory approach, water is an economic good, and, for developing countries particularly, the role of women in water use is important.

This paper has two main components with the overall goal of identifying some new approaches to IWRM that will make better use of information about water's value to consumers, particularly as related to water quality. Thus, the paper focuses upon the first three IWRM principles identified above. The first component of the paper is a review of Canadian surveys on public perceptions of the quality of municipally-supplied tap water. The second examines whether the approach to water management adopted by the United Kingdom (UK) may provide useful lessons for Canada. In the United Kingdom, two agencies act in concert to make water providers more accountable to their customers and to make customers pay for the full value of services obtained. Thus, the UK institutions are good examples of IWRM in practice. The paper concludes with some observations about the gains that could be made by adopting both demand side management and incorporating more information from consumers.

What Do Consumers Want From Their Tap Water?

Tap water has a number of different characteristics spanning both quality and quantity dimensions. With respect to the former, consumers commonly remark upon the importance of attributes such as odour, appearance and taste. In addition to caring about "quality" attributes, consumers want a reliable and continuous supply (including pressure) of water. As part of the UK Periodic Review of the water system, Mori Consulting (2002) surveyed 2,076 people. Amongst other questions, respondents were asked to rate the importance of different components of water and sewerage services. These "characteristics" included both quality and quantity attributes, as well as attributes associated with the quality of water in the natural environment, such as maintenance of the quality of coastal waters and avoidance of sewage flooding. Respondents ranked a reliable and continuous water supply as the most highly rated service aspect. Pressure and appearance came in second and third. When asked to describe their level of satisfaction with respect to the panoply of water and sewerage services, respondents were generally very satisfied. Seventy

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percent were willing to see increases in their water bills (ranging between $5 more per year to greater than $13 more per year) in the next few years in order to pay for improvements to service. On the other hand, 25% were unwilling to pay anything. When asked to identify service aspects that would most likely elicit a willingness to pay higher water bills, respondents cited: safety, taste and smell. Output from surveys of this sort can be used to design, develop and deliver improvements to water services. For example, a survey conducted in 1996 to inform Toronto's water efficiency plan led to a more efficient use of scarce resources (City of Toronto Works and Emergency Services Department, 2002). Furthermore, by seeking public input, water utilities can satisfy the public involvement principle espoused by IWRM (Global Water Partnership, 2004).

While it might be thought that taste, colour and smell are simply aesthetic concerns, these attributes are often used by consumers as indicators of the safety of their tap water (Jardine *et al.,* 1999). Results from a 1999 (United States) National Consumer Water Quality Survey reveal that 60% of the respondents believe the quality of their drinking water affects their health. Almost 50% claim to be concerned about possible health related contaminants in their water supply (Water Quality Association, 2002). In the 2001 survey, 86% of the 1,021 respondents claim to have some concerns about their drinking water quality. Moreover, a majority of the respondents say they would be willing to pay more money on top of their water bill to support removal of contaminants found in the water supply. Harding and Anadu (2000) report on a survey of residents in four Oregon communities: two that have experienced tap water quality problems and two that have not. Their findings suggest that tap water quality problems led consumers to become more sensitive and concerned with potential health risks from tap water. They become willing to spend money on tap water substitutes to "defend" themselves.

Canadian water consumers share many of the same concerns as their American and British counterparts and are also willing to purchase tap water substitutes. A survey done in 1981 revealed that 4% of 295 Canadian households used water purifiers (Health and Welfare Canada, 1983), while one done two years later in Toronto reported that 7% of respondents used some form of tap water substitute (Toronto Department of Public Health, 1984). By 1988 40.5% of the 200 respondents in a Toronto survey indicated that they used some alternative to tap water, with almost half of them indicating bottled water use and about one quarter of them using home filtration devices (Auslander and Langlois, 1993). However, in that same 1988 survey, 59.5% of respondents indicated that they used Toronto tap water exclusively.

More recent cross-Canada surveys (Krewski *et al.,* 1995; Environics, 2000) reported that 50% of the respondents rated their tap water as presenting moderate to high health risks. That Canadians see bottled water as a safe substitute for tap water is evident in sales that have increased at an annual rate of about 9% over the period from 1995 to 2000 (Statistics Canada, CASIM, table 002-0019 and catalogue no. 21-020-x, 2002). These pre-Walkerton data suggest a fair degree of concern for the health aspects of tap water quality in Canada. They do not, however, reflect the impact of the events that took place in Walkerton.

A pilot questionnaire for an internet-based survey on Canada's water quality was conducted in December 2003. In addition to asking respondents about their use of tap water and tap water substitutes, people were asked about their knowledge of possible contaminants in their water supply, and whether they had health concerns associated with their tap water. Finally, a series of questions was asked designed to identify the extent to which respondents would be willing to face higher water bills in order to reduce health risks associated with tap water. During the development and implementation of the survey we followed survey guidelines set out by the National Oceanic and Atmospheric Administration (NOAA) "blue ribbon" panel of experts (Arrow *et al.,* 1993). These include in-person focus groups to refine the questionnaire, clear definitions of the good being valued, reminders about income constraints, referendum style voting to obtain willingness to pay, and follow-up questions to ensure that respondents understood what had been asked of them.

Ipsos-Reid was employed to administer and put the survey on-line. A total of 454 email invitations were issued to their internet panel. This panel contains about 70,000 members and reflects an accurate balanced representation of internet-enabled Canadians. Households on the panel have been recruited primarily over the telephone using random digit dialing. Of those people contacted to do the pilot survey, 266 people responded affirmatively by beginning the survey. In total 107 completed responses were obtained. Of the remaining number (159), 55 people were not permitted

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to continue the survey since they answered that they did not use tap water and 72 people were over quota. (In order to maintain national representation, Ipsos-Reid disallows people from continuing once a target response rate has been met for a particular group.) The remaining 32 people did not complete the survey, with one-third stopping before even answering the first question about tap water. Further discussion of the survey is found in Adamowicz *et al.* (2004).

The pilot sample size is small (107) but nationally representative of Canadian responses. It formed the basis for the final survey, currently under way, that will collect responses from 1,600 people across Canada. About 10% of the respondents in the pilot sample say they think drinking tap water poses a moderate to serious problem for their health or that of their family, and another 30% said that it poses a minor problem. Thirty-six percent of respondents use some form of container filter system, while an additional 11% use either in-tap or in-fridge home filtration devices. About 8% boil their water frequently or always in order to make it safer (but not for making a hot drink). Thirty-five percent drink bottled water weekly or more frequently.

While bottled water purchases may be due to convenience, health concerns may also play a role. In the sample, 71% drink bottled water because of convenience, however, the rest claim to prefer the taste (15%) or have health concerns with their tap water (14%). Home filtration devices and boiling water, however, are used because of worries about the quality of tap water. Eighty-three percent of respondents claim to have heard about *E. coli* as a health concern for tap water and 23% believe it to be of specific concern to their community.

This review of consumer surveys about tap water yields important information for water utility managers. Firstly, Canadian water consumers want safe and reliable water on tap. Secondly, there has been an erosion of confidence in the safety of public water supply. Thirdly, Canadian consumers have increasingly turned to tap water substitutes and made "defensive expenditures". Such willingness to "vote" with their feet and their pocketbooks ought to have the notice of water utility managers. Yet, as Means (2000) claims, water utility managers have ignored the public's concern about potential health risks in their drinking water. He encourages them to find out what their customers think about water quality, what improvements they would like to see, and how much they would be willing to pay for such improvements.

How Much More Are People Willing to Pay for Better Quality Tap Water?

One way to determine how much money people are willing to pay for better quality tap water looks at actual defensive expenditures on tap water substitutes (Smith and Desvousges, 1986; Abdalla *et al.,* 1992). The economic models assume that people make expenditure choices to maximize their well-being when faced with increased health risks associated with exposure to unsafe drinking water.

The survey finds that respondents spent on average $28 to purchase a container-style filter and $490 for an in-tap filtration device. Assuming straight line depreciation of four years on a container style filter means an implicit 25% annual depreciation rate. Thus, the annual amortized purchase price is $7. Assuming straight line depreciation of ten years on an in-tap home filtration device means an implicit 10% annual depreciation rate. Thus, the annual amortized purchase price is $49. This calculation assumes no loss of interest on having one's money tied up in this form of asset, which would in this case be negligible. In addition, these devices have annual operating costs relating to filter purchases. The average price for a container style filter is $7 and it needs to be changed every three months. The average price for an in-tap filter is about $35. This also needs to be changed every three months. Combining the annual amortized purchase price with annual operating costs results in average annual expenditures of $35 per container style device owned and $189 per year for each in-tap filtration system owned. Considering that the average household pays between $250 and $400 per year for water services in Canada, the latter figure represents a substantial outlay over and above one's water bill.

In addition to the use of home filtration devices, Canadian consumers purchase bottled water as a substitute for tap water. Monthly amounts spent on bottled water range between $1 and $60 with a mean household amount of about $15. This suggests average annual spending per household of about $180. A comparison of the costs of using tap water substitutes is found in Table 1.

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Table 1. Calculation of Annual Costs to a Household of the Use of Tap Water Substitutes.

Tap Water Substitute	Average Purchase Price	Average Number of Years of Use	Annual Amortized Purchase Price	Annual Operating Costs	Average Annual Cost to Household
Container Style Water Filter	$28	4	$7	4 x 7=$28	$35
In-Tap Filter	$490	10	$49	4 x 35=$140	$189
Bottled Water	$1	n/a	n/a	n/a	$180

How Can This Type of Information Promote IWRM?

Information in the form of knowledge about the preferences of water customers is an economic instrument. Just as a tax informs a polluter of external costs, so can survey results and the appropriate regulatory structure inform utilities of consumer demands and the value of potable water to Canadians. Moreover, adoption of this information can result in higher revenues for water providers. Such revenues can be earmarked for maintenance of existing capital equipment and improve the planning process by making possible new equipment purchases, which will either improve water quality or services.

Currently, most municipalities do not take into account this valuable information because of reliance upon an inefficient pricing structure that does not treat water as a market commodity sensitive to price changes (American Water Works Association, 1991). There is little understanding that consumers are willing to pay more in order to have either improved levels of service or quality of the product (National Round Table on the Environment and the Economy, 1996). Instead, water utilities expand capacity in order to meet what is perceived as ever increasing demands upon the system, where these demands are essentially based in some fixed way upon the population level (Renzetti, 2005). As the population increases, the "needs" of water users increase and capacity expansion is needed.

One negative outcome of this "needs-based" system is that consumers do not pay the full cost of their use of water and wastewater systems and water utilities find themselves with insufficient revenues for either maintenance or new investment. In an examination of municipal water rates over the last decade, Burke *et al.* (2001) conclude that only half the cost of maintaining and operating water and sewage infrastructure has been recovered from users. Renzetti (1999) estimates that prices charged to residential and commercial customers in Ontario are only one-third and one-sixth of the estimated marginal cost for water supply and sewage treatment, respectively. The National Round Table on the Environment and Economy (1996) states that water and wastewater infrastructure in Canada needs an investment of about $50 billion Cdn in the next decade and that during the next 20 years, the necessary investment will be as high as $90 billion Cdn. Renzetti and Kushner (2004) provide recent evidence on understating the costs of water.

It should be acknowledged, however, that recent Ontario legislation requiring full cost accounting and full cost pricing is a step in the right direction. An interesting example of the gains from introducing full cost, asset based pricing comes from the Capital Regional District of British Columbia. This water wholesaler introduced a new pricing scheme in 1995 and water revenues have been directed at covering operating costs and an ambitious infrastructure renewal plan. This alternative approach is consistent with the principles of IWRM.

Advancing IWRM by Paying Attention to Consumers: The UK Experience

The experiences of the water system in the United Kingdom provide an interesting counterpoint to the Canadian situation. In 1989, in the face of increasing needs to modernize and invest in capital restructuring, Crown operated water companies in England and Wales were sold to the private sector. At the time, there were 29 companies supplying water or sewerage services in England and Wales. Each was given an almost complete monopoly in the area it served. In order to prevent monopoly excesses, water companies

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were subject to a variety of stringent environmental regulations — largely driven by the European Union standards — as well as domestic financial regulations. The cornerstone was regulation dictating permitted pricing behaviour. The government adopted a RPI+K form of price regulation, where the aggregate price for a bundle of the utilities' outputs was allowed to rise by the retail price index plus a K factor (Littlechild, 1988; Cowan, 1994). In principle, the K factor was meant to be negative to allow for efficiency improvements, although it was positive for the first five years of operation. Prices and other aspects of operations were overseen by OFWAT, the Office of Water Services, a non-ministerial government department. At the same time, OFWAT was granted authority to enforce guaranteed standards of service and promote competition in the output market. The latter was deemed to be very important in encouraging more efficient behaviour. Legislative changes allowed for inset appointments (allowing one firm to sell its output to customers within another firm's jurisdiction), common carriage agreements (facilitating delivery of one firm's output through another firm's network infrastructure) and prohibited anti-competitive agreements and abuse of dominant market positions (Rothenberger, 2001).

OFWAT sought early on to establish performance levels (including percentage of homes at risk of low pressure, percentage of properties at risk of flooding due to overloaded sewers, and percentage of consumer complaints not dealt with in a short period of time). The agency used actual data from the water companies to establish benchmarks. Each firm was then assessed relative to the best performing firm and data were made publicly available (OFWAT, 2003). The most recent data on the entire system (OFWAT Water and Regulation: Facts and Figures, April 2004) show that there have been substantial improvements since the early 1990s, particularly in how customer complaints are handled. In addition, the data have been used as the basis for determining allowable price increases. Stability in pricing encourages firms to undertake long-term investment in infrastructure and planning. In the early years, water utilities enjoyed higher prices for water and sewerage services. However, there was the concomitant responsibility to be more responsive to customers' needs, as well as to seek improvements leading to cost reductions in operations. Such reductions were to be passed on to consumers as lower prices.

In order to assist OFWAT, WaterVoice was created to investigate water service complaints about individual water companies. WaterVoice was set up to have nine customer service committees for England, with a tenth for Wales. The main concern of this arm's length organization has been to protect the interests of consumers. As such, WaterVoice was allowed to publish any concerns relating to the regulating body or the water companies themselves and has been referred to as the "consumer watch dog". Although it has not been granted legal powers to enforce recommendations, in practice the companies have usually complied.

In addition to being required to provide information relating to quantity aspects of operations, water utilities are required to submit water samples to be tested in order to ensure compliance with a number of water quality standards. A summary of the many tests performed each year is published by the Chief Inspector of the Drinking Water Inspectorate. Results from individual companies are highlighted and their performance in respect of meeting drinking water quality standards is noted (OFWAT, 2003). The publication of such data shows that water utilities are evaluated every year and the results are made available to consumers in a very accessible fashion. Thus, key principles of IWRM, accountability, transparency and efficiency, are all promoted.

Another important component of the new regulatory regime has been the periodic reviews to which the industry has been subjected (Reid *et al.,* 2002). For example, the 1995 review resulted in a tightening of price regulation in 1995 and there is some evidence that the combination of environmental and price regulation improve performance, including more efficient use of resources and better customer service. Subsequent price reviews and revisions have taken place every five years. In addition, the British government's recent downward revisions of the allowable rate of price increases appear to have induced cost reductions and improved efficiencies. The benefit to consumers has been lower prices combined with more satisfactory service. As part of the review process, OFWAT has undertaken a series of comparisons of important indicators over the period. It has the ability to sanction poorly performing firms by requiring them to offer compensation to their customers.

A key question is whether the customers are satisfied with the performance of their water companies. The most recent canvass of public opinion regarding

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the performance of the water companies took place in 2002 in time for the 2004 Periodic Review of the water system. Over 2,000 people were surveyed by a private customer research agency in order "to inform decision makers on customers' priorities for the water industry by providing a better understanding of customers' views on the scope and pace of potential improvement programmes during 2005 to 2010" (Mori Consulting, 2002, page 1). This survey was commissioned by OFWAT and WaterVoice, and the Drinking Water Inspectorate, along with a number of other government agencies. Amongst other results, the survey highlighted the fact that 87% of respondents were satisfied with water services and two-thirds said they received value for money, although some individuals did express dissatisfaction with services and particularly with proposed price increases since there are concerns that higher prices may simply mean greater profits for the monopoly water service providers (Mori Consulting, 2002).

In addition to the active participation of these two agencies, there was additional oversight of the water industry by the UK National Audit Office. In the last seven years it has undertaken three separate audits of water and/or sewerage services. The first took place in 1997. The report noted that the quality of the service provided to customers had improved since the new regime with respect to all six main measures of service quality used by OFWAT. In addition, the report noted that OFWAT had imposed sanctions in cases where companies had not given a satisfactory service. For example, Yorkshire Water was identified in 1995 as having fallen short of benchmark performance levels. The company agreed to address the problem by reducing future water charges to consumers over the next three years. The audit also noted that 46% of customers complaining to the Customer Service Committees (WaterVoice) were satisfied with the outcome of their complaint. It is interesting to note that this level of satisfaction had risen to 62% in 2002 (Mori Consulting, 2002). The second audit reported in 2000 and concentrated especially upon a weakness noted in the first audit, namely, the amount of system leakage. The National Audit Office (2000) reported that leakage fell from 31% in 1995 to 22% by 2000 through the efforts of OFWAT working with the water companies. It also noted that water companies were showing themselves to be more efficient in efforts to encourage water conservation by users. A third audit is currently being conducted into sewage issues, including flooding. The report is to be released later in the year.

On balance the combination of OFWAT-induced regulatory changes and the watchdog status of WaterVoice and the National Audit Office have led to a successful water services industry in England and Wales. A fair degree of regulation has clearly been important to balance off monopoly interests that otherwise might prevail. Thus, a "hands-on" approach, along with the broadly publicized indicators of performance and benchmarking of firms, appear to have led to a well functioning and consumer-oriented industry.

Conclusions and Lessons

This paper has reviewed results from a number of surveys undertaken to determine the preferences and attitudes of water consumers to tap water quality. It is noteworthy that these surveys have either been undertaken by government agencies or private university researchers and not by water utilities themselves. These surveys point out the extent to which Canadians have concerns about the quality of their tap water and are willing to pay additional monies in order to purchase better quality substitutes or to see improvements made to their tap water. In the United Kingdom, on the other hand, periodic reviews of the water system and the presence of groups to oversee and improve utility performance and accountability, have led to a high degree of satisfaction with the system. The UK experience with using economic instruments, such as information about consumer preferences, supports the development and nurturing of IWRM. This is not an endorsement of the privatization of water utilities. In fact, there is little evidence of benefits arising from privatization (Renzetti and Dupont, 2003). Rather, success in the UK has come from regulations that have encouraged utilities to take account of what the customers want and to put into place sanctions for failing to meet performance targets.

The lessons for provincial governments include the need to design regulatory mechanisms so that utilities collect and act upon consumer preference information, the setting of performance targets and sanctions for failing to meet them, and the desirability of enhancing increased public participation and scrutiny of utility operations. While regulations concerning water safety

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and health must continue to provide the rules for daily operations of water utilities, this paper argues for the incorporation of consumer preferences into pricing and planning processes. By better incorporating demand side information, Canadian water utilities will act in accordance with the principles of integrated water resource management and ensure that Canadians enjoy their valuable water resources in a sustainable way.

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References

Abdalla, C.W., B. Roach and D. Epp. 1992. "Valuing Environmental Quality Changes Using Averting Expenditures: An Application to Groundwater Contamination." *Land Economics*, 68(2): 163-169.

Adamowicz, W., D.P. Dupont and A. Krupnick. 2004. "The Value of Good Quality Drinking Water to Canadians and the Role of Risk Perceptions: A Preliminary Analysis." *Journal of Toxicology and Environmental Health Part A: Current Issues,* 67(20-22): 1825-1844.

American Water Works Association. 1991. *Water Rates Manual,* 4th Ed. American Water Works Association, Denver, CO.

Arrow, K., R. Solow, P.R. Portney, E.E. Leamer, R. Radner and H. Schuman. 1993. "Report of the NOAA Panel on Contingent Valuation." *Federal Register*, 58: 4602-4614.

Auslander, B.A. and P.H. Langlois. 1993. "Toronto Tap Water: Perception of Its Quality and Use of Alternatives." *Canadian Journal of Public Health*, 84(2): 99-102.

Burke, D., L. Leigh and V. Sexton. 2001. *Municipal Water Pricing, 1991-1999.* Enviromental Economics Branch, Environment Canada. Minister of Public Works, Ottawa, ON.

City of Toronto Works and Emergency Services Department. 2002. "Toronto's Water Efficiency Plan." Available at http://www.city.toronto.on.ca/watereff/plan.htm.

Cowan, S. 1994. "Privatisation and Regulation of the Water Industry in England and Wales." In Bishop, M., J. Kay and C. May (Eds.), *Privatisation and Economic Performance,* Oxford University Press, Oxford, UK.

Environics Research Group. 2000. *Risk/Benefit Perceptions of Biotechnology Products.* A report prepared for Health Canada, Health Protection Branch, Ottawa, ON.

Global Water Partnership. 2000. "Integrated Water Resources Management." Technical Advisory Committee Background Paper 4. *Global Water Partnership,* Stockholm, Sweden. http://www.gwpforum.org/gwp/library/Tacno4.pdf.

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Global Water Partnership. 2004. "Integrated Water Resources Management Tool Box." *Global Water Partnership.* http://gwpforum.netmasters05.netmasters.nl/en/listoftoolsFrame_en.html.

Harding, A.K. and E.C. Anadu. 2000. "Consumer Response to Public Notification." *Journal of the American Water Works Association,* 92(8): 32-41.

Health and Welfare Canada. 1983. "Tapwater Consumption in Canada." *Environmental Health Directorate,* Cat #H46-2/82-80E.

Jardine, C.G., N. Gibson and S. Hrudey. 1999. "Detection of Odour and Health Risk Perception of Drinking Water." *Water Science and Technology,* 40(6): 91–98.

Krewski, D., P. Slovic, S. Bartlett, J. Flynn and C.K. Mertz. 1995. "Health Risk Perception in Canada. II: Worldviews, Attitudes and Opinions." *Human and Ecological Risk Assessment,* 1(2): 53–70.

Littlechild, S. 1988. "Economic Regulation of Privatised Water Authorities and Some Further Reflections." *Oxford Review of Economic Policy,* 4(2): 40-68.

Means, E.G. 2000. "Drinking Water Quality in the New Millennium: The Risk of Underestimating Public Perception." *Journal of the American Water Works Association*, 28-33.

Mori Consulting. 2002. "The 2004 Periodic Review: Research into Customers' Views." Research study conducted for Department for Environment, Food and Rural Affairs, Welsh Assembly Government, Office of Water Services, WaterVoice, Water UK, Environment Agency, Drinking Water Inspectorate, English Nature and Wildlife and Countryside Link, p. 1-171.

National Roundtable on the Environment and the Economy. 1996. *State of the Debate on the Environment and the Economy: Water and Wastewater Services in Canada*. Supply and Services Canada, Ottawa, ON.

National Audit Office (UK). 2000. "Office of Water Services: Leakage and Water Efficiency." Report by the Comptroller and Auditor General, HC 971 Session 1999-2000.

OFWAT. 2003. "Levels of Service for the Water Industry in England and Wales, 2002-2003 Report." Office of Water Services, United Kingdom. http://www.ofwat.gov.uk/aptrix/ofwat/publish.nsf/AttachmentsByTitle/los2003.pdf/$FILE/los2003.pdf.

OFWAT. 2005. "Protecting the Interests of Water Customers: An Introduction to Ofwat," Office of Water Services. Available at http://www.ofwat.gov.uk/aptrix/ofwat/publish.nsf/Content/general_leaflet120104.

Reid, M., J.Elgood and C. Gevaux. 2002. "The 2004 Periodic Review: Research into Customers' Views." United Kingdom Office of Water, London.

Renzetti, S. 1999. "Municipal Water Supply and Sewage Treatment: Costs, Prices and Distortions." *Canadian Journal of Economics,* 32(3): 688-704.

Renzetti, S. 2005. "Incorporating Demand-Side Information into Water Utility Operations and Planning." In Chenoweth, J. and J. Bird, (Eds.), *The Business of Water Supply and Sustainable Development,* Greenleaf Publishing, forthcoming.

Renzetti, S. and D.P. Dupont. 2003. "Ownership and Performance of Water Utilities." *Greener Management International,* Summer: 1-11.

Renzetti, S. and J. Kushner. 2004. "Full Cost Accounting for Water Supply and Sewage Treatment: Concepts and Application." *Canadian Water Resources Journal,* 29(1): 13-23.

Rothenberger, D. 2001. "Deregulation in Water Management: Cross Country Comparison and Lessons Learned from the Electricity Sector." In Moody, D. and P. Wouters, (Eds.), *Globalisation and Water Resources: The Changing Value of Water* proceedings of the AWRA Conference, Dundee.

Smith, V.K. and W. Desvousges. 1986. "Averting Behavior: Does it Exist?" *Economics Letters*, 20: 291-296.

Toronto Department of Public Health. 1984. "The City of Toronto Community Health Survey." City of Toronto. Mimeo.

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Water Quality Association. 2002. "Perceptions about Household Water." http://www.wqa.org/ http://www.wqa.org/sitelogic.cfm?ID=88 .

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