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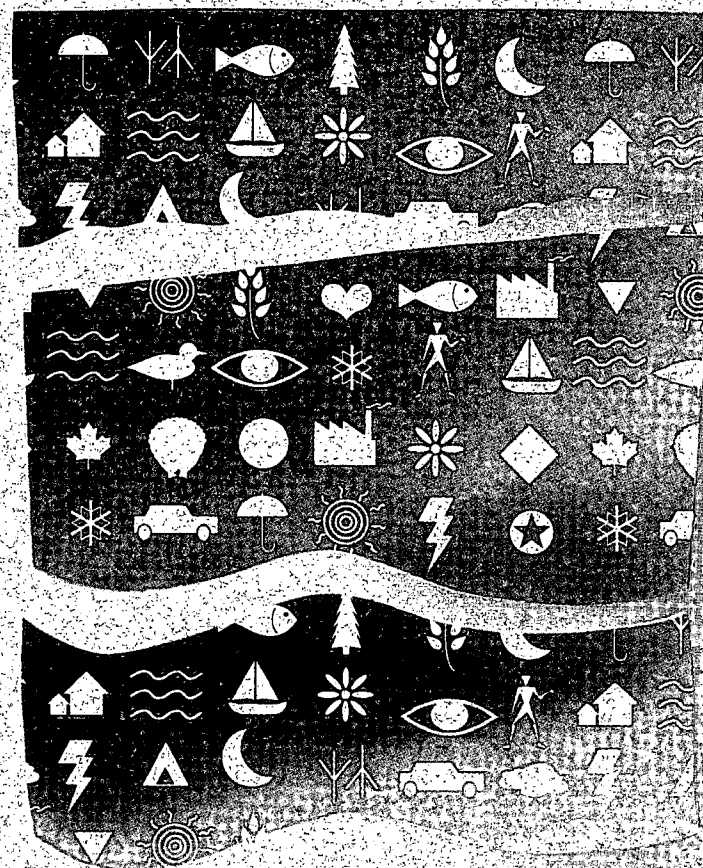
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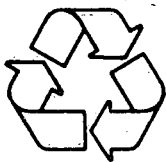
Municipal Water Rates in Canada, 1989 Current Practices and Prices

D.M. Tate and D.M. Lacelle

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Abstract

This report presents a statistical summary of the major types of municipal water rate schedules in use in Canada in 1989. These types are flat, constant unit charges, declining block, increasing block, and complex water rates.

The data were derived primarily from a letter survey conducted by Environment Canada, which collected both water usage and pricing information in a format similar to surveys conducted in 1983 and 1986. Comparisons are made to the 1986 information, and a variety of price calculations are presented within national, provincial, and urban size groupings.

Some of the theoretical concerns raised by the different water pricing systems are presented, and the report ends with an evaluation of municipal water pricing practices in terms of cost recovery, equity, economic efficiency, and local acceptability.

Résumé

Ce rapport présente un résumé statistique des principaux barèmes de tarification actuelle de l'eau des municipalités au Canada en 1989. Les principaux types de tarification sont les suivants : à forfait, à tarif constant, dégressif à tranches, progressif à tranches, et complexe.

Les données proviennent essentiellement d'une enquête écrite effectuée par Environnement Canada, qui a permis de recueillir des renseignements à la fois sur l'utilisation de l'eau et sur la tarification et qui les a présentés sous une forme similaire à celle des enquêtes menées en 1983 et 1986. On y établit des comparaisons avec les renseignements de 1986, et on y présente différents calculs des prix au sein des regroupements nationaux, provinciaux et urbains.

Ce rapport étudie certaines préoccupations théoriques soulevées par les différents systèmes de tarification de l'eau. Il se termine par une évaluation des méthodes de tarification de l'eau des municipalités pour la récupération des coûts, l'équité, l'efficacité économique et l'acceptabilité selon les endroits.

Municipal Water Rates in Canada, 1989

Current Practices and Prices

D.M. Tate and D.M. Lacelle

1. INTRODUCTION

1.1 Background

The past five years have witnessed a serious debate over the problems of funding municipal infrastructure, especially the water system. This debate has revolved around questions of adequate financing for municipal water services. Funding mechanisms currently in use involve substantial subsidies to local water systems from higher levels of government, as well as cross-subsidies among user groups. Stated another way, the debate has concerned the extent to which users should pay for water services in proportion to their water use.

Canadian water and sewer rates vary widely, primarily because each municipality is free to establish its own set of practices and criteria. In some cases, municipalities may be subject to general pricing guidelines imposed by other municipalities that provide water, by regional water suppliers, or by their provincial government. Some municipalities follow the guidelines set by the American Water Works Association (AWWA 1983), but this is by no means the case in a majority of instances. This absence of standard practice has resulted in a chaotic and, in many cases, an irrational set of rate structures, many of which have been inherited from the quite distant past.

One major requirement for meaningful discussion on these issues is a firm information base. One component of such an information base is data on the structure and levels of retail water prices across the country. With such information, policymakers can assess the effectiveness of current pricing arrangements, the degree to

which cross-subsidies exist, and the burden that water bills impose on the average water user. They can determine the impact of user-pay policies and the degree to which current cross-subsidy arrangements should continue in terms of both economic efficiency and equity. Earlier reports, by Fortin and Tate (1985) and Tate (1989) established baseline information on Canadian retail water prices. This report updates and extends the information contained in those reports, particularly the latter, which focused on water rates and prices in 1986.

1.2 Purpose and Overview

This report analyses the types of water rate schedules used by Canadian municipalities in 1989 and links them to the levels of municipal water use in these municipalities. Current prices are then presented for typical consumers in terms of unit, marginal, and total prices¹ paid for water services. The report also evaluates current water pricing practices against some commonly accepted criteria for the operation of municipal water systems.

The remainder of section 1 outlines the methodology used in this report and discusses the principal limitations of the analysis. Section 2 describes the major characteristics of the water rate schedules and includes several price

¹ In this report, unit price refers to the price per cubic metre (m^3), which is used in water rate schedules to determine the total amount of a customer's water bill. Marginal price refers to the price for one further unit of water over a given volume unit. A further discussion of these pricing criteria is included in section 2.2.

calculations. Emphasis is placed on the types of rate schedules in use, total monthly price for typical consumers, and price per cubic metre for residential and commercial water users. Section 3 assesses the water and sewage rate-setting practices against the criteria of cost recovery, equity, economic efficiency, and local acceptability.

1.3 Methodology

Information for the study was collected through an Inland Waters Directorate survey of water pricing practices in Canadian municipalities. The survey questionnaire (Appendix A) requested copies of 1989 water and sewage rate schedules, as well as related information on water use. It was sent to all municipalities with populations over 5 000 and to a random sample of 20% of those municipalities between 1 000 and 4 999. The aggregate data and prices from the 142 respondents in this latter group are representative of the possible total of 928 (Table 1) because the sample was random. The responses from this group were concentrated in the 3 000–4 999 person range, and some of the smallest municipalities did not respond because they did not have water systems. The sample did not necessarily include the same municipalities that were surveyed in 1986.

Six hundred eighteen of the 900 municipalities surveyed supplied water rate schedules (Table 1), 245 did not respond, and 37 had rate schedules that could not be analyzed systematically because of their unique water pricing practices. For example, many of these municipalities (most of which were small Quebec municipalities) based their water charges on assessed property value or frontage.

Survey returns were compiled into a data base describing the types of rates in use, the characteristics of the rates (e.g., number and size of blocks, unit prices within respective blocks), information on sewer surcharges, and total water prices for selected monthly volumes of use by both residential and commercial water users. Finally, the rates were assessed against commonly used criteria for rate setting.

The analytical task here is two-fold: to establish some common descriptive benchmarks in order to compare the rates across municipalities and to calculate retail prices to consumers so as

to draw inter-municipal and inter-provincial comparisons. More complex analyses are left for future projects.

All prices presented in the report were calculated on a monthly basis (even if billed quarterly, biannually, etc.), and all normal minimum charges (i.e., meter or service charges) have been included in the calculations. Residential and commercial rates were considered separately throughout the report. Most Canadian municipalities attempt to recover some of the costs for sewage collection and treatment through surcharges on the basic water bill; these sewer charges have been included in the price calculations. Some municipalities have set charges (i.e., flat rates) for sewer services; these have also been included in the price calculations.

Three standard volumes of monthly water supply were used to calculate the retail water prices. These correspond to those used in the analysis of 1986 municipal water prices (Tate 1989). These volumes for residential use were 10, 25, and 35 m³ per month; they represent a "lifeline" amount of usage, an average family usage, and a high family usage, respectively. Volumes for commercial use were 10, 35, and 100 m³ per month. The latter volume represents intensive uses such as light manufacturing and larger stores and offices.

1.4 Limitations

There are a number of analytical limitations to this report. First, because the survey did not collect data on system costs, such as capital or operation and maintenance costs, the extent to which these costs influence the setting of water rates has not been examined. The rates and prices presented in this report are limited to the retail conditions faced by consumers. No conclusions can be drawn about the degree to which these prices reflect the full cost of providing water services in the surveyed municipalities. Further, in some municipalities, water rates may be regarded as a method of revenue generation and, as such, may also include cost elements not related to water servicing. This absence of cost information, plus some of the following limitations, means that the comparative analysis provided here is insufficient by itself to define a complete pricing system for municipal water.

Table 1
Number and Populations of Respondent Municipalities by Province
and Population Size Group

	1 000 4 999*	5 000- 9 999	10 000- 49 999	50 000- 99 999	100 000+	Total
Number						
Newfoundland	13	8	3	1	0	25
Prince Edward Island	6	2	1	0	0	9
Nova Scotia	8	12	11	1	1	33
New Brunswick	9	7	5	2	0	23
Quebec	22	39	61	10	2	134
Ontario	34	63	72	17	18	204
Manitoba	5	8	3	0	2	18
Saskatchewan	8	4	7	0	2	21
Alberta	19	27	10	3	2	61
British Columbia	18	22	33	11	4	88
Territories	0	0	2	0	0	2
Total	142	192	208	45	31	618
Canada total†	928	268	260	53	32	1 541
Population ('000)						
Newfoundland	34	57	51	98	0	240
Prince Edward Island	13	14	16	0	0	43
Nova Scotia	31	90	211	65	122	519
New Brunswick	24	50	96	142	0	312
Quebec	61	278	1 298	705	1 330	3 672
Ontario	102	437	1 482	1 286	4 780	8 087
Manitoba	15	57	66	0	550	688
Saskatchewan	17	24	137	0	365	543
Alberta	55	170	219	173	1 230	1 847
British Columbia	59	164	661	728	945	2 557
Territories	0	0	34	0	0	34
Total	411	1 341	4 271	3 197	9 322	18 542
Canada total	2 127	1 855	5 168	3 720	9 635	22 505

* Based on a 20% sample of municipalities within this size group.

† The total for Canada is based on the contents of the Inland Waters Directorate's Municipal Water Use Database (MUD), which contains information from all Canadian municipalities with populations over 1 000. Comparison between the survey results and the contents of MUD provides an approximate indicator of the comprehensiveness of the survey.

Second, some municipalities fund some of their water-related expenditures from general revenue. This contribution from general revenue varies from year to year and was not collected for this study. Third, the analysis is limited to residential and commercial water rates and prices. Industrial, irrigation, and wholesale rates (i.e., the rates paid by municipal utilities to other municipalities or regional or provincial water suppliers) are not included. Fourth, the data

compiled during this and the earlier study of water prices (Tate 1989) are insufficient to permit a detailed time series analysis of municipal water rates. Some comparisons will be made, however, to the 1986 data.

In addition to these analytical limitations, there is one arithmetical limitation to the report: the rate and price calculations are from non-weighted data. Thus a rate from a small town is

treated the same as one from a major city. Any bias introduced by using this method could be offset by using weighted average calculations, but this was not done in order to maintain reasonable uniformity with the previous report (Tate 1989). The use of weighted averages would be complicated by the fact that many municipalities have both flat and volume-based pricing systems. Even within a single municipality, it can be difficult to determine which rate structure is the more important in terms of either volume of water or number of users. To compensate partially for biases caused by this non-weighted analysis, all tables are organized by five population size groups (1 000–4 999, 5 000–9 999, 10 000–49 999, 50 000–99 999, and 100 000+).

1.5 Survey Comprehensiveness

About 18.5 million persons, or 82% of Canada's total urban population, resided in the municipalities included in this report. (The remainder of the urban population resided in the nonrespondent municipalities and in the unsurveyed municipalities with populations between 1 000 and 4 999.) Many municipalities contain areas that are rural in nature, due in part to different provincial definitions of municipality or to the presence of large estate-type lots. Frequently, these areas are not serviced by the municipal water system.

Table 2

Population Surveyed and Served by Municipal Water Supply Systems

	Surveyed (⁰⁰⁰)	Served (⁰⁰⁰)	Percentage served
Newfoundland	240	223	93
Prince Edward Island	43	34	79
Nova Scotia	519	394	76
New Brunswick	312	302	97
Quebec	3 672	3 547	97
Ontario	8 087	7 512	93
Manitoba	688	671	98
Saskatchewan	543	540	99
Alberta	1 847	1 807	98
British Columbia	2 557	2 362	92
Territories	34	34	100
Total	18 542	17 426	94

Allowing for this factor, it was found that 17.4 million persons in the surveyed municipalities (Table 2), or 94% of the surveyed population, were served by municipal water supplies and were thereby subject to municipal water pricing.

The respondent municipalities pumped an average of 11.8 million m³ of water per day through their distribution systems (Table 3). This volume was 86% of the total pumpage by all Canadian municipalities. About 49% of the water supplied by respondent municipalities was used by residential customers. The ratio of residential volume to total volume was lower in the larger urban centres, which probably reflects a wider variety of other users, rather than any decline in residential usage.

2. WATER RATE CHARACTERISTICS AND WATER PRICES

2.1 Rate Schedule Types and Characteristics

2.1.1 Water Rates and Economic Incentives

A water utility's rate schedule governs the price that is ultimately charged to individual customers for water services. Throughout Canada, the wide variety of rate schedules in use can be categorized into two basic types: flat and volume-based. This distinction is important in determining the types of incentives or disincentives influencing the water (and sewage service) demands of customers. Evidence of the inverse relationship between price and water demand has been well documented by Grima (1972), Howe and Linaweaver (1967), and Hanke (1978). Kellow (1970) found that water use in the unmetered, flat rate areas of Calgary was substantially higher than water use in the metered areas of similar size and geographic characteristics where prices were based on volume of water usage. In general, flat rates are associated with higher water use than volume-based rates because customers pay a fixed price per billing period for an unlimited water supply and, accordingly, have no incentive to monitor or control their use (Kindler and Russell 1984, 156). Volume-based charges offer varying incentives for limiting water use, depending on their particular structural characteristics. Most volume-based rate schedules also have a minimum charge component to cover some fixed system costs. Volume-based

Table 3

**Total and Residential Municipal Water Pumpage ('000 m³/day) by Province
and Population Size Group**

	1 000- 4 999 ^a	5 000- 9 999	10 000- 49 999	50 000- 99 999	100 000+	Total
Total						
Newfoundland	15	43	25	66	0	149
Prince Edward Island	5	3	11	0	0	19
Nova Scotia	18	54	51	35	79	237
New Brunswick	13	38	47	268	0	366
Quebec	46	161	899	496	1 572	3 174
Ontario	42	182	694	724	2 847	4 489
Manitoba	5	21	35	0	268	329
Saskatchewan	7	10	76	0	236	329
Alberta	33	109	113	93	718	1 066
British Columbia	57	151	401	444	637	1 690
Territories	0	0	22	0	0	22
Total	241	772	2 374	2 126	6 357	11 870
Canada total¹	953	944	2 873	2 447	6 638	13 855
Residential						
Newfoundland	13	28	17	30	0	88
Prince Edward Island	3	3	3	0	0	9
Nova Scotia	10	28	28	16	40	122
New Brunswick	10	27	31	92	0	160
Quebec	26	109	537	280	473	1 425
Ontario	29	107	383	340	1 147	2 006
Manitoba	3	11	19	0	214	247
Saskatchewan	5	6	51	0	113	175
Alberta	23	70	82	53	330	558
British Columbia	33	78	279	295	309	994
Territories	0	0	12	0	0	12
Total	155	467	1 442	1 106	2 626	5 796

^a Based on a 20% sample of municipalities within this size group.

¹ The total for Canada is based on the contents of Inland Waters Directorate's Municipal Water Use Database (MUD), which contains information from all Canadian municipalities with populations over 1 000. Comparison between the survey results and the contents of MUD provides an approximate indicator of the comprehensiveness of the survey.

rates provide signals to consumers about the amount of water they are demanding. The linkage between resource usage, on the one hand, and economic and environmental impacts, on the other, thereby becomes visible at the individual consumer level.

2.1.2 Sewer Charges

Charges related to sewage collection and treatment (referred to in this report as sewer charges),

as noted earlier, are frequently integrated with water charges in calculating customer billings. Sewer charges take several forms across Canada. The most frequently used form (658 cases) is a fixed percentage of the bill for water supply. Thus, if the water pricing system is volume-based, then the sewage charges will also be volume-based. Other types of sewer charges are flat (81 cases) or based upon the chemical composition of the sewage (12 cases).

2.1.3 Flat Rates

The simplest rate schedule, from both a customer and an administrative viewpoint, is the flat rate. It consists of a fixed levy imposed in each billing period and is unrelated to the volume of water used. In return for this levy, the customer is given unlimited access to water and/or sewage services. Municipalities determine flat rate charges in a variety of ways, taking into account the cost of providing service and, in some cases, expected consumption. Charges may vary among user classes (e.g., residential and commercial, or among different types of commercial establishments) within the same municipality. There are also a number of indirect methods for water charging that are equivalent to a flat rate system. For example, additions to the property tax bill, frontage charges, or special assessments for water servicing are usually unrelated to water usage. As noted earlier, these indirect methods were not analyzed because they required the use of data available only locally.

The principal disadvantage of flat rate pricing is that it results in higher water use than volume-based pricing because the price of an additional amount of water (i.e., the marginal cost of water²) is zero. Customers may take as much water as they choose at no additional cost; this leads to wasteful water use practices such as lawn watering during rainstorms or failure to replace dripping faucets. In other words, customers have neither incentive nor information to conserve water, and the municipality has minimal control over water demands except through administrative measures such as lawn-watering restrictions.

2.1.4 Volume-based Rates

Volume-based rates relate the amount paid for water servicing to the amount of water supplied. Several different methods can be used for establishing this linkage, the simplest being a constant rate per unit (e.g., cubic metre) of water used. This type of pricing arrangement is referred to here as a constant unit charge. Constant unit

charges may have a fixed charge component that is unrelated to the actual volume of water used.

More commonly, however, volume charges vary with the level of water use or among user groups and may also be combined with certain fixed charges. These are referred to as block rate schedules, with the most common being the declining block rate. Under this type of schedule, water use in each billing period is divided into successive volumes or blocks, with use in each ascending block charged at a lower price per unit than in the previous block. Typically, one or two initial blocks cover residential and light commercial water use, with subsequent blocks covering heavy commercial and industrial uses. The low costs per unit associated with successively higher blocks mean that declining block rates reduce the incentive for water conservation as this type of rate has declining marginal costs.

A few municipalities employ conservation-oriented increasing block rate schedules in which the prices in successive blocks of the rate schedule increase. In other words, the unit price of water increases progressively through the blocks of the rate schedules. In these cases, consumers have an incentive to conserve water to avoid the higher rates in the upper blocks. Users of large amounts of water or users with high peak flows have the greatest impact on water system planning and sizing, since systems must be built to meet the largest demands. When applied to these types of users, increasing block rates can significantly lower water demands and system costs.

Another type of rate schedule can best be called complex. These schedules attempt to combine two different declining block rates (or as in one case in the survey, an increasing block rate) into the same schedule. Prices thus appear to fall until a certain level of usage is reached, then rise, and later fall again. These rates are usually an attempt to combine components of residential and commercial pricing systems into one schedule. Complex rates may also occur if a sewer charge is calculated on the basis of block limits that differ from those used for water supply.

The most common situation is for different types of users to be subject to parallel block rate schedules for residential, commercial, or industrial use. The setting of rates for the highest volume

² The price of an additional unit of water above current use is referred to as the marginal cost of that unit. In theory, the price of each unit of water supplied should be set at the marginal cost of supplying it (see Hirschleifer et al. 1960, ch. 5). See section 2.1.6 for further discussion.

Table 4
Frequency Distribution of Rate Types by Province
and Population Size Group

	Flat	CUC	DBR	IBR	Complex	Total
<u>Province</u>						
Newfoundland	39	9	2	0	0	50
Prince Edward Island	10	3	5	0	0	18
Nova Scotia	19	3	62	0	0	84
New Brunswick	32	7	18	0	0	57
Quebec	164	101	20	2	1	288
Ontario	156	165	179	4	5	509
Manitoba	4	8	24	0	0	36
Saskatchewan	0	16	21	6	1	44
Alberta	28	48	42	10	3	131
British Columbia	120	42	49	10	6	227
Territories	2	3	0	0	0	5
<u>Population size group</u>						
1 - 4 999	154	92	56	11	1	314
5 000 - 9 999	192	125	117	6	4	444
10 000 - 49 999	184	123	193	12	4	516
50 000 - 99 999	29	34	30	3	4	100
100 000+	15	31	26	0	3	75
Total	574	405	422	32	16	1 449

Flat = flat rate charge
CUC = constant unit charge
DBR = declining block rate
IBR = increasing block rate
Complex = complex rate structure

users may be the result of direct individual negotiations by the corporations involved and the municipalities. Customers may also be differentiated geographically or by jurisdictions, such as larger regional municipalities or water boards. Higher rates may apply to more distant customers, but this generally occurs only if jurisdictional boundaries are crossed, since equity concerns (see also section 3.1) within a municipality usually dictate against this practice.

2.1.5 Frequency of Rate Schedule Usage

The 1989 water rate survey received 1 449 residential and commercial rate schedules (Table 4). This is about 350 more than the 1986 survey. As mentioned above, many municipalities employ parallel residential and commercial schedules,

and many others maintain metered and unmetered schedules. For these reasons, there are more than twice as many rates as there are municipalities. Table 5 divides the schedules into residential and commercial groups.

Flat rate charges made up over half (387) of the 732 residential rate schedules and were concentrated in the smaller urban size groups. Flat rate residential charges were employed most frequently in Newfoundland and Quebec. The remaining 345 residential rate schedules were volume-based, with declining and constant unit rates predominating. Only 15 residential schedules were increasing block, and 4 were complex rates. These latter two types were in the western provinces and in the less than 50 000 population group.

Table 5

Frequency Distribution of Residential and Commercial Rate Types by Province
and Population Size Group

	Residential						Commercial					
	Flat	CUC	DBR	IBR	Complex	Total	Flat	CUC	DBR	IBR	Complex	Total
<u>Province</u>												
Newfoundland	23	2	0	0	0	25	16	7	2	0	0	25
Prince Edward Island	9	0	0	0	0	9	1	3	5	0	0	9
Nova Scotia	18	1	29	0	0	48	1	2	33	0	0	36
New Brunswick	20	2	7	0	0	29	12	5	11	0	0	28
Quebec	107	24	3	1	0	135	57	77	17	1	1	153
Ontario	112	73	78	2	2	267	44	92	101	2	3	242
Manitoba	3	4	12	0	0	19	1	4	12	0	0	17
Saskatchewan	0	9	10	3	1	23	0	7	11	3	0	21
Alberta	20	27	18	5	0	70	8	21	24	5	3	61
British Columbia	73	16	10	4	1	104	47	26	39	6	5	123
Territories	2	1	0	0	0	3	0	2	0	0	0	2
<u>Population size group</u>												
1 - 4 999	96	37	17	6	0	156	58	55	39	5	1	158
5 000 - 9 999	128	48	48	3	1	228	64	77	69	3	3	216
10 000 - 49 999	132	44	79	5	2	262	52	79	114	7	2	254
50 000 - 99 999	21	16	9	1	1	48	8	18	21	2	3	52
100 000+	10	14	14	0	0	38	5	17	12	0	3	37
Total	387	159	167	15	4	732	187	246	255	17	12	717

Flat = flat rate charge

CUC = constant unit charge

DBR = declining block rate

IBR = increasing block rate

Complex = complex rate structure

Much the same pattern emerged for commercial water users. The fact that 187 municipalities have commercial flat rates is particularly noteworthy in terms of water conservation, since some users in this category (e.g., car washes) may use large volumes of water. In effect, under flat rates, these users may be the beneficiaries of relatively large cross-subsidies from smaller users. Conversely, the increase in the number of increasing block rates (to 17) and complex rates (to 12) since the 1986 survey undoubtedly reflects an effort by a few municipalities to exercise greater control over their larger water users.

In some instances, a volume-based rate structure can have the same characteristics as a flat rate. This occurs if the volume-based structure contains a minimum charge that includes a volume of water greater than the normal range of residential usage. Further analysis is necessary on this topic of minimum charges. However, it is worthwhile to note (Table 6) that 410 municipalities (of 796 municipalities with minimum charges) had minimum charges that included a volume component. Thus municipalities with volume-based rate structures may in fact have many of their residential customers facing flat rate pricing conditions, with the resultant loss of any economic incentives to conserve.

Another way that a volume-based rate structure can have the characteristics of a flat rate is if a block rate structure contains a very wide initial block (i.e., with respect to volume). In this case, the rate classified as a block rate may in fact be the equivalent of a constant unit charge within the normal range (25–35 m³ per month) of household usage. Although it has not been presented in the tables, the average value of the top of the first residential block was 1 625 m³ per month, and only 32 of 182 municipalities were below this.

Table 6 presents data on some of the characteristics of the various rate structures listed in Table 4. Most of the flat rate charges fall between \$6.50 and \$20.00 per month, however, 135 municipalities charged over \$20.00 per month. Almost 300 of 575 municipalities charged less than \$13.00 per month. This is indeed cheap water, and probably does not reflect the total cost of water servicing. These low flat rates were found mainly in Quebec and British Columbia and

tended to occur in the second and third population size groups.

Minimum charges were concentrated in Ontario and the western provinces. Most of the Prairie provinces pricing schedules included specified water volumes within their minimum charges. On a Canadawide basis, the ratio between rates that include a minimum water volume (410) in a minimum charge and those that do not (386) was roughly equal.

Sewer charges, which tended to be concentrated in Ontario and the western provinces, were also higher in these provinces. They also tended to be more prevalent in the over 10 000 population size group. Some of the smaller municipalities are not completely served by sewers or sewage treatment. Over 350 municipalities levy sewer charges in excess of 40% of their water bills. These charges, therefore, generate large amounts of revenue and warrant further study.

2.1.6 Average and Marginal Water Prices

The periodic water bills paid by customers are based on the unit charges (e.g., cents per cubic metre) built into the water rates. These unit prices for both constant unit and block rate schedules³ (Table 7) vary among provinces and population size groups.

The constant unit prices in Table 7 refer to those schedules where the price of water per unit of usage was held constant or to schedules having two blocks in which the first block corresponded to a minimum bill. For both of these arrangements, there is only one non-zero price of water.

Retail water prices for the constant unit charge mode of pricing averaged \$0.52 per cubic metre on a national basis. For the block rate structures, the average ranged between \$0.62 for

³ All block rates, including increasing and complex types, were included in this analysis. A slight problem occurred in the analysis of marginal costs, caused by the coincidence of the 25 m³ and 35 m³ levels of usage with the break points in some rate structures. This causes the marginal price at those levels of usage to appear disproportionate. This was found to occur on only five occasions in 1989.

Table 6

Frequency Distribution of Flat Rates, Minimum Charges, and Sewer Charges by Province
and Population Size Group

	Flat rates				Minimum charges		Sewer charges			Flat
	<\$6.49	\$6.50- \$12.99	\$13.00- \$19.99	\$20.00+	Including volume	Excluding volume	1%- 19%*	20%- 40%	41%+	
<u>Province</u>										
Newfoundland	0	19	12	8	4	3	1	7	11	0
Prince Edward Island	0	7	3	0	8	0	0	0	16	0
Nova Scotia	0	14	5	0	3	63	0	10	5	4
New Brunswick	2	5	10	15	10	15	3	13	24	0
Quebec	18	91	42	13	39	37	8	24	15	5
Ontario	9	42	46	59	157	174	34	74	197	20
Manitoba	0	3	0	1	30	2	7	20	6	0
Saskatchewan	0	0	0	0	40	4	6	11	14	11
Alberta	1	5	5	17	60	41	13	36	31	30
British Columbia	23	60	17	20	57	46	10	27	34	11
Territories	0	0	0	2	2	1	0	1	0	0
<u>Population size group</u>										
1 - 4 999	7	65	40	42	87	61	15	40	69	17
5 000 - 9 999	21	77	45	49	129	101	29	75	79	23
10 000 - 49 999	19	83	46	36	151	149	23	74	150	36
50 000 - 99 999	4	12	5	8	21	46	9	22	34	4
100 000+	2	9	4	0	22	29	6	12	21	1
Total	53	246	140	135	410	386	82	223	353	81

Note: Includes des both residential and commercial rates.

*Percentage of total bill.

Table 7

Unit Water Prices (cents per cubic metre) for Volume-based Water Rates by Province
and Population Size Group

Province	Constant unit prices				First block prices				Last block prices			
	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile
<u>Province</u>												
Newfoundland	17	12	10	24	***	***	***	***	***	***	***	***
Prince Edward Island	26	27	***	***	31	32	31	32	23	23	22	23
Nova Scotia	32	37	***	***	29	27	13	47	15	14	8	22
New Brunswick	52	69	21	77	60	70	24	92	31	28	13	58
Quebec	26	22	14	44	26	25	17	37	16	12	4	26
Ontario	65	64	25	108	70	57	31	102	41	39	21	62
Manitoba	125	102	50	246	89	95	51	107	53	53	29	82
Saskatchewan	83	77	40	132	97	96	59	116	72	67	51	96
Alberta	72	71	26	116	100	85	31	179	74	72	32	125
British Columbia	26	22	12	42	28	24	16	48	19	8	13	35
Territories	124	159	***	***	—	—	—	—	—	—	—	—
<u>Population size group</u>												
1 - 4 999	52	42	16	100	68	42	22	126	39	31	8	72
5 000 - 9 999	54	41	16	99	60	48	25	105	37	27	12	80
10 000 - 49 999	49	35	15	102	63	51	22	109	42	38	12	76
50 000 - 99 999	53	44	16	108	44	40	19	78	31	27	10	53
100 000+	61	63	18	105	66	53	22	113	37	39	13	64
Canada	52	41	14	101	62	49	21	107	39	32	10	74

Notes: *** = too few data points.

— = no rates in this category.

These data cannot be used to estimate actual customer billings because the effects of minimum charges, minimum values, and intermediate blocks are not represented.

the first block and \$0.39 for the last. In most cases, as in 1986, the median unit prices were under the means, showing that in statistical terms the data were skewed to the left, indicating the prevalence of lower-than-average rates. The decreasing average prices from the first to the last block indicate the bias towards declining block rate structures.

On a national basis, a significant spatial variation in the unit rates emerged, as it did in 1986. The Prairie provinces had the highest rates among the provinces, with the lowest rates occurring in the coastal areas. There were no significant price patterns among the population size groups. One might expect lower rates for larger urban areas because of economies of scale. Table 7 shows no such pattern, leading to the conclusion that, if economies of scale exist, they are not being passed to consumers in the form of lower prices.

The overall observation from Table 7 is that unit water rates across Canada are very low. The differences between provinces partially reflect variations in the average cost of providing municipal water services. For instance, a number of cost advantages prevail in Quebec and British Columbia, the provinces with the lowest average rates. These advantages include abundant supplies, frequent availability of gravity fed systems, and generally good ambient quality. On the other hand, parts of the Prairie provinces incur frequent water shortages and have significant water problems in some areas, which tend to increase the costs of supply. Similarly, in the Territories, climatic conditions (especially permafrost) contribute to high supply costs. The influences of specific cost conditions may also, of course, be offset by grants from provincial authorities.

Table 8 shows the marginal cost to residential customers of an extra cubic metre of water at the 25- and 35-m³ levels of monthly consumption. Economic theory suggests that consumption of an extra (or marginal) unit of a good or service depends on the price of that unit. Basically, a consumer will demand a product up to the point where satisfaction from the last (i.e., the marginal) unit is equal to its price. If prices are lower than the satisfaction (economists call this utility) derived from consuming larger quantities, demand will increase. Conversely, if prices exceed the marginal utility, demand will fall. Only at the point where

price equals marginal utility is the level of demand economically justified. Low marginal prices will tend to create high demand. On the supply side, "the best use of resources is to produce just up to the point where marginal costs begin to exceed the price that consumers are willing to pay for the additional unit produced..." (Hirschleifer et al. 1960). The theory of marginal cost pricing for water services (see, for example, McNeill 1989) says that the price for water per unit of consumption should be set equal to the marginal cost of production. For present purposes, however, it is unnecessary to provide a complete explanation of marginalist principles, but it is important to note that the marginal price of water is an important indicator of the conditions underlying demand.

There was generally a wide range of marginal prices; the national 10th to 90th percentile range of \$0.15 to \$1.05 indicates this. Within provinces, the same wide range was evident. The wide geographic diversity of British Columbia is perhaps reflected in the range of \$0.01 to \$0.33 from a mean of \$0.19. (The other case of a very low 10th percentile value in the smallest population group appears to be a statistical anomaly that occurred as a result of a specific group of similarly low rates occurring within this aggregation.) At the 35-m³ level of consumption, the ranges were generally somewhat reduced. This is probably due to a larger number of municipalities reaching the second block of declining block rate structures. Thus, marginal prices, for the most part, fall under \$0.60 per m³, which is very low in comparison with the prices of other liquids in common use. For example the cost of a similar quantity of a soft drink is about \$800.00! The cost of water also includes transportation to the point of use as well as waste removal.

Also there are few differences between the residential values at 25 or 35 m³. This indicates that the split between the first and second blocks of residential rate schedules is above the 35-m³ level of monthly usage.

2.1.7 Price Comparisons per Cubic Metre, 1986 and 1989

One of the purposes in conducting the 1989 survey was to begin a time series of how municipal water rates are changing. The first time series comparison is for the period 1986 to

Table 8

**Marginal Water Prices (cents per cubic metre) to Residential Customers by Province
and Population Size Group**

	25 m ³ per month				35 m ³ per month			
	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile
<u>Province</u>								
Newfoundland	***	***	***	***	***	***	***	***
Prince Edward Island	***	***	***	***	***	***	***	***
Nova Scotia	28	28	13	44	28	27	13	44
New Brunswick	56	58	19	90	56	58	19	90
Quebec	26	24	11	49	27	25	14	49
Ontario	62	63	30	105	63	63	31	107
Manitoba	98	96	51	203	96	51	96	203
Saskatchewan	91	83	56	123	91	83	53	136
Alberta	79	76	24	126	78	75	22	126
British Columbia	19	16	1	33	23	19	9	36
Territories	***	***	***	***	***	***	***	***
<u>Population size group</u>								
1 - 4 999	56	46	1	107	57	51	11	107
5 000 - 9 999	59	56	18	107	59	56	19	107
10 000 - 49 999	61	57	20	107	61	57	20	107
50 000 - 99 999	51	59	8	87	52	59	18	87
100 000+	58	63	20	103	58	63	23	103
Canada	58	56	15	105	59	55	16	105

Notes: Marginal price as used here is the extra amount residential customers must pay for one additional cubic metre at the 25-m³ and 35-m³ per month usage levels.

Nineteen municipalities were removed from the analysis at the 25-m³ level because their marginal costs were equal to zero. This occurs when minimum volume or minimum charges were not reached, and the rates were effectively flat rates. At 35 m³, this value had fallen to 12 municipalities.

*** = no data due to small sample size.

1989 (Table 9). Flat rates are not included in this table.

A high degree of variability is apparent during this three-year period. This variability occurs for three reasons. The municipalities in the smallest size group represent a sample that is not necessarily the same as that taken in 1986. Sewer charges are attracting increasing attention as a means of revenue generation, and the national water industry is in a state of transition, with some municipalities having such charges, others not having them. Finally, some municipalities have modified their rate structures in such a way as to move them from one category to another.

A comparison between 1986 and 1989 shows, in many cases, substantial increases in unit water prices. For instance, the national averages for all block categories increased by at least 30%. The marginal prices (at 35 m³) also rose from \$0.38 to \$0.59. This change was especially notable in Ontario and Saskatchewan. New Brunswick showed a decrease, and British Columbia, with the lowest prices in the country, was the only province to remain constant. This overall increase in water prices will have to continue into the future both for environmental conservation and protection, as well as to provide revenue for replacement of aging municipal water and wastewater infrastructures.

Table 9

Mean Unit Water Price Comparison (cents per cubic metre), 1986 and 1989, by Province and Population Size Group

	Constant unit prices		First block prices		Last block prices		Marginal prices 35 m ³ per month	
	1986	1989	1986	1989	1986	1989	1986	1989
<u>Province</u>								
Newfoundland	64	17	34	***	17	***	14	***
Prince Edward Island	***	26	30	31	32	23	15	***
Nova Scotia	***	32	88	29	43	15	21	28
New Brunswick	127	52	110	60	53	31	79	56
Quebec	24	26	22	26	21	16	23	27
Ontario	40	65	43	70	24	41	37	63
Manitoba	77	125	89	89	58	53	81	96
Saskatchewan	56	83	54	97	39	72	54	91
Alberta	56	72	72	100	46	74	59	78
British Columbia	19	26	24	28	13	19	23	23
Territories	115	124	***	***	***	***	57	***
<u>Population size group</u>								
1 - 4 999	39	52	55	68	36	39	42	57
5 000 - 9 999	40	54	52	60	28	37	39	59
10 000 - 49 999	38	49	42	63	27	42	37	61
50 000 - 99 999	29	53	39	44	23	31	28	52
100 000 and over	47	61	55	66	24	37	40	58
Canada	38	52	48	62	29	39	38	59

Notes: *** = no data due to small sample size.

These data cannot be used to estimate actual customer billings because the effects of minimum charges, minimum values, and intermediate blocks are not represented.

The largest movement of unit prices occurred in New Brunswick, where one municipality actually lowered its unit rates. In spite of this, the province retained its place as having the highest unit rates in Eastern Canada. As in 1986, the three Prairie provinces tended to have the highest unit rates in the country.

2.1.8 Summary

Water rate schedules across Canada are extremely diverse, with each municipality setting its own rates. In the 618 municipalities included in this study, 1 449 residential and commercial rate schedules were analyzed. There were five main types of rate schedules: flat rate, constant

unit rate, declining block rate, increasing block rate, and complex. The most common type of rate schedule was the flat rate, which can be the sole form of charging or can form part of a block rate schedule (e.g., a minimum bill with additional charges based on water use). Most municipalities have some form of sewer charge associated with their water rates.

Almost none of the rate schedules provide financial incentives to conserve water, avoid wastage, or minimize the costs of providing water servicing. As a result, over 70% of the rate schedules in use in 1989 tend to be associated with high urban water demands. Marginal prices at normal domestic usage levels changed

Table 10

Total Price (dollars per month) to Residential Water Users for Selected Volumes of Water by Province and Population Size Group

	10 m ³ per month				25 m ³ per month				35 m ³ per month			
	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile
<u>Province</u>												
Newfoundland	11.18	12.00	7.45	14.60	11.96	12.00	6.42	14.60	12.43	12.00	8.18	14.60
Prince Edward Island	13.90	12.75	10.78	18.51	13.90	12.75	10.78	18.51	13.90	12.75	10.78	18.51
Nova Scotia	13.05	13.08	7.30	19.06	15.69	17.11	8.60	23.43	17.46	19.47	8.75	26.85
New Brunswick	18.60	18.19	7.40	28.17	21.08	22.01	7.50	33.88	22.81	22.01	7.50	35.26
Quebec	9.97	8.92	4.76	16.35	10.69	10.00	5.76	16.57	11.25	10.42	6.25	17.81
Ontario	15.96	14.54	7.82	26.15	21.00	20.16	10.82	31.43	24.57	22.91	11.67	39.76
Manitoba	13.47	12.17	8.51	26.49	26.30	26.33	14.47	47.23	34.85	33.82	19.16	65.07
Saskatchewan	17.15	15.21	10.99	23.69	28.87	22.32	21.55	36.80	34.84	36.66	27.33	47.79
Alberta	21.32	20.90	10.80	31.06	28.54	29.67	14.99	41.81	34.16	33.48	16.68	54.60
British Columbia	10.58	8.90	4.83	19.45	11.24	9.61	5.50	20.00	11.87	10.20	6.00	21.88
Territories	27.82	26.78	***	***	35.77	38.46	***	***	41.07	38.46	***	***
<u>Population size group</u>												
1 - 4 999	14.75	12.13	7.36	22.75	17.73	15.00	7.50	30.30	19.81	16.00	7.50	34.26
5 000 - 9 999	14.42	12.50	6.21	25.36	17.83	15.00	6.59	31.21	20.40	16.83	6.84	38.39
10 000 - 49 999	14.83	13.25	6.26	25.83	18.94	17.23	7.50	31.25	21.92	18.90	7.80	39.71
50 000 - 99 999	12.98	11.58	6.08	20.05	17.07	15.11	6.70	28.28	19.98	17.68	7.84	34.98
100 000+	11.67	11.46	6.48	19.15	17.56	16.93	8.26	26.59	21.81	19.88	8.26	35.26
Canada	14.40	12.67	6.30	24.35	18.15	16.16	7.08	31.00	20.88	17.94	7.50	37.87

*** = no data due to small sample size.

quite substantially, from a 1986 mean of \$0.38 to a 1989 mean of \$0.59 for 35 m³ per month. There was a wide range of variation between provinces, which probably reflected natural advantages and/or provincial subsidies.

2.2 Monthly Water and Sewer Prices to Customers

To demonstrate the impact of water prices on residential and commercial users, the water rates described in the previous section were used to simulate total monthly prices for selected standard volumes of monthly usage. This permits interprovincial and intermunicipal comparisons of water prices at the retail level. The data provided below include any relevant minimum and/or sewer charges.

2.2.1 Residential Water Prices

Water rates to residential customers vary widely across the country (Table 10). As in the

1986 survey (Tate 1989), 10, 25, and 35 m³ were the standard volumes of monthly water supply. The first volume represents a minimal monthly water use (i.e., a "lifeline" rate), while the second and third represent average and high family usage, respectively. The mean monthly residential water price nationally at the 25-m³ level was \$18.15 (\$20.88 at 35 m³), reaching lows in Quebec and the coastal areas, with the highest prices occurring in the Prairie provinces and the Territories. Median prices in most provinces fell below the means at the 35-m³ level of usage, indicating that more rates fell below the provincial averages than above them. This tended to be less so at the 25-m³ level of usage, for reasons which are unknown at this time. The only apparent trend among population size groups occurred at the 10-m³ level of usage, where the monthly price fell as population increased.

A substantial increase in residential water prices occurred between 1986 and 1989 (Table 11).

Table 11
Comparison of Mean Monthly Prices (\$) for Residential Customers, 1986 and 1989

	1986			1989		
	10 m ³	25 m ³	35 m ³	10 m ³	25 m ³	35 m ³
<u>Province</u>						
Newfoundland	7.97	7.97	7.97	12.18	11.96	12.43
Prince Edward Island	11.26	13.46	14.93	13.90	13.90	13.90
Nova Scotia	10.06	11.98	13.26	13.05	15.69	17.46
New Brunswick	14.87	26.57	17.75	18.60	21.08	22.81
Quebec	8.12	8.87	9.54	9.97	10.69	11.25
Ontario	11.49	14.84	17.39	15.96	21.00	24.57
Manitoba	11.76	24.11	31.91	13.47	26.30	34.85
Saskatchewan	12.59	20.47	26.26	17.15	28.87	34.84
Alberta	18.04	24.25	29.86	21.32	28.54	34.16
British Columbia	8.62	9.21	10.09	10.58	11.24	11.87
Territories	19.80	27.50	33.19	27.82	35.77	41.07
<u>Population size group</u>						
1 - 4 999	12.96	15.56	17.62	14.75	17.73	19.81
5 000 - 9 999	11.03	14.03	16.40	14.42	17.83	20.40
10 000 - 49 999	10.54	13.46	15.82	14.83	18.94	21.92
50 000 - 99 999	9.41	11.71	13.57	12.98	17.07	19.98
100 000+	8.34	12.69	15.91	11.67	17.56	21.81
Canada	10.90	13.68	16.08	14.40	18.15	20.88

For example, at the 35-m³ month level, the national mean grew from \$16.08 in 1986 to \$20.88, with the most extensive changes occurring in Ontario and Saskatchewan. The apparent decline in Prince Edward Island is believed to be due to the accidental inclusion of a commercial rate in the residential sector in 1986.

Table 12

Total Price (dollars per month) to Residential Water Users at 25 m³ Excluding Sewer Charges by Province and Population Size Group

	25 m ³ per month			
	Mean	Median	10th percentile	90th percentile
<u>Province</u>				
Newfoundland	10.02	11.50	6.00	14.50
Prince Edward Island	6.29	6.02	5.99	6.75
Nova Scotia	13.79	15.75	8.35	19.72
New Brunswick	13.57	13.05	5.83	20.70
Quebec	9.81	8.76	5.40	15.83
Ontario	14.33	12.77	8.08	21.96
Manitoba	17.26	17.35	10.12	23.07
Saskatchewan	20.43	20.87	13.18	27.48
Alberta	20.44	20.17	9.90	33.96
British Columbia	9.05	8.26	5.04	13.42
Territories	33.36	38.46	***	***
<u>Population size group</u>				
1 - 4 999	13.86	11.91	6.40	23.75
5 000 - 9 999	13.80	12.49	6.15	24.01
10 000 - 49 999	13.17	11.57	6.39	21.49
50 000 - 99 999	11.35	10.88	6.08	18.14
100 000+	12.61	12.30	7.96	19.36
Canada	13.38	11.83	6.25	22.00

*** = no data due to small sample size.

The data in Table 10 contain sewer charges when applicable. To examine the effect of these sewer charges on water prices, the 25-m³ portion of the table was calculated without the sewer charges (Table 12). Other portions of this paper

(see section 2.1.2) have indicated that the sewer charge portion of the water charges is quite large. For example, at the national level, the average monthly price to residential customers fell to \$13.38 without the sewer charges (cf. \$18.15 with the charge included). In the aggregate, therefore, the sewer charges account for about 26% of the average monthly residential water bill. The effects of sewer charges were most noticeable in Prince Edward Island, Ontario, and the Prairie provinces. There was very little change in Newfoundland, Quebec, and British Columbia, and there were no obvious trends within the population size groups.

2.2.2 Commercial Water Prices

Commercial water prices (Table 13) showed the same patterns as those described above, except that commercial rates tended to be somewhat higher. A higher monthly volume (100 m³ per month) was used as individual commercial establishments tend to use greater amounts of water than a residential user. Direct comparisons between the two user groups can be made at both the 10-m³ and 35-m³ levels.

2.2.3 Summary

Mean prices to residential consumers for 25 m³ and 35 m³ of water monthly (average family water usage) vary from \$10.69 and \$11.25 in Quebec to \$28.80 and \$34.84 in Saskatchewan, being substantially higher in western than in eastern Canada. (Rates are higher in the Territories, but this can likely be attributed to small sample size and unique environmental conditions.) Most prices increased considerably from 1986 to 1989, with the major changes among the provinces occurring in Ontario and Saskatchewan. Nationally, about 26% of the average billing at 25 m³ consists of sewer charges. Commercial water prices tend to be higher than residential prices across the country.

3. EVALUATION OF CURRENT PRACTICES

3.1 Criteria for Evaluating Water Pricing Practices

Current municipal water pricing practices may be evaluated as a means of promoting effective operation and assuring financial adequacy.

Table 13

Total Price (dollars per month) to Commercial Water Users for Selected Volumes of Water
by Province and Population Size Group

Province	10 m ³ per month				35 m ³ per month				100 m ³ per month			
	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90th percentile
Newfoundland	16.60	12.50	3.44	23.20	17.87	12.50	7.98	23.36	21.30	20.00	11.40	24.60
Prince Edward Island	16.78	16.35	13.42	21.60	16.78	16.35	13.42	21.60	26.15	27.60	21.17	31.84
Nova Scotia	21.42	19.74	11.63	33.06	28.21	28.40	15.76	37.70	45.17	46.64	24.45	60.41
New Brunswick	26.05	21.22	11.50	49.14	32.18	30.17	12.52	55.36	47.84	34.76	14.06	88.62
Quebec	11.10	9.17	2.10	22.67	14.31	11.55	6.42	24.67	23.93	21.00	8.58	43.98
Ontario	20.28	15.67	7.86	38.31	30.85	27.18	13.22	49.99	61.04	59.52	16.88	109.32
Manitoba	20.59	19.92	12.23	29.15	36.50	36.04	22.54	49.63	93.36	86.41	49.14	124.56
Saskatchewan	19.11	15.68	11.47	28.50	39.28	36.61	27.24	50.54	93.37	90.32	65.65	113.47
Alberta	25.23	22.62	12.05	42.71	41.82	40.50	20.67	69.47	93.22	88.79	33.25	165.48
British Columbia	14.50	12.27	5.95	26.65	17.62	15.25	7.50	31.52	28.95	26.43	8.00	53.00
Territories	***	***	***	***	***	***	***	***	***	***	***	***
<u>Population size group</u>												
1 - 4 999	17.25	15.46	6.06	29.82	23.14	21.25	8.26	39.34	42.03	31.84	10.20	89.51
5 000 - 9 999	18.36	15.62	5.10	32.20	25.68	21.68	7.58	45.36	48.39	37.41	10.00	95.95
10 000 - 49 999	18.31	14.63	5.90	36.23	27.23	22.82	8.04	50.13	52.41	44.21	11.00	107.98
50 000 - 99 999	17.63	13.86	4.86	35.66	26.05	23.42	9.37	47.34	51.04	45.98	14.17	107.39
100 000+	14.87	12.07	6.03	29.35	26.14	25.87	9.46	40.68	58.05	57.84	12.89	106.70
Canada	17.84	14.67	5.39	32.90	25.71	22.05	8.00	48.38	49.09	38.00	10.83	101.60

*** = no data due to small sample size.

A number of criteria can be used for conducting such an evaluation.

The first is cost recovery. According to the water rates manual of the AWWA (1983), municipalities should completely recover the costs of operating, maintaining, upgrading (where necessary), and expanding their water systems through their water rates. The AWWA, in fact, fixes this objective as one of the two primary functions of water rate design. Accordingly, it was chosen as a criterion in this evaluation.

The second primary objective of effective rate design according to the AWWA is equity, in the sense of sharing the costs of water systems among customers in a fair manner. This concept, while appearing simple and beneficial, is difficult to define in practice and is open to misinterpretation among bodies that set water rates. This will be discussed briefly in section 3.2.2, while using the concept of equity as the second evaluation criterion.

A third concept that can serve as a criterion of water pricing practice is economic efficiency. Simply put, economic efficiency means achieving a given objective at least cost. (See Hirschleifer et al. [1960] for a more complete explanation.) This point occurs when the price (in this case of water) equals the cost incurred in supplying the next additional unit of usage. In other words, price should equal marginal cost for a system to be deemed economically efficient. The OECD (1987) report on water pricing supports this principle as a condition for effective water management.

A final criterion used here local acceptability. Municipal water rates are established by municipal councils, which must meet the perceived needs of constituents. Local considerations, such as the desire to remain competitive with neighbouring municipalities by offering incentives for potential industrial location, may reduce concerns with regard to cost recovery and equity. This may be a partial explanation of why declining block rate systems, commonly referred to as promotional rates, are often favoured.

Other local concerns, such as disaster, unexpected mechanical failure, change in source water quality, or even micro-climate change, may have to be addressed at the local level

independent of equity or economic efficiency. This type of unique expenditure is usually addressed as a separate tax levy in most municipalities.

3.2 Evaluation of Current Water Pricing Practices

3.2.1 Cost Recovery

A report on water costs and revenues for Canadian municipalities with populations over 10 000 prepared by the Federation of Canadian Municipalities (1985) presented evidence that 82% of water distribution and 65% of waste treatment costs were currently covered by user charges, normally collected through water and sewer rates. The remainder were covered through mechanisms such as lot levies, general property taxes, transfers from other levels of government, and increased debt. Although this report did not consider accumulated past debt, which was required to build the infrastructure, as a cost, it still appears that users paid a substantial portion of water systems costs.

This view is somewhat contradicted by the current funding crisis in municipal water funding as expressed by various municipal leaders across Canada. This crisis suggests that, for some years, users have been shielded from the full costs of maintaining water systems, probably through cross-subsidization via general property taxes and through the provision of long-term debt financing, which may not appear in water bills. As systems have aged, insufficient means have been available for renewal. As a result, a serious repair and upgrading backlog has occurred, and a substantial funding problem has emerged.

3.2.2 Equity

The AWWA used the equity concept as the basis for its recommended water rate setting procedure, which resulted in declining block rate schedules. The fixed portion of a municipality's total costs (e.g., administrative and billing costs) are incurred regardless of the amount of water used by individual customers or customer classes. Accordingly, these systemwide costs should be borne by all customers. Since all customers face the price conditions of the first or second blocks of the rate schedule, the fixed costs should be recovered in these blocks. Thereafter,

the costs of service decline, since only treatment, pumping, and sewage expenses are incurred, and some economies of scale come into effect. Accordingly, prices in the upper blocks should be lower than in the initial ones according to the AWWA. Hirshleiffer et al. (1960) have demonstrated that this type of reasoning is faulty and that municipalities should base their rates on marginal cost pricing principles (see also McNeill 1989).

Equity is also the principle used in establishing flat rates. Under a flat rate system, all customers in a given category (e.g., residential) are charged equally, regardless of usage levels. It also underlines other practices used in rate setting, such as establishing equal rates across a common jurisdiction, regardless of the costs of service.

The interpretations of equity given here (and there are many more) show that this is a difficult concept to define and use objectively. For example, usage of any amount of water for a fixed price and charges based on volume of usage cannot both be equitable. In other words, perceptions of equity vary widely among water rate setters.

Furthermore, situations that may appear equitable at first sight may prove inequitable on closer examination. Consider, for example, the case of declining block rates. Under this type of rate schedule, the greater the volume of water used, the less paid per unit of use. For municipal water systems, a few large users may dictate the system design capacity, one of the most important (and costly) design parameters for water systems. Large users may also have high usage rates, high peaking requirements, or both. Thus, in many cases, a municipality may be forced to have systems larger than required to meet the needs of most users in order to cater to the needs of a few large users. In these cases, the majority (small users) are actually subsidizing the needs of a few (large users), and an apparently equitable charging system is actually inequitable. The same criticism is even more serious in instances of flat rate systems.

3.2.3 Economic Efficiency

Economic efficiency means achieving given ends at the lowest cost possible. In the water

servicing field, efficiency occurs when water prices reflect the cost of providing the extra, or marginal, unit of usage. (This concept of marginal pricing was discussed in section 2.1.6). Furthermore, all users, regardless of category, should face this same price. Under such conditions, service occurs at minimum costs, customers are treated equally, system repair and upgrading costs are adequately covered, and system expansions occur only when required by demand conditions. Further, since the customer is accurately informed about the true costs of water services through the water rate, water demands occur efficiently at least cost to society. This sound management of water resources will also have environmental benefits.

Declining block rates imply that marginal costs decrease in progressively higher blocks of the rate schedule. While such conditions may pertain in a static situation, they almost certainly do not through time, as upgrading and expansion costs occur. With flat rates, the implied marginal cost of water is zero. In such a situation, water becomes a free good and is subject to overuse and artificially high system costs due to a lack of concern for both over-sizing and conservation measures. Most declining block rates have minimum charges, i.e., a flat rate block at the lower levels of use. For many low volume users, these are effectively flat rates. Since most municipalities across the country are using either flat or declining block rates, it seems clear that economic efficiency is not an important consideration in water rate setting.

3.2.4 Local Acceptability

Municipal decision makers must set water rates that are acceptable to their constituents. In many cases, costly decisions are postponed to keep water rates low, and rate schedules are adopted that appear equitable to constituents. This, perhaps, explains best the preponderance of flat and declining block rate schedules across Canada and also the low cost of water in most communities, as noted in section 2. The consequences of decisions made on this basis are increasingly obvious with the passage of time. When insufficient revenues are raised to support water servicing, systems deteriorate and capital works backlogs become common. This appears to be happening in Canada at present.

3.2.5 Summary

Rate-setting practices can be assessed against the criteria of cost recovery, equity, economic efficiency, and local acceptability. It appears that acceptability to local ratepayers is currently the most important factor in rate setting, accounting for the wide variety of rates across the country. Cost recovery and equity considerations are used to varying degrees, but current rates fail to meet any rigorous definition of these criteria. Economic efficiency, which calls basically for achieving sufficient water service at minimum cost, appears to be a neglected factor in current rate-setting practices. There are, accordingly, few economic incentives to conserve Canadian water supplies.

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Appendix A

QUESTIONNAIRE

Please return completed questionnaire to: Environment Canada, Ottawa, Ont., K1A 0H3

A. Municipal Office (please give name) _____

1. Please attach your water rate schedule.
2. Is there a sewer surcharge? _____ Yes
_____ No _____ % of water charge
3. Approximately what percentage of all households have water meters? _____ %
4. Please estimate the percentage of your water used by the following groups: Residential _____ % Industrial _____ %
Commercial _____ % Unaccounted _____ %

B. Water Supply System (please give name): _____

5. Have you recently encountered problems with the following (please check if appropriate):
_____ water supply quantity: give year(s) _____
_____ Water supply quality: give year(s) _____
6. The source of water supply is (please check):
_____ surface _____ ground _____ both
7. The average daily flow at the plant is: _____ m³/day
_____ thousand imperial gallons per day
_____ other (please specify units)
8. The population served by this water supply system is: _____
9. This system also serves the following other areas (please list): _____

C. Sewage System and Plant (please give name) _____

10. The population served by this sewer system is: _____
11. The population served by this sewage treatment plant is: _____
12. The average daily flow at the plant is (please give units, i.e., m³/day, thousand imperial gal. etc): _____
13. The type of the sewage treatment plant is (please check):
_____ primary (mechanical)
_____ secondary (biological)
_____ tertiary (i.e., phosphorous removal)
14. This sewage treatment plant also serves the following other areas (please list): _____

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