Irritations from Shaving Peaks: Barriers to the Implementation of Residential Seasonal Water Rates in Southwestern Ontario

by

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A thesis
presented to the University of Waterloo
in fulfillment of the
thesis requirement for the degree of
Master of Environmental Studies
in
Environment and Resource Studies

Waterloo, Ontario, Canada, 2009

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revision, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Kurtis Elton

Abstract

The water soft path (WSP) has been formulated as a progressive paradigm in water management. The WSP has four main principles: water should be viewed as a service; ecological sustainability is of utmost importance; water quantity *and* quality should be conserved; and planning should be done from the future backwards, not projected from the present. It may be possible to use conservation-based water pricing programs, especially at the residential level, in order to incrementally implement the WSP. Moreover, the implementation of residential seasonal water rates has been suggested as a method to curb peak demand in municipal water systems, thereby deferring infrastructure expansion. The purpose of this thesis is to answer the question: what are the barriers to implementing residential seasonal water rates in the Region of Waterloo? This question is addressed using a variety of data sources, with the majority of the information coming from academic and non-academic literature, and from interviews with water professionals and local councillors. The results provide a descriptive case study concerning the barriers to implementing seasonal water rates in one particular region of southwestern Ontario, but the conclusions can be generalized to describe some of the barriers to the implementation of seasonal water rates in Ontario. Results suggest that some barriers are more severe than others, and that the more serious ones may be addressed by: expounding the potential for seasonal water rates to curb peak demand; carefully designing a rate study to be administered with non-price programs; and implementing the designed rate structure as a pilot study. It is suggested that the implementation of seasonal water rates can be used as an incremental step towards the adoption of WSP principles, but not without first envisioning a desirable future.

Acknowledgements

To my family, Judith Manger, Jim Robinson, Paul Kay, Glen Pleasance, and the Texas grad crew: thank you.

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Chapter 1 – Introduction

1.1 Overview

The implementation of residential seasonal water rates has been suggested as a method to curb peak demand in municipal water systems. The purpose of this thesis is to answer the question: what are the barriers to implementing residential seasonal water rates in the Region of Waterloo? This question is addressed using a variety of data sources, with the majority of the information coming from academic and non-academic literature, and from interviews with water professionals and local councillors. The results provide a descriptive case study concerning the barriers to implementing seasonal water rates in one particular region of southwestern Ontario, but the conclusions can be generalized to describe some of the barriers to the implementation of seasonal water rates in Ontario.

1.2 Research Background, Rationale, and Purpose

Conservation based seasonal water rates are a form of water demand management. Generally speaking, water demand management is defined as "getting the most from the water we have" (Brooks 2006, p. 3). Why might it be necessary for a given water utility to practice water demand management (WDM)? The main reason is that the alternative to WDM is to expand water supply infrastructure, which is extremely expensive. For example, it has been estimated that in the United States, the asset requirement per dollar of revenue in the water utility industry is approximately ten to twelve dollars; this is about three or four times the capital intensity of the telephone and electric utility industries (Hanemann 1998). WDM provides a means to defer capital costs. Additionally, WDM can: lower water treatment chemical costs; reduce power requirements needed to pump water; reduce disposal of waste products from the treatment process; and, reduce treatment costs at a utility's wastewater treatment plant (Mackenzie & Parsons 1994; Sharratt et al. 1994). Overall, WDM has many benefits.

Water pricing seems to be more or less an unpopular subject in Canada. The dearth of discourse has in part resulted in very low water prices relative to other countries in the world. According to the Organization for Economic Cooperation and Development, Canada is one of the highest per capita users of water, and yet has the second lowest average unit price of all OECD countries, after the Czech Republic (OECD 1999). The under-pricing of water services during the peak period (i.e., summer months when water customers irrigate their lawns, fill their pools, etc.) results in over-consumption, thereby encouraging over-development (Mayer & DeOreo 1999; Hanemann 1998). Virtually all water utilities in Ontario use some form of water demand management (de Loë et al. 2001), and yet very few use a seasonal water rate as a specific water demand management tool. If residential peak season demand can be curbed, increasing water demands from a growing population can be met not with new infrastructure, but with the water saved from the implementation of new pricing mechanisms. Reducing demand through pricing mechanisms can result in substantial monetary savings for a municipality and its residential customers, and promote a culture of water conservation. There are potential down-sides to the use of conservation-based pricing mechanisms, many of which will be interpreted to stand as barriers to the implementation of these measures.

Chesnutt and Beecher (1998, p. 61) illustrate why careful consideration of water pricing is important using a parable called, "Using the Wrong Costs Can Lead to the Wrong Decision":

> A water agency has one supply source, the Ol' Faithful groundwater basin, which has a safe yield of 100 acre-ft [123 300 m^3] per year. By charging $1 for each billing unit ($1/BU) sold, the agency has been able to match expenses with revenues. Water demand grew rapidly and, as a result, the agency

> decided it needed to expand capacity. After a great deal of study, the cheapest new source of supply was determined to be a new reservoir fed by Trickle Creek.
>
> Tapping Trickle Creek yielded an additional 50 acre-ft [61 650 m^3] per year, but nowadays even cheap reservoirs are not very cheap. Water rates increased to $2/BU to cover the debt service for the Trickle Creek reservoir. The doubling of water bills caught the attention of most customers who, though appreciative of the improved water supply reliability, adjusted their water use on the basis of the water's "new" value of $2/BU. Water sales were about 20 percent lower in the following year, as water demand dropped to 80 acre-ft [98 640 m^3] per year.
>
> Because the water agency priced water based on historical costs, it added new capacity much sooner than needed. Customers saw their rates double for the sake of an unused water supply project.

The implementation of residential seasonal water rates stands as one method to possibly avoid a situation like the one described here.

The purpose of this research is to understand the barriers that exist to implementing residential seasonal water rates in the Region of Waterloo. The issue is complex and multi-faceted. As Maas (2003) pointed out, "[w]ater pricing reform is a component of larger policy issues concerning the way in which urban water systems are financed, and the way in which efficiency and equity are defined" (p. 19). In an effort to understand the issues *in situ*, individuals with knowledge of and influence over water pricing in the Region of Waterloo were interviewed. The results provide a descriptive case study of the barriers encountered regarding residential seasonal water rates in the Region of Waterloo.

1.3 Research Objectives

Through the use of a literature review and three phases of informant interviews, this paper examines the characteristics of a residential seasonal water rate as a demand management tool in the urban water sector; elucidates the theoretical efficacy of seasonal water rates; reveals and explains the barriers to seasonal water rates; and suggests measures for future action and research. Moreover, this paper contributes to the water soft path, which is a paradigm shift in water management thinking that has four main principles: water should be viewed as a service; ecological sustainability is of utmost importance; water quantity *and* quality should be conserved; and planning should be made from the future backwards, not projected from the present (Brandes & Brooks 2007; see section 2.1.2 for more on the water soft path). This paper will help to contextualize the role of water pricing programs in the soft path conceptual framework. In other words, instead of examining water rates in a strictly financial framework, it is stipulated that water conservation for the sake of environmental prudency is desirable, and therefore there is interest in understanding how seasonal water rates can contribute to far-reaching environmental initiatives.

1.4 Study Area and Groups

The geographical area of study is the Region of Waterloo, located in southwestern Ontario. The main informants are individuals as representatives of water services or Regional Council at the Region of Waterloo.

1.5 Organization of Paper

The thesis begins with a literature review covering some of the important issues regarding water management paradigms, conservation-based water pricing mechanisms, and the barriers to implementing these mechanisms, with a focus on residential seasonal water rates. Next, the Region of Waterloo is put into context to show how water pricing fits into the greater provincial picture. After that, the research strategy and methods employed in this study are explained.

Then follow the results from data collection and a discussion of these results. Finally, conclusions are drawn and recommendations are made for future research.

Chapter 2 –Literature Review

2.1 Water Management in Southwestern Ontario

2.1.1 Framing the Problem: "Irreconcilable Priorities"

Canada is typically envisioned to be awash with freshwater (Sprague 2007). In southwestern Ontario, the proximity of the Great Lakes often makes the procurement of new water a trivial matter, since laying pipe into one of the lakes is considered to be cheap and easy. This propinquity to nature's liquid abundance is all in strict contrast to drier climatic regions such as the southwestern United States, where massive dams and their reservoirs dot an otherwise water-barren landscape (Reisner 1986). The $400 billion (unnormalized) spent on water infrastructure in the United States in the twentieth century influenced other projects around the world (Gleick 1998). As a result, across the globe, large-scale water infrastructure projects were common following World War II, also aided by a post-war development mentality, rising populations, and inexpensive fossil fuels (Dovers 2008). The practice of building large-scale water infrastructure projects is still evident in places like the Region of Waterloo, where a growing population has resulted in a plan to construct a Great Lakes displacement pipeline from Lake Erie to the Region, to be online by 2035 (XCG Consultants Ltd. 2007). Ironically, in the United States, large-scale, federally funded water infrastructure projects are becoming a thing of the past, in part because their astronomical capital investments cannot be justified (Gleick 1998; Postel 1992). The scale of the proposed Region of Waterloo pipeline is on par with those in the United States that are no longer acceptable. The estimated cost of the pipeline construction is $700 million, and is likely to be higher (XCG Consultants Ltd. 2007). This figure does not include annual operating and maintenance costs. So why is the Region of Waterloo considering such an option?

A large part of the problem comes from the fact that Ontario, like countless other places around the globe, has what have been referred to as "irreconcilable priorities" (Environmental Commissioner of Ontario 2007). This term refers to the goals set out in Ontario's *Places to Grow Act* (2005), which legislates rapid population (and economic) growth *and* environmental protection; the two priorities seemingly have ideologically irreconcilable agendas. For example, the Environmental Commissioner of Ontario shows that the *Places to Grow Act* requires that water demand management and conservation strategies be implemented before water infrastructure expansion, and that municipalities should coordinate planning. The proactive adoption of water demand management is a desirable concept, but it may be rhetorical:

> [The *Places to Grow Act*] does not require that population allocations be appropriately adjusted in communities where watersheds are close to carrying capacity. Instead, the [*Places to Grow Act*] favours the *artificial extension* of water and wastewater capacity in such communities, through major infrastructure projects designed to pipe water in from outside of the local watershed (Environmental Commissioner of Ontario 2007, p. 24, emphasis original).

Since the *Places to Grow Act* stipulates a population increase of four million people by 2031 in already urbanized areas, and large water infrastructure projects are generally regarded as a useful tool to encourage growth (Swain et al. 2005), the Region of Waterloo can claim it has been legislated to expand water supply in order to meet this growth.

2.1.2 A Paradigm Shift in Water Management

Despite the disappointing shortcomings of the *Places to Grow Act*, it is important to understand why it recommends water demand management (WDM). Simply put, WDM is the practice of implementing water efficiency, and sometimes conservation. WDM is commonly practiced in many water utilities. For example, the Region of Waterloo has been "actively promoting and implementing water efficiency programs since 1974" (Transportation & Environmental Services: Water Services 2006). Its toilet replacement program (TRP) has been particularly successful. The TRP provides residents with a partial refund from the Region if they replace an old thirteen litre (or greater) per flush toilet with a toilet rated at six litres per flush or less, and has funded over 40 000 toilet replacements between 1994 and 2005 (ibid.). By 2009, the ongoing TRP will save an estimated 1762 m^3/day (ibid.), which is a savings of about four litres per person per day. WDM produces change at the margin in that its implementation requires existing water using behaviours to be tweaked instead of fundamentally changed. As such, the magnitude of its effect is not necessarily large.

At this point, it is useful to briefly elucidate the concept of "sustainability" which so often suffers the fate of falling into rhetorical purgatory. For the purposes of this paper, Gibson's sustainability criteria will be regarded as the most comprehensive set of requirements available. Specifically, Gibson et al. summarize eight criteria required for decision-making for sustainability assessment (Gibson et al. 2005, p. 116-118):

- (i) socio-ecological system integrity
- (ii) livelihood sufficiency and opportunity
- (iii) intragenerational equity
- (iv) intergenerational equity
- (v) resource maintenance and efficiency
- (vi) socio-ecological civility and democratic governance
- (vii) precaution and adaptation
- (viii) immediate and long-term integration

Although this paper will not be able to address all of these criteria individually, and one can see from the list that some criteria in concert would require difficult (if not impossible) tradeoffs, they nonetheless comprise a framework for thinking about sustainability. At the very least, Gibson et al. argue that "sustainability" is not an end but a process, one which is as hopeful as it is critical (ibid., p. 38). Other authors have specifically called for processes akin to Gibson et al.'s criteria in order to advance management in the water sector (e.g., Brandes & Ferguson 2004; Gleick 1998; Orlóci & Szesztay 2008).

With "sustainability" in mind, a concept in utility management has been developed that rejects the constant need for infrastructure expansion to meet population increases. The modern idea was conceptualized and described by Lovins (1977), who named it the *soft energy path*. Particularly concerned with the rise of the nuclear power industry, Lovins showed that new energy demands from a growing economy and population could be "supplied" using conservation and efficiency measures. Thus, new supply infrastructure could be avoided, eliminating the need for nuclear power. These ideas have had an influence on other thinkers, some of whom adapted the ideas to the characteristics of the water sector and formulated the concept of the *water soft path* (WSP).

In developing the WSP concept, Brooks (2005) expounds the shortcomings of its predecessor, water demand management, stating that it suffers from at least three defects, two of which are examined here. First, WDM is usually seen as just a temporary solution to be implemented until the next water supply can be built. Such is the case in the Region of Waterloo, as demonstrated by the plan to build the Great Lakes displacement pipeline. Second, it does not shift conventional thinking far enough to truly be able to cope with long-term water concerns. To put it another way, the single most important characteristic of the soft path for water is that it makes sustainability a new and explicit goal of water management (Holtz 2007). While WDM is necessary in the move to a sustainable water future, it is far from sufficient.

Gleick (1998) recognized the need for a shift in the water management paradigm. Although the term *water soft path* was not yet coined, Gleick was able to succinctly frame the problem:

> The current lack of consensus on a guiding ethic for water policy leads to fragmented decision-making and incremental changes that satisfy none of the affected parties (p. 9).

In other words, piecemeal approaches to water management, including the use of WDM, are generally insufficient, and are downright inappropriate if a sustainable water future is desired. Thus, a new vision for water management is necessary. One such vision is the water soft path.

The WSP is not a difficult concept, as it is composed of just four premises (Brooks 2005; Brandes & Brooks 2007). First, it is necessary to conceptualize water as a *service* instead of a *resource*. Second, the quality of the water needed for a given function should be met by a water supply of the same quality. The typical example is the toilet: there is no reason to use potable water to flush away waste when gray water (water from showers, dishwashers, etc.) is adequate. Combining the first two premises, one could argue for toilets that use *zero* water, since the service of eliminating waste can be accomplished without any water (i.e., by using a composting toilet). Third, ecological sustainability needs to be considered before allocating water supplies for human use. Finally, in concert with the notion of developing a water ethic, it is desirable to envision a future water scenario and work backwards from there ("backcast") by finding the appropriate soft path. Creese and Robinson (1996) anticipated this last WSP premise by suggesting that the question "how much water resource use per capita is desirable?" must be answered, meaning that future goals must be sought instead of simply continuing with the status quo.

Currently, the WSP concept is just that: a concept. The operationalization of the WSP is dauntingly difficult. For example, if premise three is accepted as necessary, it follows that the water needed for sustainable ecological function must be defined, measured, metered, and monitored. Literature on this topic is as yet scant with few exceptions (e.g., Katz 2007). As such, although the WSP may be a desirable goal, it is best to approach the problem incrementally. In order to do so, it is helpful to analyze the notion of "water scarcity".

Wolfe and Brooks (2003) argue that "water scarcity" can be divided into three parts. First order scarcity refers to the abundance or scarcity of physical water resources. Second and third order scarcity refer to the social adaptive capacity available to cope with first order scarcity. Responses to second order scarcity would be "those adaptations—whether technological or institutional—that make management of [water] more efficient" (p. 101). Water demand management is typically associated with responses to second order scarcity, and adopts technological and economic approaches. Responses to third order scarcity "would shift the efficiency emphasis away from the technical and microeconomic realm, and would therefore depend on substantial social, political, and cultural changes" (ibid.). It should be noted that these three parts should not be understood as being mutually exclusive, since each affects the other two. The water soft path concept is understood as existing as a response to third order scarcity. However, in relatively "water-rich" countries like Canada, the implementation of economic measures as a response to second order scarcity is important, and exists as a precursor to the water soft path. Grima (1972) expressed the importance of pricing programs in the following passage:

> In general the emphasis in water utility management has been to develop new sources of municipal water in order to meet projected "requirements" for municipal water. This emphasis on the "supply fix" disregards the efficiency principle that investment in water resources for whatever purpose should be increased up to the point where it is justified by the value that the commodity puts on it (p. 4).

Thus, having demonstrated the need for proper economic measures as an incremental step in achieving the WSP, it is necessary to understand how water pricing fits into this concept.

2.2 Water Pricing

2.2.1 The Importance of Peak Demand

Residential demand for water from a given system is not constant. As such, "peaks" occur at different times, and there are different kinds of peaks depending on the unit of time being assessed. For example, the average day has diurnal peaks in the morning and evening (HDR Engineering 2001). More importantly, for many utilities, the largest peak occurs in the summer months as a result of seasonal water use for lawn irrigation, filling up swimming pools, etc. (Mayer & DeOreo 1999). Peak demand is one of the main drivers for infrastructure expansion (Chesnutt & Beecher 1998; Furst et al. 1981; Grima 1972; Michelsen et al. 1998; Renzetti 1999). Hanemann (1998) succinctly explains the nature of the problem:

> [A water] distribution main jointly provides base capacity for off-peak service and extra capacity for peak service. To increase capacity by one unit for peak service necessarily increases capacity by one unit for off-peak service… [the] two costs are inextricably linked (p. 148).

To further illustrate the link between peak and off-peak water, consider a hypothetical situation in which water demands are constant throughout the year. As such, it is possible to build this water system to the exact specifications necessary to deliver this constant amount of water on a daily basis. Now consider another hypothetical system, identical to the first except for the fact that water demand doubles one day out of the year. As such, the *entire system* is built to provide this doubled demand at a much higher cost than the first system, even though the demand occurs only one day of the year. So, peak demand water disproportionately drives up the total cost of a given water system. If peak demand can be lowered, then a great step in the effort to reduce infrastructure expansion would be achieved. Demand management through economic measures provides one option to help curb peak demand.

Microeconomic theory suggests that demand for a good is affected by the price for that good (e.g., Lipsey & Ragan 2003). Residential demand for water is endogenous in that "a representative household's demand for water is a function of the price of water, the prices of other goods and services, income, the stock of water-using capital, socio-demographic characteristics of the household, and possibly… [climate]", all variables which (except for the last) can be analyzed in the realm of economic theory (Renzetti 2002, p. 133). In fact, Renzetti argues that water demand management *by definition* effects change in one or more of these variables in order to influence residential demand levels (ibid.). For the purposes of this paper, the price of water as an influence on residential water demand will be examined.

2.2.2 Current Pricing Practices

Many public water utilities price their water using average cost (AC), which is the total cost of providing water divided by the quantity sold. Because water utilities are seeking only to bring in revenues equal to their costs (i.e., to break even), average cost pricing makes perfect sense in theory. In reality, the nature of supplying public water makes AC pricing very difficult.

To maintain revenue neutrality, AC pricing is the simplest option for public water utilities, but according to economic theory, it does not maximize economic efficiency, since economic efficiency is achieved when the marginal price of a unit of water is equal to the marginal cost of providing it. Marginal cost pricing will be examined more closely in section 2.2.4.

Renzetti (1992) illustrates three problems with AC pricing. First, utilities tend to undervalue capital costs, since they measure these costs as "the scheduled expenditures to retire debt rather than the user cost of capital" (Renzetti 1992, p.

149). In other words, the "cost of water provided" is based on historical costs, even though total cost is comprised of both fixed costs and variable costs (Chesnutt & Beecher 1998; Renzetti 2002). Fixed costs do not generally vary with the amount of water delivered through the system, whereas variable costs do. But even fixed costs can vary depending on the timescale being considered. In the short-run, capital is "unmalleable", but in the long-run, capital can wear out or be replaced, and becomes variable (Hanemann 1998, p. 144). As a result, AC pricing based on historical costs cannot, by definition, account for future costs stemming from infrastructure expansion. So, the costs of capacity expansion undertaken in any period are not incorporated into that period's prices. Reviewing the water rates used in Ontario in 1991, Renzetti (1999, p. 700) wrote, "[the] most important finding is that prices understate the marginal costs of providing these [water and wastewater] services by a wide margin".

The second problem with AC pricing is that there is no price signaling, no feedback; consumer demands are considered to be exogenous,[1] and resource scarcity is not communicated.

Third, the basis for most utilities' prices is AC at the predicted level of output, but there is no guarantee that output will end up as predicted. This can lead to revenue losses in the short-term. In all, these issues lead to historical capital costs being undervalued, and financial losses for utilities. In Ontario, the Ministry of Public Infrastructure Renewal has estimated a cost of $25 billion for renewal and replacement of existing assets (Swain et al. 2005). Until recently, municipalities received subsidies in the form of capital grants from provincial and federal governments, but these did not fill the funding gap (ibid.). In recent years, water prices in Ontario have started to go up, following the trend seen in many OECD

[1] In economic theory, there are two important and broad types of variables. An endogenous variable is one whose value is determined within the theory. An exogenous variable can influence endogenous variables but is itself determined by factors outside the theory (Lipsey & Ragan 2003).

countries (OECD 2003). The reason for price changes will be explained in section 3.5.

2.2.3 Desired Characteristics of a Pricing Initiative

A desirable water pricing initiative will exhibit a number of different characteristics. Table 2.1 shows the range of provisions suggested in the literature. Different types of literature were consulted for the purpose of constructing the table. Some were written as policy papers, others focused on rate structures as a method for water demand management, while still others were concerned with water economics in general. Additionally, much of the literature used was targeted towards members of either the American Water Works Association or the Canadian Water Resources Association, that is, water management professionals. All authors except for Herrington and Savenjie & van der Zaag wrote specifically for a North American audience. Of particular note is the inclusion of characteristics stated in the Region of Waterloo's *Water Efficiency Rate Study – Phase 1 Report* (Regional Municipality of Waterloo Water Services Division 1999). This report is described in section 3.3.3.

No matter the type of paper, every one used for this section explicitly focused on the issues pertaining to understanding, designing, or implementing water rate structures. This narrow focus stands in contrast to the larger variety of literature used throughout the rest of this chapter, which ranges in subject matter from water demand management in general, public water management policy, "water as an economic good", and literature on the water soft path and sustainability.

Table 2.1 was constructed without preconceived notions of what characteristics authors might suggest for the making of a "good" pricing initiative. In some cases, authors listed a set of stipulations explicitly (e.g., Lawson & Fortin 1994), whereas in other cases characteristics were implicit. The table is ordered from highest frequency to lowest, but this does not imply that one characteristic is more important than another. Other characteristics were included by some authors, but are not listed here if less than three authors mentioned them.

Desired Characteristic	Cited Authors
Full cost recovery	Grima 1972; Hanemann 1998; Herrington 2007; Lawson & Fortin 1994; Loudon 1994a; OECD 1999; Policy Research Initiative 2005; RMWWSD 1999;[2] Rogers et al. 1997; Savenjie & van der Zaag 2002; Sharratt et al. 1994; Swain et al. 2005
Economic efficiency and proper allocation	Grima 1972; Hanemann 1998; OECD 1999; Lawson & Fortin 1994; Policy Research Initiative 2005; Renzetti 1992
Social equity	Herrington 2007; Lawson & Fortin 1994; OECD 1999; OECD 2003; Savenjie & van der Zaag 2002
Rate structure transparency	Grima 1972; Hanemann 1998; Lawson & Fortin 1994; OECD 1999; RMWWSD 1999; Sharratt et al. 1994
Foster conservation	Hanemann 1998; Lawson & Fortin 1994; Policy Research Initiative 2005

Table 2.1 – Desired water pricing initiative characteristics.

As can be seen in the table, full cost recovery is the most frequently cited desired characteristic of any given pricing initiative. While some authors simply mention this need in passing, others explore it in more detail. For example, Hanemann (1998) divides this characteristic into three parts. First, the need for *revenue sufficiency* suggests that a pricing structure should allow a utility to be self-sustaining. Revenue sufficiency in effect eliminates transfers from property taxes or higher levels of government. Second, *net revenue stability* refers to financial stability over time, or utility longevity. Finally, the *administration costs* of a new

[2] RMWWSD 1999 is Regional Municipality of Waterloo Water Services Division 1999.

rate structure must be balanced against the potential benefits of its implementation.

The second characteristic, "efficiency", is used in terms of economic theory, and the term will be explained in further detail in section 2.3.11 below. In essence, the desire for allocative efficiency is a desire for water to be used for purposes that will maximize utility (i.e., move to the edge of a production possibilities curve; see section 2.3.11.c for more on production possibilities curves). Moreover, a pricing system based on the efficiency principle "regulates the demands and system growth" of a given water system (Lawson & Fortin 1994, p. 272).

The third characteristic, social equity, refers to fairness. The OECD (2003) suggests that affordability is the aspect of water service that is most clearly and closely linked to pricing policies. As one of the more progressive thinkers in water pricing economics, Herrington (2007) is able to split the requirements of a good water rate into just two parts:

> There are two requirements [for water tariffs]: for *sustainability*, metered tariff structures which encourage conservation and penalise wasteful use; and, in order to make metering acceptable, *social* tariffs which reduce the financial burden on lower-income households (p. 3, emphasis original).

Thus, in an effort to usher normative thinking into the economic realm, Herrington calls for more from the implementation of water rates than is usually demanded. Authors who argue for "equity" in terms of keeping water prices low for commercial and industrial users were not included.

The fourth characteristic, rate structure transparency, refers to the fact that water consumers should generally understand the rate structure in order to effect desirable change. Economists describe this as setting a proper price signal (Hanemann 1998; Maas 2003). In principle, the best medium for sending price signals is the consumer's water bill, but as will be seen, the reality of most contemporary water billing makes this difficult.

Finally, fostering water conservation is of course the main objective of the water soft path, so it is somewhat disappointing that it is not often mentioned as a goal for water pricing. The lack of frequency for this characteristic is most likely because conservation does not fit into the conventional economic paradigm.

2.2.4 Water Pricing Options

The purpose of this section is not to review all possible options for water pricing, but instead to focus on the options that may affect seasonal use. In very general terms, this usually implies raising the rate for water in the summer compared to the winter. Seasonal rates can be implemented in a variety of ways, each with advantages and disadvantages.

In concert with welfare economic theory, it is sometimes argued that water should be priced at its marginal cost as opposed to being based on the embedded costs of the water system. The latter approach "looks backward to the costs that the utility has already incurred, and emphasizes the estimation and allocation of historical (i.e., embedded) average cost" (Hanemann 1998, p. 143). Conversely, proponents of marginal cost pricing "are generally forward looking: as a basis for setting prices, they look to marginal cost rather than average cost, and replacement cost rather than historical cost" (ibid.). Therefore, if it is desirable to defer a future large project like the Region of Waterloo's Great Lakes displacement pipeline, it would seem reasonable to argue for long-run marginal cost (LRMC) pricing. However, this suggestion is at odds with a public water utility's mandate to break even, often through the use of average cost pricing. The following figures help to illustrate the difference between marginal costs and average costs. Figure 2.1 shows the short-run cost curve for a single capital project. The short-run marginal cost (SRMC) curve lies below the average cost curve when the SRMC of providing an additional unit of water is small once capital costs are already "sunk". Many utilities have systems that are much more complex, especially since they must continue to expand in order to meet new demands from growing populations. Thus, once an initial supply source is fully used, a new source is built and made operational, often making SRMC now *greater* than short-run AC. This trend will continue, and in the long-run, marginal cost will be greater than average cost. As can be seen in figure 2.2, and as stated by Grima (1972):

> It may be concluded that residential water is a commodity whose supply increases in discrete quantities, that within each unit of increment the average costs decline until capacity is reached and that the marginal costs of supplying residential water are increasing in the long run (p. 134).

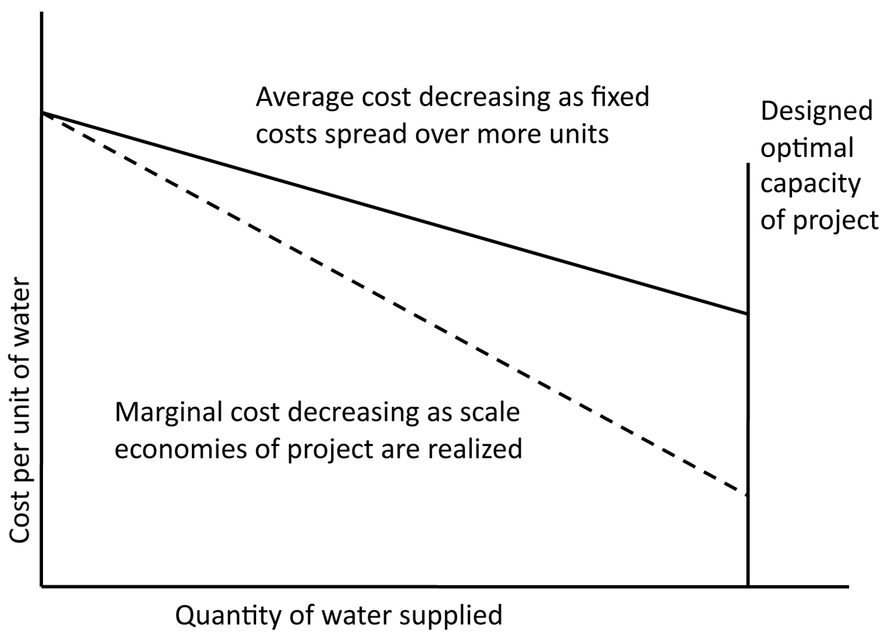

Figure 2.1 – Short-run cost of supply for a single project. (Adapted from Hanemann 1998.)

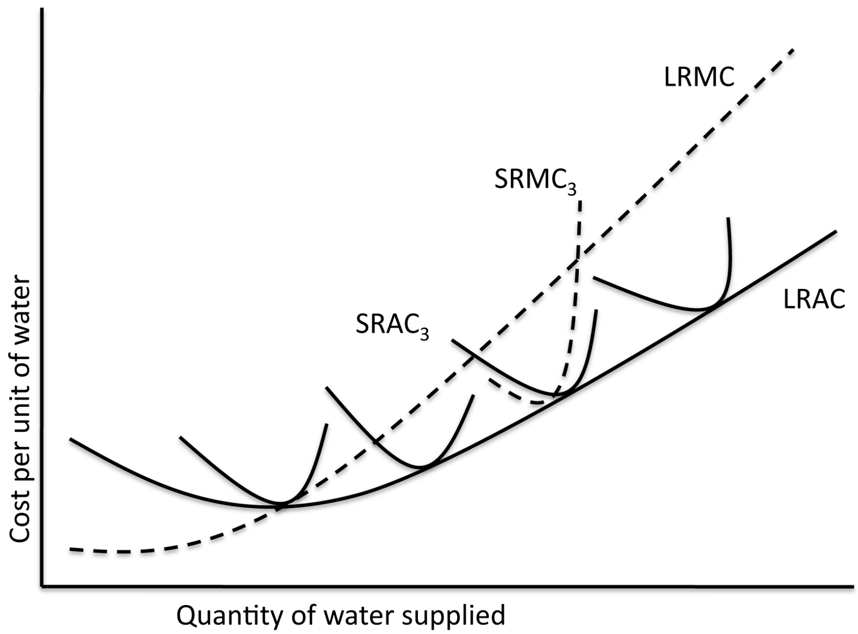

Figure 2.2 – Average and marginal cost curves of municipal water supply. The short-run marginal cost for a third water supply infrastructure expansion is shown. Short-run marginal cost is less than short-run average cost when the latter is falling, equal to SRAC at its minimum, and then it rises steeply when design capacity is reached. This pattern is typical for most water supply systems. (Adapted from Grima 1972.)

These figures help to illustrate that there is no simple way of deciding how to charge for water. Even authors who argue for the use of LRMC pricing acknowledge the difficulties. For example, there is a certain amount of guesswork inherent to the use of marginal costs: "marginal cost estimation still lacks the attractive precision of historical costs, which are known to the penny" (Chesnutt & Beecher 1998, p. 65). Additionally, Harris (1994) suggests that the determination of the "long-run" is more or less arbitrary. Finally, Grima (1972) observes that even though it is economically efficient to charge for water using marginal costs, in most cases, LRMC is either less or more than LRAC, implying losses or profits by the water utilities. In the former case, a standing charge can be used to supplement the revenue based on volume, and in the latter case, a certain volume of water could be free of charge. Nonetheless, it is clear that the use of marginal cost pricing for water is not a trivial matter.

Some forms of seasonal rates are built on the notion of marginal cost pricing. In order to understand this, recall the importance of peak demand. Hanemann (1998) explains the notion of "peak responsibility": those who create the peak should pay for the peak (p. 160). Certain peak uses, like water used for fire fighting, are stochastic and therefore unpredictable. Conversely, lawn irrigators are considered to have "systematic variation on demand", and therefore might be accordingly targeted with seasonal rates (ibid.). Water used to irrigate lawns is in a sense not equal to water for more essential uses:

> Where customers' demands vary in the degree to which they impose a peak load on the system, some differential service or demand charge can be justified. In a sense, the commodity delivered off-peak is not the same as that delivered on-peak (Hirshleifer et al. 1975, p. 434).

Since lawn irrigators, like every other user, draw from the water system at the margin, then it makes sense to have "differing on-peak and off-peak prices" if it is considered desirable to curb demand and defer infrastructure expansion (ibid.). But how does one determine the price of peak-use water compared to off-peak water? Renzetti (1992) suggests two simple formulae:

$$p^{peak} = LRMC$$

$$p^{off} = SRMC$$

where LRMC is the long-run marginal cost of providing water, and SRMC is the short-run marginal cost. These formulae, however, run into the same problems as those examined above.

If it can be assumed that, despite its problems, MC pricing is desirable, then it is necessary to go beyond the theory of water pricing and examine what structures might be used to actually implement seasonal water rates. There are basically two choices: the use of an increasing block rate (IBR), or the use of a summer levy.

An IBR water pricing structure charges per volume of water used, and increases in discrete steps as more water is used (see figure 2.3). Water for essential purposes such as drinking, washing, and the like is charged at a low amount (or is free). As volume increases, uses are considered more discretionary, and higher prices are used to reflect the cost of delivering this water. Water for lawn irrigation might fit into the fourth tier of an IBR, thereby either discouraging the use of this water, or better reflecting the cost of providing it. Grima (1972, p. 175) states, "the same effect of summer charges may be expected from an increase in the marginal price or from an increasing price block schedule, and they are relatively costless alternatives", thereby suggesting that IBRs are a better alternative to summer levies. Loudon (1994b) also points out that IBRs can be effective against day-to-day water wastage as well as summer peaks.

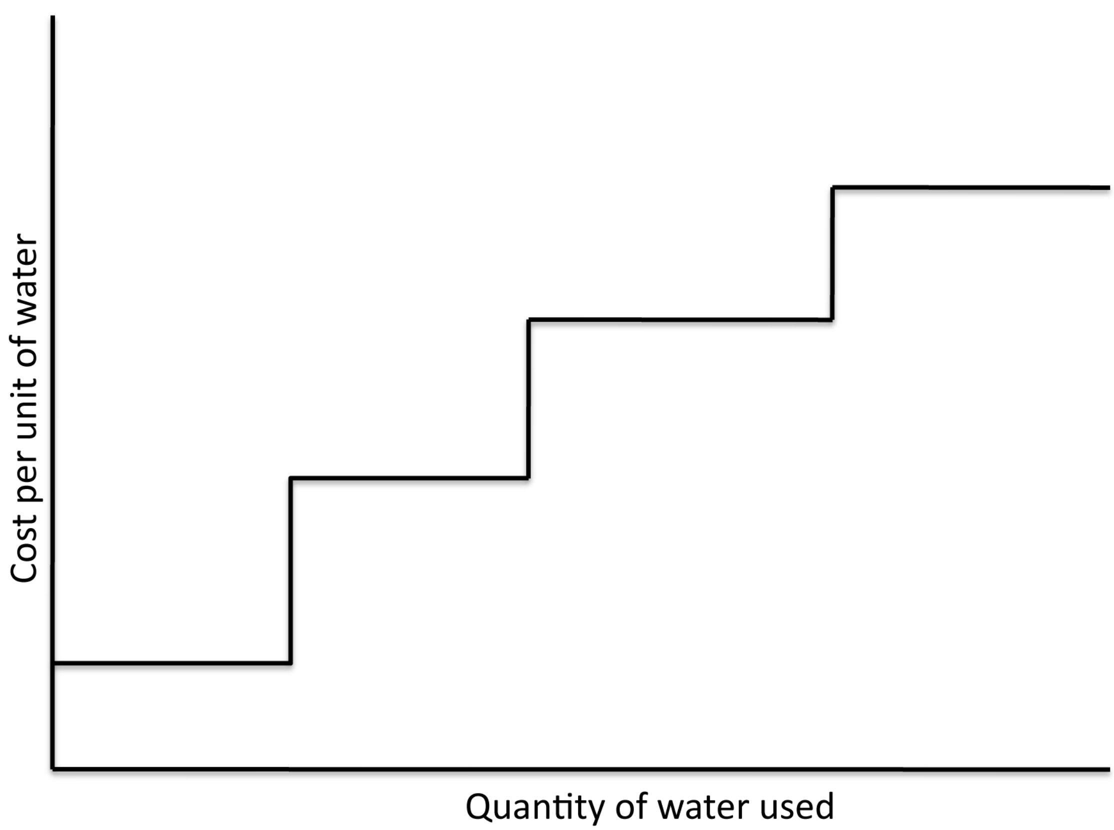

Figure 2.3 – Basic structure of an increasing block rate (IBR).

In contrast to an IBR, a summer levy rate charges a higher price during a utility's peak use season. Due to the irrigation of lawns and the filling of swimming pools, this season is usually the summer. For a given period in a year (e.g., May 1 to October 1), residential water users are subject to a modified water rate. The simplest modification is to charge a levy of a certain percentage on all water used during this period. However, this practice might be viewed as inequitable, so many authors suggest that utilities utilize each customer's off-peak use as a basis for determining peak use (Loudon 1994b). For example, off-peak use may be determined by calculating the monthly average for a given household during the winter period (e.g., October 1 to May 1). The summer levy can then be softened by choosing a ratio to allow for some extra water use in the peak season (e.g., a ratio of 1.25 would indicate that customers could use 25% more water than their base (winter) use in the summer before being subjected to a summer levy). Given that such a rate structure is based on average use in the winter season, it would most likely be viewed as equitable. See Furst et al. (1981) for a good example of how to calculate a summer levy.

Overall, summer levies represent a powerful option for public water utilities that are interested in changing their pricing structures. The next section explores some of the examples of the implementation of seasonal rates around the world.

2.2.5 Examples of Seasonal Rates Around the World

To begin this section, it is important to know that "very few examples of the regular use of seasonal tariffs in OECD countries have been reported" (OECD 1999). Nonetheless, at least a few examples can be examined.

The United States contains the most examples of seasonal water rates (Herrington 2007). Fairfax County Water Authority, which serves Washington D.C., was the "first system in the [United States, 1973-74] to design and adopt an entire series of cost-of-service rates, fees, and charges" (Griffith 1991, p. 61). Included in these new charges was a peak use charge, considered at the time to be radical. The design of the new rate was simple: peak use applied from June 1st to November 30th. All customers who utilized water in excess of 30%, or 6000 gallons (whichever was larger), above their winter quarter (February to April water bills) had to pay $2.45 per 1000 gallons on top of the existing charge of $0.95, for a total of $3.40 per 1000 gallons. Fairfax County was specifically targeting lawn irrigators. Griffith explains that the rate was successful at charging more to those who created peak demand, which was the goal of the pricing change, but he does not claim the program reduced peak demand.

In the United Kingdom, a study is being conducted to test seasonal rates on two hundred new homes:

> Between 2006 and 2010, half the homes will go on [a] standard tariff, for 2007-08 paying a standing charge of £23.40 and a volumetric charge of £0.90/m^3, and half on to a seasonal tariff, paying in 2007-08 the same standing charge and a volumetric charge of £1.78/m^3 over May-August and £0.46/m^3 for the rest of the year (Herrington 2007, pp. 23-24).

The results from the study might give a good indication of the efficacy of the implemented seasonal rate, including users' perceptions. However, it should be noted that this study employs the less popular form of a summer levy, since it penalizes *all* water use in the summer period, not just water used *above* a winter average. Analysis of results from the study should take this fact into account, since the pricing method employed may be deemed as less equitable than one based on winter averages. Nonetheless, some sort of pilot study should be considered prudent for any utility interested in seasonal rates: instead of implementing throughout an entire jurisdiction all at once, it is logical to first try it on a subsection of the population in order to gather empirical evidence of its effects.

Canada has very few examples of seasonal rate implementation. Windsor is an exception, where a summer levy was introduced in 1989. In an effort to curb peak demand, Windsor Public Utility Commission calculates the winter use of every customer for the November to April billing period, and tacks on a summer levy for the May to October billing period for any water consumed above that base amount. In 2003, the base rate was $0.266/m^3$ and the summer levy was $0.249/m^3$, totaling $0.515/m^3$. Windsor's maximum (peak) day to average day demand ratio dropped from 1.63 (average 1980 to 1988) to 1.5 (average 1989 to 2003) (OCMBP 2004). Although this drop in peak-to-average ratio is encouraging, there is no clear evidence as to whether the drop might have been a result of other factors.

Computer simulations testing the hypothetical implementation of seasonal rates have demonstrated reductions in peak demands in the range of 6 to 8%, but it is difficult to trust the validity of such simulations (Herrington 2006). In general, the implementation of seasonal rates generates peak ratio reductions of 8 to 14% (mean: 12%), but again, it is difficult to attribute these changes exclusively to the seasonal rates (Herrington 2007).

Wherever seasonal rates are implemented, most authors (even the economists) argue that they cannot be implemented without concurrent non-price programs. Price and non-price programs are part and parcel (Hanemann 1998). Windsor Public Utility Commission would not have been able to follow through with their summer levy if it was not for their parallel education program about the levy (OCMBP 2004). Likewise, "if the plea for conservation is not accompanied by an increase in water rates, the plan is likely to fail in the long run" (Nieswiadomy 1992). As such, it makes little sense to speak of demand management if only pricing or non-pricing programs are being considered.

2.2.6 Example of a Conservation-Based Rate in a Two-Tiered Supply System

As will be described below, the Region of Waterloo's water supply system is two-tiered, in that the responsibilities are allocated to both the Region and the area municipalities. This two-tiered system makes implementation of conservation-based rates difficult, but there exists at least one example of a two-tiered system using this type of rate.

The City of Dallas, Texas, is a wholesale water provider, selling both untreated and treated water and wastewater treatment services to cities. Wholesale treated water rates have two components: a volume charge per thousand gallons and a demand charge per million gallons per day (MGD) of "rate of flow controller" (ROFC) setting, which wholesale customers have to predict as precisely as possible in order to avoid incurring penalties. For example, if a city had a ROFC setting of 10 MGD, they would pay 10 times the current rate of $174 633/MGD plus they would pay $0.3716 per thousand gallons used during the year. If a wholesale customer needs to increase its setting, the increase is retroactive to the start of the "water rate year" and must stay in effect for five years. If a customer wants to reduce its setting, the setting is reduced and the customer is tied to the existing rate setting for five years. According to an email communication from Lowery, Senior Program Manager, Financial Planning Division for the City of Dallas Water Utilities, this structure is intended to keep the wholesale customers from "peaking off the system" and to only reserve the capacity they need (Lowery 2009, pers. comm., 2 June). Overall, the method is considered to be quite successful in reducing peak demands but, due to unusual weather periods over the last several years, the reduction to the peak ratio has not been empirically determined, as outlined by Lowery in an email communication (Lowery 2009, pers. comm., 9 June).

2.3 Barriers to Implementing Seasonal Rates

2.3.1 Framework for Studying Barriers

Painuly (2001) offers three steps for the identification of barriers: conducting a literature review, visiting the site of interest, and interacting with appropriate stakeholders. This section will survey the existing literature related to the implementation of seasonal water rates, and will draw out some common themes.

This paper will use a straightforward definition of barriers: "barriers to environmental management are conditions that may adversely affect the implementation or effectiveness of environmental initiatives" (Kirkland & Thompson 2002, p. 60). Jordaan et al. (2009) offer a set of barriers that apply specifically to the implementation of water conservation. These were chosen from a larger list of barriers to the implementation of environmental management in general, gathered by Kirkland and Thompson (2002), and also build on the work of Brandes and Ferguson (2004). According to these authors, the important categories of barriers with respect to water conservation implementation are: attitudes and perceptions; organization and management; financial; data and information; and policy and governance. Other barriers specific to seasonal water rate implementation include: possible inefficacy of price programs; water billing; equity; and general problems with respect to economic instruments. Each of these barriers will be examined, along with a look at the problem of conflicting definitions.

2.3.2 Attitudes and Perceptions

Jordaan et al. (2009) argue that attitudes and perceptions are mostly intractable, and are often value-laden. For example, the "myth of superabundance" suggests that many people in Canada believe there is a near limitless amount of water available, and therefore there is little need to conserve (Brandes & Ferguson 2004). Jordaan et al. (2009) also specifically mention the perceived disconnect between human systems and ecological systems, and the fact that some people believe that conservation will lead to financial losses and generally ill-fated futures.

On a more general level, change in environmental thought is seen as unlikely, since it counters "the inevitable logic of the inherited urban system, market-defined social expectations, the inertia and discouragement of powerful organizations, and the growth imperative of the economic system" (Dovers 2008, p. 94). The suggestion to change water pricing mechanisms is met with similar skepticism.

2.3.3 Organization, Management, and Administration

Jordaan et al. (2009, p. 149-150) argue that, "[o]rganizational structures and management approaches, within any organization or decision-making authority, can create barriers to [demand management] when they conflict with existing practices and protocols". This barrier may exist in the case of the Region of Waterloo, where a "two-tier" government structure makes certain types of policy implementation, like the introduction of seasonal water rates, more difficult. The authors also explicitly mention the problems of fragmented management (i.e., different departments as separate "silos"); prominence of formulaic approaches; and performance management focused on monitoring rather than problem solving.

2.3.4 Financial

Any effort to implement water conservation or efficiency measures, including new pricing measures, requires financial resources. Jordaan et al. (2009) suggest there is often a perceived cost of initiatives and an underestimation of benefits, and that a gap in payback can hinder the implementation of water conservation or efficiency programs.

Jordaan et al. (2009) also point to "fiscal viability" as a barrier that is especially pertinent to the implementation of new water rate structures. Public water utilities need to maintain sufficient revenue; this could be compromised in cases where marginal cost pricing is used if the marginal cost is lower than the average cost, but this would not be the case for most instances of seasonal water rates. Water utilities need predictable and stable revenues, a need that is echoed by the Policy Research Initiative (2005) and others (see section 2.2.3 above). Seasonal water rates would not necessarily be as predictable as, for example, average cost pricing.

2.3.5 Data and Information

The Policy Research Initiative (2005) decried the general paucity of data in the water sector. Michelsen et al. (1998) stress the need to have accurate information about residential consumers' responses to conservation programs. With regard to pricing programs, they suggest that the effects of pricing programs are not well understood, and that the synergistic effects of price and non-price programs are even less well understood. In general, it is difficult to isolate the effects that might be induced by a price program:

> The underlying problem about estimating the effects of metering and tariff structure (and tariff level) changes (or differences) is that when the changes (or differences) are taking place (or being revealed), the likelihood is that there are simultaneously other factors at work that may also affect household behaviour. (Herrington 2007, p. 18)

Jordaan et al. (2009) point specifically to a lack of regular time series data on water withdrawals, use, and consumption, and a lack of access to relevant case studies and success stories as data and information barriers.

2.3.6 Policy and Governance

Water pricing requires that different actors representing different parties place "different weights on the alternative criteria" during the decision-making process, thus making it political in nature (Hanemann 1998, p. 141). Additionally, "proactive changes to policy related to future water efficiency and conservation goals are less common and often more difficult to achieve" (Jordaan et al. 2009, p. 155). Political will can be lacking, which is especially detrimental to conservation programs, which require major and continued commitment to implement (Michelsen et al. 1998, p. xxiii).

2.3.7 Possible Inefficacy of Price Programs

Some authors have argued that non-price programs are often more effective at inducing residential water users to reduce their demands than price programs due to the inelasticity of water (Atwood et al. 2007). Others have suggested that information policies (through educational programs, etc.) and subsidies (in the form of rebates) appear to be more effective than rising prices (Policy Research Initiative 2005). Combine these two issues with the lack of supportive data for the efficacy of seasonal water rates, and it is not surprising that pricing programs are considered to be ineffective by default.

2.3.8 Residential Water Billing

In general, water bills are distributed infrequently, and are *ex post facto* in nature (Michelsen et al. 1998, p. 12). Consumers thus have a limited amount of information about the quantity of water consumed at any given time (ibid.). Thus, price signals are absent, and changes in water rates lose their efficacy, leading to a further lack of residential efficiency and conservation practice (Jordaan et al. 2009; Maas 2003). Additionally, in the case of some summer levies, all applicable meters would ideally be read on approximately the same date as the summer charge comes into effect, which may prove to be logistically very difficult (Grima 1972). Finally, new water rates need to be explained clearly and simply through the water bill; this can make the implementation of more sophisticated pricing structures difficult (Policy Research Initiative 2005).

2.3.9 Equity

Surprisingly, very few authors address the equity concerns of implementing new water rates. One exception is Herrington, who holds that higher water prices may "pose intolerable burdens on the budgets of lower-income and other vulnerable households" (Herrington 2007, p. 15). This risk is true even for seasonal water rates. In one computer model designed to test the outcomes of implementing a seasonal rate, "the big losers from [the seasonal rates] are, as expected, the top three deciles, but at the same time the "losing" households among the two lowest income deciles surprisingly numbered nearly 40% of the total" (Herrington 2007, p. 34). It should be noted that in this study, households were assumed to be changing from an unmetered flat rate to a seasonal rate without allowance for family size and without establishing a base rate for each household based on winter consumption. Overall, it is not necessarily true that lower income groups would suffer in all cases of seasonal water rate implementation, but the possibility remains that more than just lawn irrigators may be affected by higher prices for water, and so equity stands as yet another barrier.

2.3.10 Inherent Problems of Economic Instruments

Some authors argue residential water in an urban setting is a private good, since it is characterized by "competition in consumption and excludability" (Edwards 2006). So, public water suppliers must cope with the knotty reality of providing a private good from a public utility. Only recently in Ontario has water been seriously thought of as an "economic good"; this is perhaps one of the main reasons why water pricing as a demand management tool has historically not seriously been considered.

The authors Savenjie and van der Zaag (2002) find serious problems with the notion of "water as an economic good". They argue that this notion has two schools of thought. The first school "maintains that water should be priced at its economic value", the concept of which is fraught with difficulties such as defining the term "economic good" and over dependence on the nebulous forces of the market (p. 98). The second school "interprets the term to mean the process of integrated decision making on the allocation of scarce resources, which does not necessarily involve financial transactions" (ibid.). Savenjie and van der Zaag argue that the concept "water as an economic good is about making integrated choices, not about determining the right price of water"(p. 99). Other authors question whether the emphasis on water pricing might shift the thought of water as a commons good to a commodity (e.g., Maas 2003). Finally, water pricing is doubtlessly targeted towards the individual user, and this can be problematic: "[at] best, a focus on individual consumption behaviour change ignores how a modern society functions" (Dovers 2008, p. 83).

2.3.11 Conflicting Definitions

A significant barrier to the implementation of any environmental initiative is the lack of perfect communication between different actors. One of the reasons for the existence of this barrier is that there are a number of terms with incongruous definitions, depending on who is using the term and to what aim. This section will list and examine some of these problematic terms.

2.3.11.a Efficiency

The term *efficiency* is often interchanged with *conservation*, but the two words have significantly distinct meanings. The word *efficiency* is especially problematic, since it is used as an important term in a variety of disparate disciplines. For example, Lipsey and Ragan (2003) draw distinctions between *engineering efficiency, technical efficiency,* and *economic efficiency*. *Engineering efficiency* refers to "the physical amount of some *single key input* that is used in production" (p. 186). *Technical efficiency* refers to "the physical amount of *all factors* used in the process of producing some product" (ibid.). The first two are often conflated. Finally, *economic efficiency* is "related to *value* (rather than physical amounts) of all inputs used in producing a given output" (ibid.).

There are cases where the term "efficiency" is not used precisely, and this can lead to problems. For example, Edwards (2006) argues that the "state" (in this case, Australia) defines efficiency as "using small amounts of water", whereas the economic definition simply implies high marginal value of water. As will be seen below, the "state" is actually arguing for *conservation*, not *efficiency*. The "state" might be interested in promoting *conservation* through the use of high-*efficiency* devices (e.g., low-flush toilets, low flow showerheads, etc.), but this is not clear.

It is possible to imagine an increase in *technological efficiency* leading to an increase to total consumption for a given resource. This phenomenon was demonstrated by Jevons in 1865, and is now known as the Jevons paradox (Jevons 1906). The existence of the Jevons paradox demonstrates the importance of clarifying the goal of a given water rate structure change, especially if *conservation* is valued more highly than *efficiency*.

Efficiency is a means, not an end. Hirshleifer, deHaven, and Milliman (1975) suggest, "[e]conomics alone cannot give us answers to policy problems; it can show us how to attain efficiency and what the distributional consequences are of attaining efficiency in alternative possible ways, but it does not tell us how to distribute the gain from increased efficiency" (p. 425). Undoubtedly, these authors are referring to *economic efficiency*. Unpacking the meaning of this definition implies that water should be utilized as long as someone is willing to pay for it: "[we] may say that, on efficiency grounds, additional units [of water] should be made available so long as any members of the community are willing to pay the additional or marginal costs incurred" (p. 429). Clearly, this issue of potentially insatiable water demands is an issue that pertains to seasonal water rate implementation. If people are willing to pay for water for lawn irrigation, and an economically efficient system is desirable, then water should be delivered to these people. Conversely, if the goal of implementing seasonal rates is to curb demand and reduce water use, then unfettered water delivery is problematic. What is important, then, is the elasticity of seasonal use water.

2.3.11.b Elasticity

Elasticity itself is well defined. For a given product x, *elasticity* is the percent change in quantity demanded per percent change in price:

$$E = \%\Delta x \;/\; \%\Delta p$$

So, an elasticity of - 0.1 would imply a ten percent *decrease* in demand (demarcated by the negative sign) for product *x* given a price increase of 1 (i.e., 100%).

The major barrier to implementing seasonal water rates with regard to *elasticity* is that there is no consensus as to what the elasticity of summer water demand might be. Table 2.2 shows a summary of summer water elasticity estimates from a number of different studies.

Estimate of Summer Water Demand Elasticity	**Type of Analysis**	**Location**	**Source**
– 1.07	Cross-sectional	Toronto, Canada	Grima 1972
– 0.70 to – 1.57	Cross-sectional	U.S.A.	Howe & Linaweaver 1967
– 0.82	Cross-sectional	U.S.A. & Canada	Mayer & DeOreo 1999
– 0.20	Cross-sectional	Southwest U.S.A.	Michelsen et al. 1998
– 0.20	Cross-sectional, time-series	California, U.S.A.	Renwick & Green 2000

Table 2.2 – Summer water demand elasticity estimates.

One will notice from this table that the studies were conducted in different regions across North America, and at different times. The impact of a price increase can be divided into income effects (where an individual's income affects his or her ability to pay more for a given product) and substitution effects (where product or service B can be substituted for product or service A if A should go up in price), which vary widely (Billings & Agthe, 1980). Additionally, because most locations have just one "market" price for water, elasticity is generally difficult to determine (Shaw 2005). Given the wide range of elasticities measured, it is probable that a good measure of elasticity for lawn irrigation water for a given region (i.e., the Region of Waterloo) can only be derived empirically, that is, *ex post facto*.

Despite the lack of consensus of a numerical representation of demand elasticity for water, many authors still consider water to be inelastic. Chesnutt and Beecher (1998, p. 63) give some reasons as to why this might be so:

- Potable water has no close substitutes to which customers can switch, and water for other purposes has limited substitutes.
- Water utility bills generally amount to a relatively small proportion of a household's total expenditures.
- Water prices historically have been sufficiently low to undermine any incentive consumers might have to monitor and alter their water use in response to price changes.

Overall, water demand elasticity is perceived by many to be quite low. However, it is important to keep in mind that elasticity is not fixed, and indeed can change over time depending on price.

2.3.11.c Conservation

Like many of the words in this section, *conservation* is a word with many meanings (Adamowicz 1994; Chesnutt & Beecher 1998). Whereas *efficiency* is a means, *conservation* is an end. The best illustration of this distinction comes from Brooks (2006), who uses a production possibilities curve as an exemplary heuristic: whereas gains in water *efficiency* reflect a move onto the production possibilities curve, gains in water *conservation* reflect a shift in the position of the productions possibility curve (figure 2.4). Whereas efficiency is associated with *how* questions, conservation is associated with *why* questions. Only by asking *why* questions is it possible to properly address sustainability criteria.

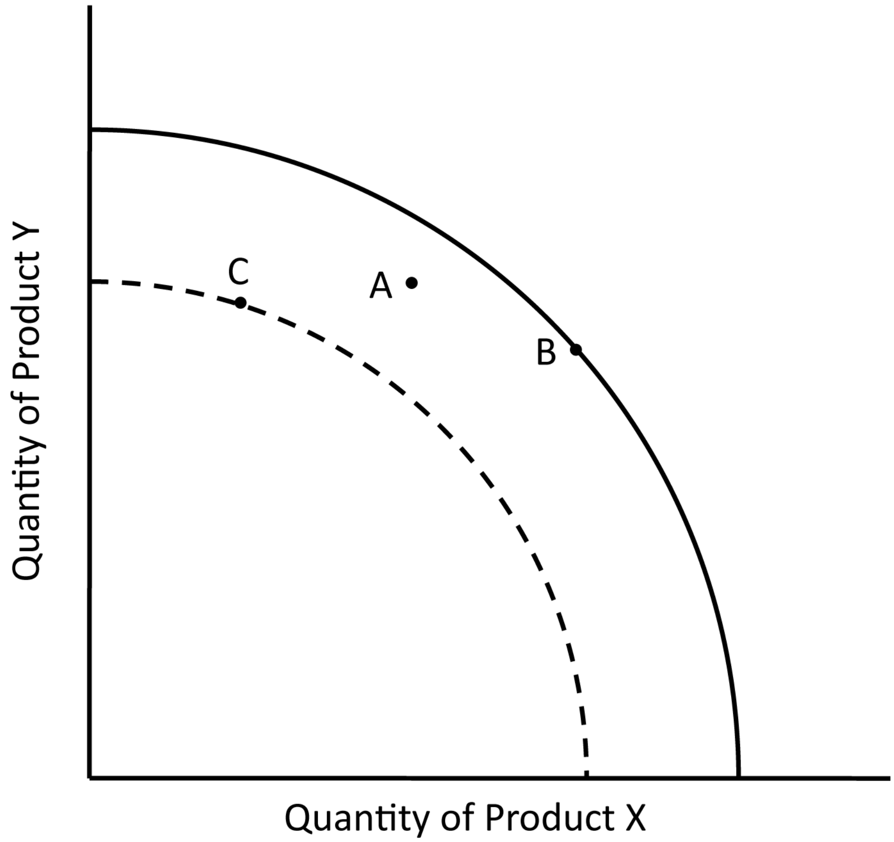

Figure 2.4 – Conservation and efficiency illustrated with production possibilities curves. Two production possibility curves (PPC) are shown, one drawn with a solid line, the other with a dashed line. The two axes represent the manufacturing of a product; each product requires water for its creation. The negative slopes of the two curves represent the opportunity cost of manufacturing one product over the other. For each PPC, there is a set amount of water available. Production at point A is not at maximum efficiency relative to the solid line PPC because that point is within the boundary of the curve. Changing production to point B maximizes efficiency for this PPC. If the entire system uses less water in total (i.e., conserves), the PPC may shift to the dashed line. Point C represents one point of maximum efficiency for this PPC. For the dashed PPC, production at point A is unattainable.

2.3.11.d Value

In economic theory, *value* is closely associated with willingness-to-pay: "[the] *value in use* of any unit of water, whether purchased by an ultimate or an intermediate consumer, is essentially measured by the *maximum* amount of resources (dollars) which the consumer would be willing to pay for that unit" (Hirshleifer et al. 1975, p. 426, emphasis original). Nonetheless, *value* can be split into parts. Rogers et al. (1997) argue "full value" of water is the sum of intrinsic value (e.g., concerns such as stewardship, bequest values, and pure existence value) and economic value. *Economic value* can then be further divided into: value to users of water; net benefits from return flows; net benefit from indirect uses; and adjustments for societal objectives (see figure 2.5).

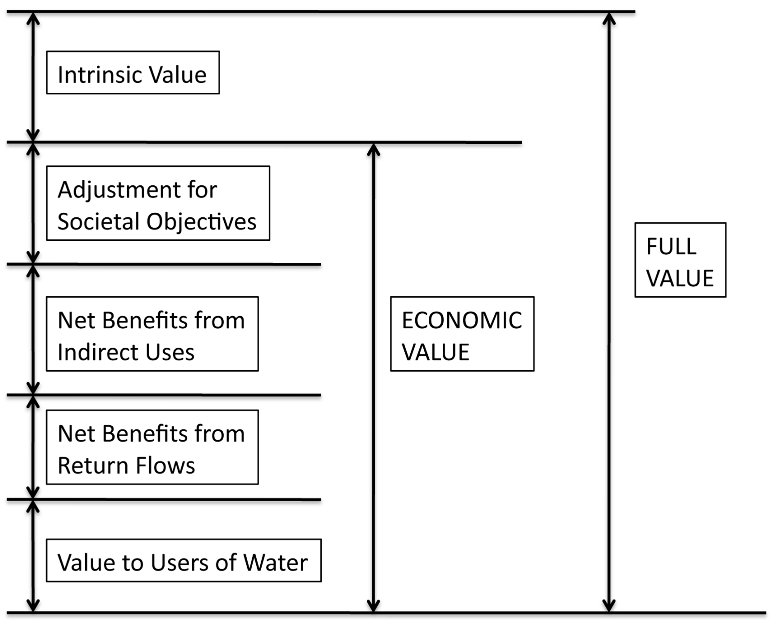

Figure 2.5 – Components of full value. (Adapted from Rogers et al. 1997.)

Figure 2.5 illustrates a more nuanced definition than the typical willingness-to-pay definition, and suggests that it is difficult to equate costs and value in order to maximize utility, as called for in economic theory. Rogers et al. (1997) give three case studies to show that water values are typically much lower than costs, and tariffs are much lower than both cost and value.

2.3.11.e Full Cost

The term *full cost* is used extensively throughout the literature on water pricing. Ontario's *Sustainable Water and Sewage Systems Act* 2002 requires, "Every regulated entity that provides water services to the public shall prepare and approve a written report about those services" (2002, c. 29, s. 3 (1)) which must contain, *inter alia*, "an assessment of the *full cost* of providing the water services and the revenue obtained to provide them" (2002, c. 29, s. 3 (5)). Fortunately, the act does define the components of full cost, which include "the source protection costs, operating costs, financing costs, renewal and replacement costs and improvement costs associated with extracting, treating, or distributing water to the public and other such costs as may be specified by regulation" (2002, c. 29, s. 3 (7)).

Rogers et al. (1997) suggest *full cost* as being comprised of economic cost and environmental externalities. *Economic cost* is the sum of the full supply cost (operating and maintenance (O&M) costs plus capital charges), opportunity costs, and economic externalities (see figure 2.6).

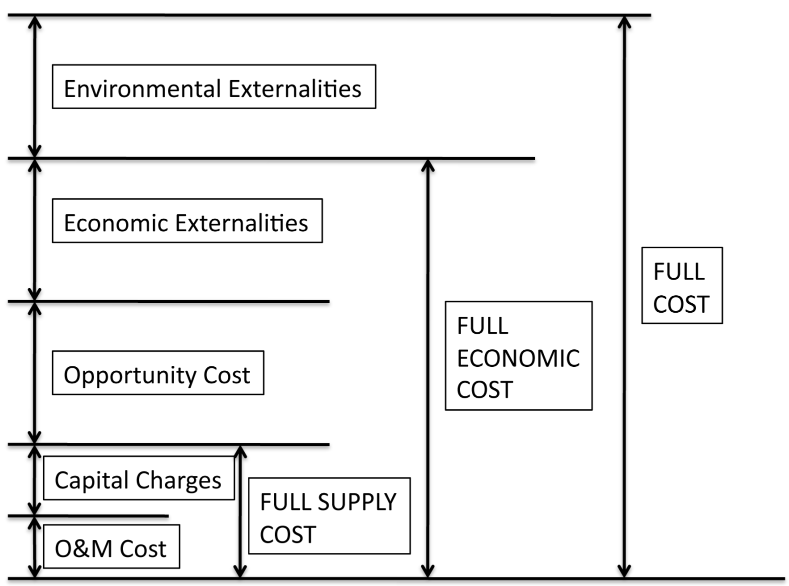

Figure 2.6 – Components of full cost. (Adapted from Rogers et al. 1997.)

Briscoe (2005) illustrates the components of *full cost* slightly differently, plotting "use costs" (infrastructure) on one axis, and "opportunity costs" on another, as shown in figure 2.7.

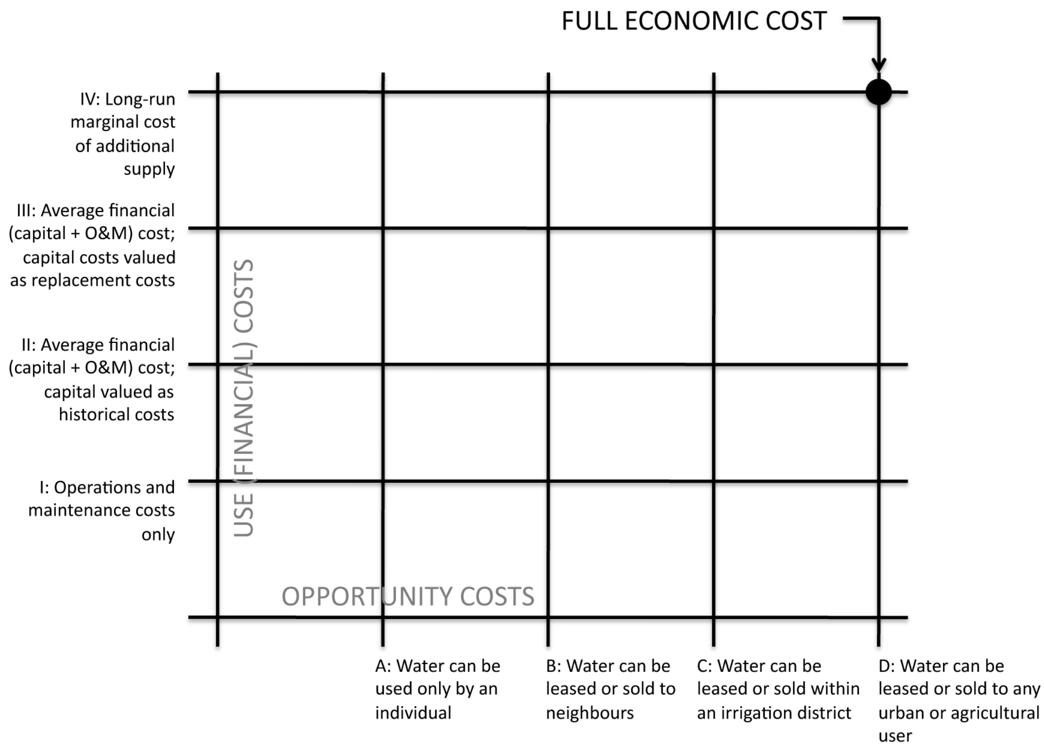

Figure 2.7 – Another version of components of full cost. (Adapted from Briscoe 2005.)

Commenting on *full cost*, the OECD considers a water utility's cost recovery to be "strong" if taxes are not necessary to cover both direct economic costs and related environmental costs (OECD 1999).

While Ontario's definition of *full cost* undoubtedly encompasses use costs (operating and maintenance and capital charges), it makes no mention of opportunity costs and externalities, either economic or environmental. These omissions do not necessarily mean that the definition is lacking, but they do demonstrate that definitions of *full cost* are inconsistent in water policy literature.

Seasonal water rates may help a public utility to achieve *full cost* revenue, but it is important to achieve consensus on the term. Even then, *full cost* is very difficult to determine for a given jurisdiction, especially given time and place dependency (Policy Research Initiative 2005).

2.4 Summary

Through the literature review, a total of ten barrier categories have been identified related to the implementation of residential seasonal water rates. Future findings will be compared against this list.

The importance of peak demand was explained, as were the general principles that explain the ways in which pricing measures can help to shave peak demand. It was noted that there are few examples of the implementation of seasonal rates.

Overall, seasonal rate implementation was suggested as one tool that can be used to aid and influence the paradigm shift in water management, moving from the status quo of supply capacity expansion to demand management and, ultimately, the water soft path.

Chapter 3 – Regional Context

3.1 General Overview

The Region of Waterloo is located in southwestern Ontario, approximately 100 km west of Toronto. It is comprised of three urban municipalities – Cambridge, Kitchener, and Waterloo – and four rural townships – North Dumfries, Wellesley, Wilmot, and Woolwich.

Water is withdrawn from both groundwater and surface water sources. The biggest component of the supply system is known as the Integrated Urban System (IUS), which permanently interconnects the communities of Cambridge (including Brown's subdivision in the Township of North Dumfries), Kitchener, Waterloo, and Elmira and St. Jacobs of the Township of Woolwich (Region of Waterloo 2008). The population being served by the IUS was over 460 000 in 2006, and is expected to climb over 708 000 by 2036 (XCG Consultants Ltd. 2007).

Figure 3.1 helps to illustrate the fact that water demands are not constant throughout the year. Water demands in the IUS are shown for the year 2007. One can see that peaks are higher for the summer months. For this particular year, the peak day occurred on June 18.

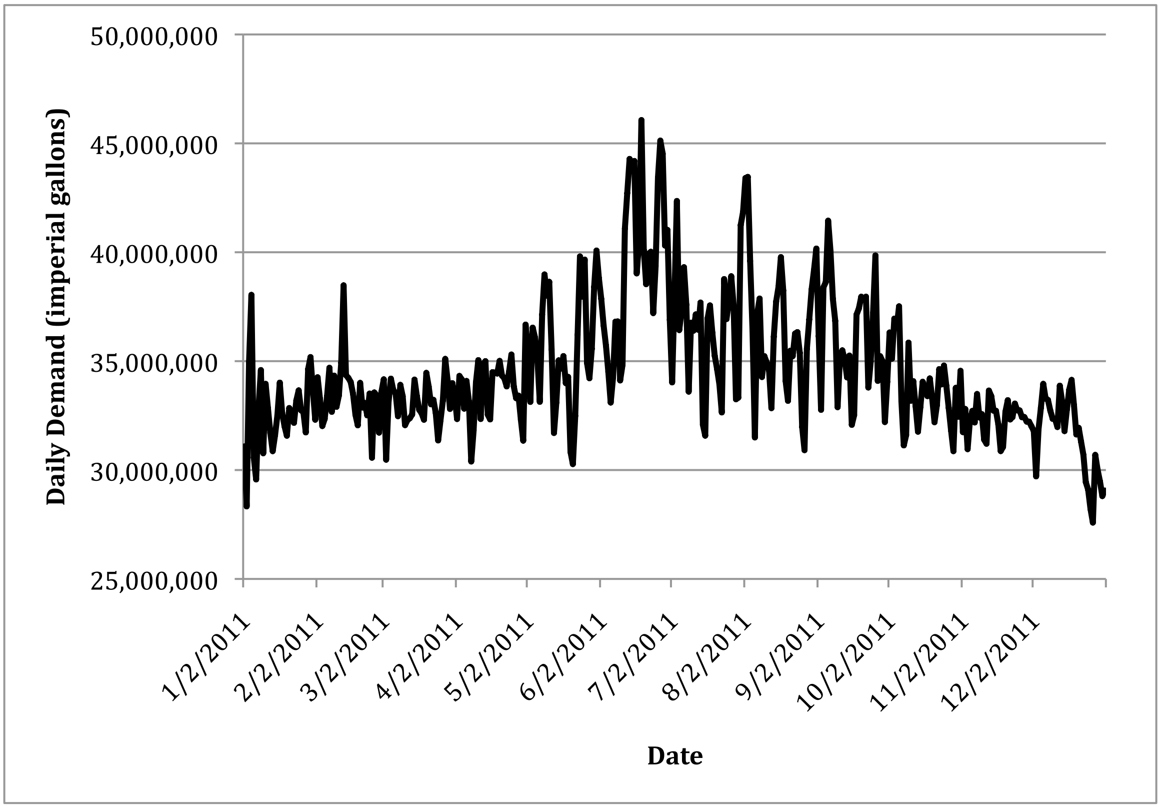

Figure 3.1 – Daily water demands for the Region of Waterloo's Integrated Urban System (IUS) for the year 2007. Note that demands are measured in imperial gallons.

3.2 Government Structure

The Regional Municipality of Waterloo came into being on January 1st, 1973 pursuant to the provincial legislative provisions of the *Regional Municipality of Waterloo Act*. The Act established a two-tier system of local government, whereby the Region was to be generally responsible for services and programs that cross municipal boundaries while the local tier was to be responsible for services and programs that were community specific and local in nature (Region of Waterloo 2009a). The Regional government is responsible for water supply, treatment, and wastewater operations (Region of Waterloo 2009b). The local area municipalities buy water at a wholesale rate from the Region, and are in charge of distribution and billing to individual customers.

3.3 Water Supply Strategy

3.3.1 Contemporary Strategy

The official document outlining the Region of Waterloo's water supply strategy is the *Water Supply Strategy Report*, prepared for the Region by XCG Consultants Ltd. (2007). This document is an update to the 2000 Water Supply Master Plan, which established a long-term water supply strategy to 2041 for the Integrated Urban System (mentioned above). The report is informed by a variety of perspectives, and comes up with some interesting results. The projected maximum week demand by 2041 is 304.1 ML/day (million or mega-litres per day), accounting for water efficiency and water use restrictions. To meet this demand, the report suggests the use of three major supply infrastructure projects. The first, currently being constructed, is Phase II of the Region's Aquifer Storage Recovery facilities, which will add 23 ML/day of reserve water. Second, by 2018, additional groundwater supplies will add another 23 ML/day of water capacity. The third and biggest project, the Great Lakes displacement pipeline, is scheduled to come online in 2035, with a predicted capacity of 432 ML/day. The costs of these different projects will be explored in section 3.6 below. In 2006, the short-term peaking capacity for the IUS was 282 ML/day.

The projected demands from the Water Supply Strategy take into account savings from water efficiency measures. The report outlining these measures is the *Water Efficiency Master Plan*, last updated in 2006 (Transportation & Environmental Services: Water Services 2006). This document lauds the Region's ongoing toilet replacement program, and shows how the Region will focus on outdoor water use by-laws, residential rainwater harvesting incentives, water efficient landscaping seminars, and other marketing initiatives over the time period established in the report (2007-2015). The total budget for all water efficient measures in the Region over that same time period will be $10.1 million, with a targeted savings of 8.146 ML/day by 2015.

3.3.2 Rate Study – 1989

Although there is no indication of the possibility of changes to water prices in either the *Water Supply Strategy Report* or the *Water Efficiency Master Plan*, it is interesting to note that in 1989, the Region of Waterloo commissioned a study that culminated in the writing of a report entitled *Development of a Plan for Equitable and Effective Water Rates in the Region of Waterloo*. According to the report, the purpose of the study was to "examine the feasibility and ways and means of managing and reducing peak demands" (Koehler et al. 1989, p. 1). The report acknowledged the fact that, at that time, the Region was facing severe supply problems, and suggested that a reduction to peak demand would help reduce system capacity needs and defer capital costs.

The Region was completely dependent on groundwater in 1989 because the Mannheim project, which withdraws surface water from the Grand River, did not yet exist. According to the Region of Waterloo's *Summary Report* (Region of Waterloo 2007), Mannheim currently provides approximately 28% of the Region's water supply.

The 1989 *Water Rates* report developed computer models to "test" two different types of water rates. Overall, the report stressed the need for a "user-pay" philosophy, but did not suggest that the Region change its wholesale rates to the individual municipalities. Instead, the municipalities themselves were encouraged to implement increasing block rate pricing. Additionally, the report claimed that water rate changes could not be used to curb demand, since the magnitude of increase needed to do so would not be equitable, and would be politically unacceptable (p. 45). Finally, the possibility of using any type of seasonal rate was "eliminated due to the length and staggering of the billing cycle for consumers" (p. 62).

The *Water Rates* report is being described here since it demonstrates that the Region was at one time at least formally considering changes to its water pricing structures. Nothing came of the report. It was presented to Regional Council on November 16th, 1989, but other than Councillor Telegdi questioning, "whether the burden will be placed onto the homeowner", the report stirred no action (Region of Waterloo Council 1989). The next year, it was reported that the Water Supply Review Steering Committee had decided that the "outstanding matter" concerning the *Development of a Plan for Equitable and Effective Water Rates in the Region of Waterloo* was to be dealt with by the Commissioner of Engineering (Richardson 1990). The Commissioner must have decided to shelve the report, since it was never mentioned again in council.

3.3.3 Rate Study – 1999

Almost ten years after the 1989 *Water Rates* study, the Region's 1998 Water Efficiency Master Plan recommended that the Region again investigate the possibility of introducing water efficient rate structures with the area municipalities. A project team was formed to evaluate the feasibility of implementing water efficient rate structures using a cost-benefit analysis, and to determine the effectiveness of the rate structures at reducing peak water demand, resulting in a document entitled *Water Efficiency Rate Study: Phase 1 Report* (Regional Municipality of Waterloo Water Services Division 1999). The project's authors argued that substantial differences between base rates and summer surcharges are required to achieve water reduction goals, meaning that the elasticity demand for water was perceived as being very low. Additionally, based on the background research for the project, it was found that summer seasonal surcharges did not result in peak demand reduction in four of the five utilities that implemented this rate structure. However, this comment on the inefficacy of seasonal rates should have been tentative, since the authors also mentioned that many municipalities were not able to measure the impact of any rate increase due to the lack of a proper database. The authors did not explain what a "proper database" might entail.

A "supply expansion mentality" is exhibited throughout the 1999 *Water Efficiency Rate Study*. For example, the authors explain that two different supply "philosophies" were considered for the Region's long-term water supply strategy: a "traditional" one, where additional capital is added just prior to it being required to meet increasing demands, and a "security of supply" philosophy, for which some additional capacity is added to the system in the short-term to provide a buffer against any unexpected loss of capacity in the existing system (Regional Municipality of Waterloo Water Services Division 1999). Nonexistent is the paradigm that makes demand management a priority.

The conclusion of the *Water Efficiency Rate Study* stated that it was not prudent to continue pursuing the implementation of seasonal water rates. The main deciding factor in this conclusion was the fact that the cost-benefit analysis showed that seasonal water rates were only fiscally viable for the deferral of the supply projects furthest in the future, such as the Great Lakes displacement pipeline. Since the short-term benefits of the implementation of seasonal rates were calculated as being outweighed by their costs, the idea was dismissed.

3.4 Current Water Prices

All three urban municipalities (Waterloo, Kitchener, and Cambridge) charge a uniform volumetric rate for water and wastewater (sewage) services. Additionally, Waterloo and Cambridge also have service charges that vary depending on the size of the consumer's water meter. Table 3.1 shows the different prices and service charges for typical residential water meters.

	Water Rate (per m³)	Sewer Rate (per m³)	Service Charge per mo.
Waterloo	$1.26	$1.40	$2.56 (15 mm diameter water meter)
Kitchener	$1.4285	$1.5737	N/A
Cambridge	$1.1835	$1.1839	$6.06 for water; $3.83 for sewer (25 mm diameter or less water meter)

Table 3.1 – Single-family residential water and sewer rates for Waterloo, Kitchener, and Cambridge.

3.5 Applicable Provincial Legislation

The Region of Waterloo does not exist in a vacuum. In order to fit the Region of Waterloo into its provincial context, it is necessary to briefly explain some germane legislative documents.

Although there are many documents that pertain to water supply in Ontario, the two that relate most to the themes in this paper are the *Places to Grow Act, 2005* and the *Sustainable Water and Sewage Systems Act, 2002*. The *Places to Grow Act* stipulates that population growth be focused on intensification of the existing built-up areas in the Greater Golden Horseshoe. For example, the urban growth centres of Downtown Kitchener and Uptown Waterloo will be planned to achieve, by 2031 or earlier, a minimum gross density of 200 residents and jobs combined per hectare (Ministry of Public Infrastructure Renewal 2006). The increase in population in the Region of Waterloo will result in water demand increases, even though the Growth Plan for the Greater Golden Horseshoe encourages a "culture of conservation", including the use of water demand management (ibid.).

The *Sustainable Water and Sewage Systems Act, 2002* is one of the many provincial legislative documents created (or altered) as a result of Walkerton and the

O'Connor Inquiry.[3] This act stipulates that every regulated entity that provides water services to the public must prepare a report indicating, *inter alia*, how that entity intends to pay the full cost of providing those services. In the document, the term "full cost" is explained explicitly:

> The full cost of providing the water services includes the source protection costs, operating costs, financing costs, renewal and replacement costs and improvement costs associated with extracting, treating or distributing water to the public and such other costs as may be specified by regulation. 2002, c. 29, s. 3 (7)

Moreover, water suppliers are expected to make changes to their accounting system:

> Every regulated entity shall establish and maintain a dedicated reserve account that segregates from its general revenues the revenue allocated in its approved cost recovery plan to pay the full cost (including sources protection costs and operating and capital costs) of providing water services or waste water services, and shall do so in accordance with the regulations. 2002, c. 29, s. 22

Despite the attempt at clarity in this act, it is not clear what timescale is supposed to be used in making these changes. If the long-term is used, as seems to be the case in the *Places to Grow Act*, then the Region of Waterloo is required by law to consider how to pay for the full cost of their supply projects, including the expensive Great Lakes displacement pipeline (see next section). Otherwise, the *Sustainable Water and Sewage Systems Act* is simply demanding implementation of

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[3] In May 2000, the drinking water system in the town of Walkerton, Ontario became contaminated, primarily with *E. coli* O157:H7, leading to seven deaths and more than 2300 illnesses. The Honourable Dennis R. O'Connor, Associate Chief Justice of Ontario, was commissioned to investigate the event. Among his many recommendations for the province were changes to source protection measures and the adoption of effective standards and technology for treating water and for monitoring its quality (O'Connor 2002).

the initiatives economists have been arguing for all along (e.g., Fortin & Mitchell 1990).[4]

3.6 Water Supply Cost Comparisons

The Region of Waterloo's *Water Supply Master Plan* gives the costs of two water supply projects, while its *Water Efficiency Master Plan* explains the costs associated with the Region's efficiency program. This section will break down the costs per kL (or m^3) per day in each case, and inquire as to why efficiency programs are not being more aggressively pursued.

Proposed Measure	**Total Cost ($ million)**	**Volume added (kL/day)**	**$/kL/day**	**Target Year**	**Peak demand by target year (kL/day)**	**Short-term peaking capacity by target year (kL/day)**
[Baseline data]	--	--	--	2006	206 000	282 000
Water Efficiency Program	10	8146	1240	2015	222 000	305 000
New groundwater supplies	47	23 000	2043	2018	230 000	327 000
Great Lakes displacement pipeline	700	432 000	2465	2035	284 000	432 000

Table 3.2 – Cost comparisons of three water strategies proposed by the Region of Waterloo.

Table 3.2 shows the costs of three water strategies being adopted by the Region of Waterloo. The cost of the water efficiency program (WEP), its daily volume

[4] It is important to note that the *Sustainable Water and Sewage Systems Act* has not yet been regulated. In the meantime, a financial regulation regarding the "Drinking Water Quality Program" (453/07) was amended to the *Safe Drinking Water Act, 2002* , which requires public water utilities in Ontario to maintain their systems through water revenues only (i.e., transfer payments from property taxes, for example, are prohibited).

“added”, and its target year were taken from the *Water Efficiency Master Plan* (Transportation & Environmental Services: Water Services 2006, p. 8). For the two supply infrastructure expansion projects, costs and volumes added were taken from Table 7.5 in the *Water Supply Master Plan* (XCG Consultants Ltd. 2007, p. 70), and target years were taken from page 6. In all three cases, peak demand by target year was derived from Table 3.4 (ibid., p. 17) in the *Water Supply Master Plan*, which assumes 100% participation in water efficiency programs.

For the WEP and the new groundwater supplies, the cost per kilolitre per day was calculated by dividing the cost of the project by the daily supply volume added. Conversely, for the pipeline, one will notice that the daily supply volume added far exceeds the peak demand at the target date. Therefore, at the time that the pipeline comes online, its cost per volume added can be derived by dividing the total project cost by the peak demand in 2035.

It is clear from Table 3.2 that the cost of the water efficiency program (WEP, $1240/kL/day) is far cheaper than the cost of new groundwater supplies ($2043/kL/day), and the pipeline is almost double the cost of WEP ($2465/kL/day). This price discrepancy underlines the question: why are water efficiency programs not being more aggressively pursued? One answer to this question can be derived from examining the last column in Table 3.2, which shows the short-term peaking capacity of the IUS by the target year for each project. The WEP “provides” just 2.7% of its respective short-term peaking capacity, while groundwater provides 7%, and the pipeline provides 100% (i.e., other supplies will be taken offline after the pipeline becomes operational). Thus, if a supply management perspective is adopted, projects that will provide a larger percentage of (if not all of) the IUS’s capacity might be justified for the sakes of facility and convenience. Conversely, from a water soft path perspective, if water is considered to be a service instead of a resource, then the possibilities for WDM grow exponentially. Only by adopting a different mentality is it possible to understand how WDM can be more than just marginal.

Due to the fact that WEP is much cheaper than the other two options, it would seem prudent to explore any further efficiency options as much as possible. It could be argued that a seasonal water rate program could be commissioned using extra funding allocated to water efficient practices. In a purely fiscal sense, any possibility to provide extra capacity to the Region's water systems through WDM should be pursued, and this may include conducting an empirical study of the effect of implementing seasonal water rates.

Chapter 4 – Research Strategy and Methods

4.1 Introduction

This chapter will specify and explain the methods adopted for the study. First, the research strategy will be described, including the justification for using water management professionals and Regional Council members as informants. Next, interviewing as a research method will be elucidated. Following is the description of the three phases of interviews, and a description of the analysis of the data from these interviews. Finally, the limitations of this thesis will be briefly discussed.

4.2 Research Strategy

The purpose of this thesis is to give an account of the barriers to implementing seasonal water rates as a demand management tool in the Region of Waterloo. Although there exists some literature on the barriers to implementing seasonal rates (see Chapter 2), there are virtually no examples of specific illustrations of this matter. This thesis will fill that gap with an idiographic account of the barriers encountered at the Region of Waterloo. This research is exploratory in that there is very little known about specific examples of barriers to implementing seasonal water rates, and it is descriptive because it will describe the pertinent issues (Singleton & Straits 2005, p. 68).

The overarching methodology employed in this thesis is *qualitative*, meaning that this is a study in which

> (a) an alternative to the positivist paradigm is used; (b) words, behaviours, actions, norms and gestures are data; (c) a primarily inductive or interpretive approach to data analysis is used; (d) there is a focus on action and change in everyday life; and (e) the emphasis is on understanding and description, and not on prediction (Rothe 1993, p. 21).

The first research method employed was a review of the existing literature, both academic and non-academic, on the topic of water pricing as a demand management tool. The focus of this literature review was the barriers to implementing seasonal rates. The literature provides a basis for the understanding of pertinent issues and a foundation on which the field research methods were built.

Qualitative field research is distinguished from other methods "designed to produce data appropriate for quantitative (statistical) analysis" (Babbie 2007, p. 286), and is therefore quite encompassing in its definition. Its main strength comes from the fact that it is "especially effective for studying subtle nuances in attitudes and behaviours and for examining social processes over time" (Babbie 2007, p. 312). Since water rate design and implementation is "an inherently political process" (Hanemann 1998, p. 142), qualitative field research offers a good method for understanding the barriers to implementing seasonal rates. Additionally, as seen in Chapter 3, the Region of Waterloo seemed to have been interested in water rates in the 1980s, and yet nothing came of the nascent interest; field research is an appropriate method for examining the underlying issues over time.

Interviewing was chosen as the specific method employed for the qualitative field research. There were three phases of interviews. The first phase comprised the use of structured interviews with water professionals from four different regions in southwestern Ontario in order to gather their professional opinions on the link between water rates and demand, and their thoughts on water rates in general. The second phase consisted of interviews with water professionals who had been working for the Region of Waterloo in the fall of 1989; these interviews were conducted to understand the barriers facing the implementation of water rate changes in the Region at that time. The third phase consisted of interviews with Regional Council members of the Region of Waterloo's Water Efficiency Advisory Committee including the Chair of the Region of Waterloo, and senior level employees from both the Region and the municipal water services departments. This phase was used to compare the contemporary barriers to implementing seasonal water rates in the Region according to the selected interviewees with the information gained from the literature review and the second phase of interviews.

There are two reasons why only water professionals or council members were chosen for data collection. First, whereas public opinion on a topic as encompassing as water rates is important, de Oliver (1999) has shown that, "when measuring popular attitudes toward conservation, the gap between survey respondents' stated attitudes and manifested actions can be considerable" (p. 387). So, a public survey related to water rates in the Region of Waterloo may not be entirely useful, since people tend to respond to environmental surveys in socially desirable ways. Additionally, the Regional Council members being interviewed are elected to represent the views of their constituents, so some aspect of public opinion can be derived from the data collected for this project. Second, while there exist some examples of research on expert views of water demand management (e.g., De Young & Robinson 1984; Sawyer 1983), they are few in number. Wolfe (2009) expounds the importance of studying water practitioners about "their ability and willingness to adopt, implement, and, most critically, to sustain [water demand management]" (p. 475). The workings of the "suppliers" side of public water utility management are complex, and this research exists to further the understanding of these workings.

Overall, the research herein can be described as a descriptive case study, since the purpose is to fully describe the idiographic nature of the barriers to implementing seasonal water rates at the Region of Waterloo (Yin 2003). The use of a single case study is justified due to the facts that the Region of Waterloo represents a unique case of water management, and the research represents a longitudinal example, since the barriers encountered 20 years ago are used to inform the contemporary situation. Figure 4.1 shows the overall research strategy adopted. Research protocol received approval from the Office of Research Ethics at the University of Waterloo.

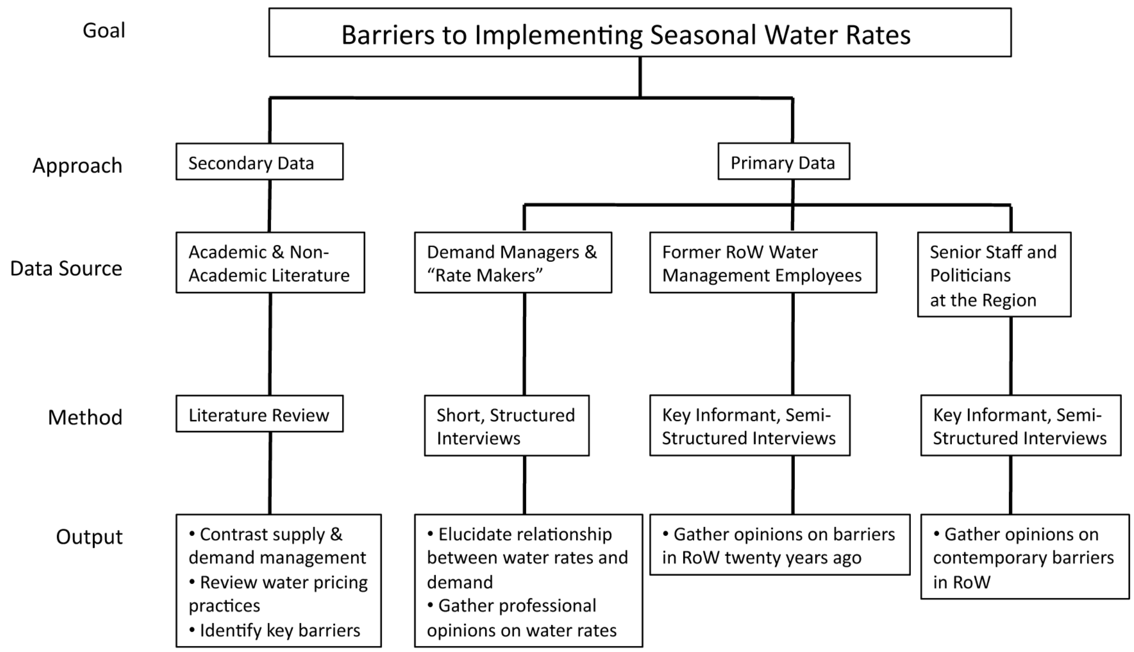

Figure 4.1 – Overall research strategy.

4.3 Interviewing as a Method

Interviewing is a method for collecting data where the interviewer him- or herself is the research instrument (Seidman 2006). As such, interviewing has several advantages over other methods for data collection such as questionnaire administration, since the interviewer can adapt to an interviewee in a way to best elicit rich communication (Rothe 1993). For example, the interviewer can clarify or elaborate questions, probe or prompt the interviewee for expansion on a given answer, and so on (Babbie 2007; Gillham 2000; Singleton & Straits 2005).

Interviewing has disadvantages as well. The interaction between interviewer and participant is nuanced, and as a result, method *reliability* can be questioned. Seidman (2006) words the problem in this way:

> Although the interviewer can strive to have the meaning being made in the interview as much a function of the participant's reconstruction and reflection as possible, the interviewer must nevertheless recognize that the meaning is, to some degree, a function of the participant's interaction with the interviewer (p. 23).

Nonetheless, Babbie (2007) argues that interviewing and field research methods in general provide greater *validity* than do survey and experimental measures, since the researcher is able to explore the issues in great depth.

Both structured (phase one) and semi-structured (phases two and three) interviews were employed for this thesis research. In a structured interview, objectives are very specific, all questions are written beforehand, and the interview conversation does not depart from the regimented schedule (Singleton & Straits 2005). In a semi-structured interview, specific objectives are again sought, "but the interviewer would be permitted some freedom in meeting them" (Singleton & Straits 2005, p. 222). Key questions are developed in advance, but the interview conversation has a wider selection of paths down which it may travel.

All questions in all interviews were open-ended, and all interviews were audio recorded (with the permission of the participant) to facilitate data collection and to ensure accuracy. To further bolster accuracy of information, interviews were transcribed in full and sent to participants for their review.

The third phase of interviews and some of the second phase were conducted face-to-face. This type of interview typically results in full and well-developed responses, and permits the interviewer to make unobtrusive observations (Singleton & Straits 2005). Conversely, the first phase of interviews and most of the second phase were conducted over the telephone. Telephone interviews take substantially less time than face-to-face interviews, in no small part because of reduced travel time for the researcher. These time considerations were especially important for this thesis research, since telephone interview participants were dispersed across southwestern Ontario, and the researcher had limited transportation options.

Telephone interviews have some disadvantages compared to face-to-face interviews. Mainly, telephone interviews may yield shorter answers than face-to-face interviews, and it may be difficult to establish a proper amount of trust and rapport between interviewer and participant (Singleton & Straits 2005). These problems were respectively tackled by sending questions to respondents ahead of the scheduled interview time to allow them to spend some time thinking about their responses beforehand (as recommended in Gillham (2000)), and by communicating with participants several times before the interview via email and telephone.

In all three interviewing phases, respondents were chosen using purposive sampling, in that they were judged to be useful for information gathering according to the researcher (Babbie 2007). Justification for the specific list of informants used in each phase will be given in the respective sections below.

Overall, "interviews are an essential source of case study evidence because most case studies are about human affairs" (Yin 2003, p. 92). The interview method allows for the collection of rich data from the interviewees, but yields difficult analysis. This problem is explored further in the "data analysis" section below.

4.4 Phase One Interviews

The purpose of the first phase of interviews was to understand how water professionals understand the link between water rates and residential demand. The interview consisted of only six questions, and was designed "so that [the researcher] appear[ed] genuinely naïve about the topic and allow[ed] the respondent to provide a fresh commentary about it" (Yin 2003, p. 90-91). Interview questions are shown in the appendix.

Water professionals from four regions in southwestern Ontario were contacted to participate. The four regions were chosen based on the fact they all have similar populations (i.e., in the same order of magnitude) and are slotted for rapid population growth over the coming decades according to the province's *Places to Grow Act* (2005). From each region, the "demand manager" (i.e., the person in charge of water efficiency and conservation programs) and the "rate maker" (i.e., the person in charge of setting water rates, typically in the financial department) were contacted in an attempt to gain their participation. The people occupying these positions were contacted because they are familiar with the demand management operations at their respective water utilities. Since these recruits are well versed in the phenomenon that was being studied (demand management), Babbie (2007, p. 186) would call these participants "informants". Of the eight possible informants, six agreed to participate.

Interviews took place over a three-week period from the end of January to the beginning of February 2009. In each case, interview questions were emailed to the participants at least a day before their interview to allow them to think about their responses. The durations of the interviews were quite short, ranging from approximately 10 to 30 minutes. All interviews took place over the telephone, and were recorded onto the researcher's laptop computer with the aid of the telephone's speakerphone. Transcripts were sent to participants via email for verification of accuracy.

4.5 Phase Two Interviews

The purpose of the second phase of interviews was to collect data on the Region of Waterloo's water management strategies in 1989. The reason this date was chosen is because a study that culminated in a document entitled *Development of a Plan for Equitable and Effective Water Rates in the Region of Waterloo*, produced by the consultancy firm Stevenson Kellogg Ernst & Whinney, had been commissioned by the Region. As noted in Chapter 3, despite the fact that this report went to Regional Council, it was ostensibly ignored. At least, the water rate recommendations in the document were not implemented. As such, water professionals who had been working at senior positions for the Region of Waterloo at the time of the document's creation and publication were recruited in an attempt to explore and describe what was going on at that time. Interview questions are shown in the appendix. The questions related to water rate setting in general in the Region of Waterloo in 1989, with only the last question pertaining directly to seasonal water rates.

A list of possible participants was created first by finding out from the researcher's thesis advisor who might be appropriate informants, and then building on this list using snowball sampling, the "referral technique which uses a process of chain referral" (Singleton & Straits 2005, p. 138). Tracking down participants took a bit of effort, since none of them still work for the Region of Waterloo, and some of them have since retired. The most successful method for finding recruits' correct phone number was through the use of the online "whitepages" (http://www.whitepages.ca), although for some participants with relatively generic names, it was necessary to find out where in Ontario they resided from other participants. All of the possible informants contacted agreed to give responses, for a total of five respondents.

Due to scheduling difficulties, interviews took place over a six-week period, straddling April 2009. Interviews were semi-structured, and varied in duration depending on how interested the participants were in the material. The shortest interview was 15 minutes, while most others lasted around 30 minutes. Two interviews were conducted over the phone, two were conducted face-to-face, and one participant responded via email. Interview questions were emailed to the participants at least a day before their interview to allow them to think about their responses. All verbal interviews were audio-recorded onto the researcher's laptop computer with the permission of the participants. Transcripts were sent to participants via email for verification of accuracy.

4.6 Phase Three Interviews

The purpose of the third phase of interviews was to gather data from a variety of actors from the Region of Waterloo about the contemporary barriers to the implementation of seasonal water rates. The range of actors interviewed ensured a wide variety of views were incorporated. Interview questions are shown in the appendix. Whereas the first phase of interview questions was quite broad in nature and the second phase explored topics related to water rate setting *in general*, the third phase of interviews related more directly to the barriers to implementing *seasonal* water rates in the Region of Waterloo.

In order to ensure that the interviewer and respondent were congruent regarding the idea of seasonal water rates, each respondent read a sheet, provided by the interviewer, called "An Argument for Seasonal Water Rates" after the third question (box 4.1). This document was not intended as a *specific* plan on how seasonal water rates might be implemented in the Region of Waterloo. Rather, respondents were asked to read the document to ensure a focused topic of conversation.

Additionally, in order to demonstrate how the numbers for question seven were derived (regarding demand-side versus supply-side costs), respondents were provided with a sheet called "Approximate Costs of Different Water Strategies" (box 4.2).

A list of possible respondents was created by first contacting the Regional Councillors who sit on the Region's Water Efficiency Advisory Committee, as well as the Regional Chair and the Region's Chief Administrative Officer. The CAO (who was not interviewed) deferred his responses to another person, who was added to the interview list. This person also recommended another in his or her department, thus again setting into motion a round of snowball sampling.

Box 4.1 – An Argument for Seasonal Rates

This argument will help put us on the same page when talking about seasonal rates over the course of this interview:

You may have heard this before, but some people have argued that just as peak demand rates are being used for electricity in Ontario, some form of seasonal water rates should start to be used for water. The rationale is that the size of the Region's water system is measured by peak week capacity, and it costs a lot to build infrastructure (new wells, reservoirs, the proposed Great Lakes displacement pipeline, etc.) to supply demands that may be needed for only a few weeks of high use in the summer. In other words, because more infrastructure is needed to supply peak demands, extra water withdrawn in the summer for uses like watering lawns and filling swimming pools can be considered much more expensive for the Region to supply than water used all year.

The argument being proposed here is that, as some other municipal governments with wholesale water utilities have done, the Region could move to a wholesale rate that includes a peak demand component. Such a rate could get the cities on side with the Region, as the cities then would be financially incented to lower their, and therefore the Region's, peak demands. This contrasts with the present situation, in which the cities make more money every time water demand increases. Everyone in the Region could benefit financially from the Region charging this seasonal rate, since the Region would potentially be able to defer construction of the Great Lakes Displacement Pipeline for as long as possible. How the cities would choose to encourage reduction of peaks by their customers, whether through some form of seasonal rates, or by regulation, or by education would not matter. At the very least, the Region's rate structure would be a public declaration that water for summer use is more scarce and expensive to supply, thereby encouraging more sustainable water use. Additionally, the Region would be able to continue to source water locally from within its boundaries for as long as possible.

Box 4.2 – Approximate Costs of Different Water Strategies

Provided by: Kurtis Elton

As indicated in the interview, it will cost:

- about $1200/1000 litres/day for new "supply" from water efficiency measures by 2015
- about $2000/1000 litres/day for water from additional groundwater supplies by 2018
- about $2500/1000 litres/day for water from the Great Lakes displacement pipeline by 2035

On page 6 of the *Water Supply Strategy Update – Final Report, 2006*, it is reported that the construction of 13.6 to 22.7 ML/d of **additional groundwater supplies** will be online in **2018**. On the same page, it is reported that the construction of a nominal 432 ML/d **displacement pipeline from Lake Erie** will be online in **2035**.

Year	**2006**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
IUS Total Max Week (ML/d)	205.8	212.9	224.2	238.4	252.9	270.7	287.1

Taken from Table 3.4 (p. 17) in *Water Supply Strategy Update – Final Report, 2006*.

Item	**Revised Cost Year 2007 ($ million)**
New Groundwater Supply (14 – 23 ML/d)	$47
Displacement Pipeline from Lake Erie (Nanticoke) (432 ML/d)	$700

Taken from Table 7.5 (p. 70) in *Water Supply Strategy Update – Final Report, 2006*.

Sample Calculations:

To calculate the cost for the **pipeline** to provide water for peak demand when it comes online in 2035, I first figured out the volume of peak demand in 2035 from Table 3.4.

Assuming linear growth in demand between 2031 and 2036, this gives a peak demand of about 284 ML/d in 2035. At a rated volume delivery of 432 ML/d, the Pipeline would be able to provide all of the water for peak demand in 2035.

Thus, we have:

$700 000 000/284 000 kL/d

= $2465/1000 litres/day

(Note: 1 ML = 1000 kL, and 1 kL = 1000 L)

For the purposes of this interview, I rounded out this figure to $2500/1000 litres/day.

Additionally, one person of a senior position from water services from each of the urban municipalities (Waterloo, Kitchener, and Cambridge) was contacted in order to gather views from the "lower tier" part of water services in the Region of Waterloo. In total, ten people were interviewed, all of who have a good knowledge of some aspect of water rate setting in the Region of Waterloo.

Interviews took place over a four-week period from May to June 2009. Interviews were semi-structured, and were on average about 30 minutes in duration. One interview was conducted over the phone, while the other nine were conducted face-to-face. All interviews were audio-recorded onto the researcher's laptop computer with the permission of the participants. Transcripts were sent to participants via email for verification of accuracy.

4.7 Data Analysis

According to Babbie (2007), qualitative analysis is "the non-numerical examination and interpretation of observations, for the purpose of discovering underlying meaning and patterns of relationships" (p. 378). Many authors recommend a method that is akin to content analysis, which has two essential strands: (i) indentifying in the data the key, substantive points, and (ii) putting them into categories (Gillham 2000, p. 59). Singleton and Straits (2005) suggest that the basic idea when doing content analysis is to "reduce the total content of a communication to a set of categories that represent some characteristic of research interest" (p. 371). In concert with this thesis' research question, the main effort in content analysis was to draw out the barriers to the implementation of conservation-based water rates, with a specific focus on seasonal rates.

This content analysis process is not exactly an act of coding, which would be necessary if the content was to be computer analyzed. It is assumed that more than just the words stated by the informants are important. The researcher thus analyzes the *latent content* of the collected data, where the "underlying meaning of communications" is deemed important (Babbie 2007, p. 325).

The results from the three interview phases were all analyzed through inductive content analysis. The first phase used structured interviews, and the results are therefore categorized according the questions that were asked. For the other two phases of interviews, commonalities were identified that corresponded with the set of barriers indentified in the literature review, while any new categories were added to the list.

4.8 Limitations

Aside from the inherent weaknesses of some of the methods as listed above, this study has some limitations. First, for the second phase of interviews, the researcher cannot be sure that all important informants were included. Since the report that framed the questions did not have a list of people to whom it was addressed, the researcher had to depend on the memory of the other informants to determine who else to contact. An additional problem in this phase was the fact that the informants were asked to talk about events from 20 years ago; despite the fact that they were given a substantial amount of time to contemplate their answers, it is quite possible that some important issues were forgotten.

Second, despite the justification given for speaking only with water professionals and council members, there is no doubt that the public's perception on seasonal water rates is important. Instead of suggesting survey research to gauge hypothetical opinions about seasonal rates, it would most likely be more beneficial to gather the opinions of customers whose rates have recently had a seasonal component added to them. Indeed, without firsthand knowledge of the workings of rate structures, the likelihood is that residents may not fully understand the altering of rate structures (De Young & Robinson 1984).

Third, the focus of this thesis is on *residential* seasonal water rates, thus ignoring the industrial, commercial, and institutional (ICI) sectors. As some water users in the ICI sectors irrigate heavily in the summer months, it may be desirable to include these users as well when considering the implementation of seasonal rates. However, in order for a water utility to not be viewed as making water rates "uncompetitive" for the ICI sectors, it would most likely be necessary to have a separate meter to measure irrigation water for these users if seasonal rates were implemented. This topic will be left for future research projects to explore.

Finally, this study has chosen only to look at water supply, while ignoring completely its complement: wastewater collection and treatment. Separating these components may not be prudent (Renzetti 1999; Creese & Robinson 1996), but was necessary in order to keep the scope of the paper manageable.

Chapter 5 – Results

5.1 Introduction

This chapter will present the results of each phase of interviews in succession, incorporating some preliminary analysis in each case to identify commonalities in the responses. The final section in this chapter will summarize the collected data.

5.2 Results from Phase I Interviews

Recall that interviews in phase I were structured, and responses were collected from water professionals from four regional municipalities in southwestern Ontario. Because of the structured nature of the interviews, answers are neatly separated into independent parts.

5.2.1 Drivers for Infrastructure Expansion

Each respondent[5] expounded the fact that his or her respective regional municipality made master plans based on forecasts of population and demand in order to determine how and when water supply infrastructure should be expanded. One respondent put it very simply: “overall, it’s demand and consumption”. Respondents were careful to note that master plans tried to look long-term, and required a lot of time and preparation. Two participants (from different regions) stated that their municipalities took cues from the Province of Ontario to gauge growth rates, with one specifically citing the *Places to Grow Act* as a major influence on the regional growth strategy, thus influencing projections of water demand and therefore supply. Interestingly, only one participant explicitly mentioned peak demand as a major driver for infrastructure expansion.

[5] One participant deferred the answering of this question to a colleague who never reported his or her answer. Thus, five out of six participants responded to this question.

Overall, the responses seem to indicate that population growth and its concomitant demands dictate water infrastructure expansion. At a primary level, growth takes priority over water demand management.

5.2.2 Rate Structures

Two of the represented regional municipalities used uniform volumetric rates,[6] another used a uniform volumetric rate *plus* a fixed charge, while the final used a declining block rate.

5.2.3 Effect of Rate at Reducing Peak Demand

Three respondents seemed to think their region's water rate was not effective at reducing peak demand, one adding that this fact was "obvious". Another of these respondents chose to start talking about non-price conservation programs at this point, perhaps in an effort to defend the use of his or her region's water rate.

Two other participants claimed they did not know if these rates (in both cases uniform volumetric) reduced peak demand due to a lack of evidence, but added, "it doesn't encourage extra use at least", or, "the volumetric component of the rate structure does provide some incentive for water conservation".

The final participant answered that a volumetric rate is better than something like a humpback rate, and that it works in concert with that region's outside water use bylaw, revealing that this participant does not look at water rates as independent of other conservation efforts.

5.2.4 Decision-Makers

Not surprisingly, all participants described the presence of a decision-making hierarchy in their respective regional municipalities. In one region, the commissioner of what could be called the "public works" department makes

[6] Upon verification, it was found that one of these regions also used a fixed charge.

decisions on rate structures with input from the Director of Water Services. Above the commissioner are the Chief Administrative Officer and the regional municipality's council. Two other participants from different regions reported a very similar hierarchy, one adding that the financial department, which oversees billing and budgets, had a substantial influence.

A third respondent mentioned an on-going water and wastewater rate study to which staff would make recommendations before presenting findings to the public for consultation. This participant claimed that ultimately, local council had the final say in any rate recommendations. Another participant echoed these sentiments.

Finally, one participant chose to mention that a study reviewing rate structures would be beginning soon, and would work in similar ways as the other rate study mentioned, but would also incorporate input from third-party consultants. This participant did not explicitly mention the use of public consultation.

Overall, all participants viewed their regional council as making the ultimate decisions regarding water rates. Since councillors are elected to represent their public constituents, one might conclude that the concerns of the public have an influence on decision-making regarding water rate structures.

5.2.5 Rate Structures for Reducing Peak Demand

The most common answer for a rate that might be useful for reducing peak demand was an "increasing block rate" or an "inclining structure" with five responses, whereas a "seasonal excess rate" was quoted twice, and the use of a "water budget model" was mentioned once.[7]

Almost every respondent qualified his or her answer in one way or another. One participant, referring to communities other than his or her own, observed that

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[7] There are more than six responses because participants were free to mention more than one type of rate structure.

metering is necessary, and that substantial fixed charges should be eliminated. Another respondent suggested that even though a seasonal excess rate might curb peak demand, it may be considered punitive. Likewise, another participant believed non-price programs to be quite effective, and stated, "it's not clear that the implementation of a conservation rate structure would provide *further* significant conservation principles, without unduly impacting fairness and affordability, which are also important values that a rate structure should support". Finally, one participant mentioned the need for monthly billing periods in order to facilitate an increasing block rate.

5.2.6 Rate Structures Worth Considering (Or Not)

Responses varied greatly for the question regarding what rate structures should (or should not) be considered. One respondent claimed his or her regional municipality had at one time considered a change in rate structures, but had abandoned the idea for reasons possibly related to the governance structure of the water supply system. Another suggested the use of "an inclining, or competitive rate, since our rates in [this region] are so low".

Two other respondents emphasized the effectiveness of non-price programs, thereby not embracing the idea of the adoption of new types of rates. One of these respondents however, "wouldn't recommend implementation of a humpback or decreasing block structure".

One participant divided his or her answer into two parts: in the short-term, options are limited, and perhaps only a summer excess rate is feasible. In the long-term, "all of the different rate models will be on the table". This participant also emphasized the success of non-price programs at reducing water demand.

Finally, one respondent was quite clear with his or her opinion: "Well, the ones that we really shouldn't be doing are the ones we're doing, and the ones I think we should be doing are [ones like] an inclining block with a monthly billing period". Indeed, this was the only one with a specific idea of necessary changes to water rate structures. All other answers were cautious and hesitant to talk about the subject.

5.2.7 Summary of Phase I Interview Findings

Each regional municipality makes master plans that indicate when water supply infrastructure will be expanded, based on population growth and demand forecasts. These master plans attempt to look long-term, and each requires a lot of time and preparation. Provincial legislation dictates growth rates in some cases. Only one person explicitly labeled peak demand as a driver for infrastructure expansion.

Uniform rates are used in three of the four regions, and two of these have additional fixed charges. The other region used a declining block rate. When asked how effective these rates were at reducing peak demand, responses can be summed up as "I don't know", "they're better than nothing", or "they're not very effective".

Decision-making in each region is embedded in a hierarchy, with the local council determining the ultimate outcome.

Increasing block rates or inclining rates along with seasonal excess rates were suggested as possibly being able to reduce peak demand, but only one person advocated their use, while the others were reluctant to do so.

5.3 Results from Phase II Interviews

The purpose of the second round of interviews was to determine the barriers to implementing residential seasonal water rates in the Region of Waterloo 20 years ago, in 1989. This set of interviews used a question schedule, but participants were asked to share their thoughts as they had them, thereby making the interviews semi-structured. The resulting responses are therefore not categorized in the same way as for Phase I interviews, but are rather divided into eight barrier categories plus an additional two pertinent categories that are not barriers. Of the eight barrier categories, six were identified in the literature, leaving two new categories. The six barrier categories that overlap with those from the literature review will be summarized first, followed by the two new barrier categories, and then the two pertinent non-barrier categories will be explained.

5.3.1 Phase II Respondents

To preserve anonymity, respondents were informed that their job titles would not be reported in this research. The respondents previously worked either in water services or operations departments. Two of the respondents held senior level positions at the Region's water services department, another held a mid-level job in the same department, and another worked for one of the urban municipalities at a senior level position. The other respondent held a senior level position in the Region's operations department.

5.3.2 Attitudes and Perceptions

Attitudes and perceptions are indicators of the general atmosphere that surrounds an issue like changing water rates. For example, when summarizing the reasons why the Region of Waterloo decided against making changes to water rates, one respondent said: "Nobody was all for it, they hadn't bought into it fully. The issue was providing more water." This quote is reminiscent of the supply-side mentality that is generally stronger and more prevalent than demand-side paradigms into which the subject of water rates would fall.

One respondent noted that, at the time that he or she worked for the Region of Waterloo in 1989, there was a perception that "water rates are cast in stone." This respondent went on to argue that this perception has since changed (in a large part due to Walkerton; see section 5.3.11 below), but the perception that water rates should not be meddled with was a barrier to changes in rate structures at one time.

5.3.3 Organization, Management, and Administration

The fact that water supply is administered by a two-tier system in the Region of Waterloo is a definite barrier that fits into the category of "Organization, Management, and Administration", but since it is specific to the Region, it will be given its own section below.

One management barrier that can be generalized to other water supply situations is the problem of reactive management. One respondent stated the problem in this way: "The only place where municipalities really feel the need to do anything is where there is a [supply] shortage." Proactive management is largely absent, and as a result, problems are tackled as they arrive or worsen. A change to water rates would stand as a proactive measure to reduce peak demand, but would not fit in a reactive management regime.

Another participant saw the difficulty of changing the inertia of financial staff, looking at this group as a cause for the "non-starter" fate of water rate changes: "[Financial staff would] have to recalculate to reflect the real cost of water. Staff regarded that as a hassle. So from the financial end of things, I particularly blame financial staff." However, this same participant noted a change in staff over the last 20 years: "I think on the positive side, staff are now more… more educated? For lack of a better word." According to this participant, Regional staff are now more interested in (or at least aware of) the concept of "sustainability", perhaps making the possibility of change to water rates more realistic.

One other respondent noted the lack of vision on the administrative side of water supply and distribution: "there was really nobody there that had a good feel for water supply and the big picture. Absolutely none." This lack of vision stood as a barrier to the implementation of water rate changes.

5.3.4 Financial

Any kind of change to water rates, be they seasonal or otherwise, requires a financial commitment. In the case of the water rate changes being proposed in the Region of Waterloo in 1989, changes to meters would have been necessary, and the cost would have been non-trivial. As stated by one respondent:

> Nobody's metering systems were automated enough to really do the kind of job that was necessary to fulfill the requirements of this report… I believe that one of the questions that became a negative to implementation was the cost of metering, the cost of putting in different billing systems, at the finance departments, both at the regional and the municipal [levels].

This respondent later added, "nobody would even consider the money involved in that type of process." As such, the need for financial commitment stood as a barrier to the implementation of water rate changes.

The need for a constant and steady revenue base was viewed as another financial barrier. Whereas one participant did not personally view this as a problem, he or she felt that others in the Region did, both 20 years ago and now. In fact, uttering one of the best quotes from this set of interviews, this participant went on to say, "In twenty years, we're still fighting that same uninformed battle." In other words, there are methods to account for changes in revenue as a result of water rate changes that are simply not considered by many people.

The other participant who mentioned revenue issues thought a water supplier "should be selling every gallon of water [it] can, because it's a matter of generating revenue to pay for the system." Following this logic, pricing water for conservation purposes would be excluded as a possibility.

5.3.5 Policy and Governance

Three out of five participants felt they could sum up the reason for the Region of Waterloo not implementing water rate changes in one barrier: lack of political will. Given that Regional Councillors are publicly elected officials, the participants who mentioned this barrier thought there was little motivation for councillors to push for something as politically sensitive as changes to water rates.

One of the participants who mentioned a lack of political will believed whereas water management staff have improved over the last 20 years and now may be more amenable to water rate changes, political will is still lacking. This same participant believed that mandates for water rate changes from the Province of Ontario might help any effort to implement water rate changes. It will be seen below that this might already be the case, due in part to the Walkerton tragedy.

Another respondent suggested that government involvement in water management through the use of demand management practices should not occur in a public water utility:

> I still feel that when a municipality tries to initiate water conservation, they're not doing their job. It's me as a consumer that has to look after conservation. The municipality has to look after supplying the demand, and making sure it's there for firefighting and reasonable use.

One can immediately see how this argument might be countered (e.g., what is reasonable use? etc.), but it demonstrates the fact that government involvement is sometimes viewed as inappropriate.

Finally, one participant speaking about water supply management in general stated that Regional council never took interest, believing, "it just wasn't a big issue" in their minds. It is therefore unlikely that councillors would pay it much attention to the possibility of seasonal water rates or any other rate changes outside of the conventional agenda.

5.3.6 Possible Inefficacy of Price Programs

Only one participant alluded to the possibility of seasonal rates lacking efficacy, stating that in his or her own case, he or she "would just pay the bill". In other words, seasonal rates for the sake of conservation may only work to increase revenue, depending on the magnitude of rate changes and the demand elasticity of summer-use water.

5.3.7 Equity

Two respondents saw affordability as a barrier to the implementation of new water rates. One seemed to view this barrier largely as a political maneuver:

> Some councillors even went as far as to say, well what happens to the woman who is a widow and has six kids, and uses a lot of water because of the size of her family but can't afford an increased water bill… it's largely political when it comes to rate structures.

The other respondent stated the Region had a priority to keep water rates "as low as possible". This can be interpreted either as a desire for affordability for social equity purposes, or as a push for incentives for growth.

5.3.8 Complexity

Complexity of setting new water rates is one of two new barriers discovered through the course of the Phase II interviews. Given the number of factors that must be considered when setting new water rates, two respondents cited the complexity of the situation and the accompanying difficulties. Said one respondent, "It gets very, very complicated and it requires a lot of political will." Another participant believed the document that was supposed to guide changes to water rates was very complex: "The more we got into [the study], in my view, the more it became complex… the model [the consultants] came up with seemed to be very complex…" As a result, implementation of new water rates was hindered.

5.3.9 Two-Tiered Water Supply

The two-tiered nature of water supply is a barrier specific to the Region of Waterloo that was described during the course of the Phase II interviews. To put this barrier into context it is worthwhile to give a short narrative of the Region of Waterloo 20 years ago, built up from information gathered in these interviews.

In the 1980s, the Region of Waterloo was completely dependent on groundwater, with a well system that was, as quoted by one participant, "probably one of the most complex in the world". The water supply system had little to no difficulty delivering day-to-day water supplies, but every May, "over a period of about two or three days, water use [would] just skyrocket". This rapid increase in water use was attributed mostly to lawn irrigators. The cost of providing these peak flows was large, and so talk began of building the Mannheim water scheme or a Great Lakes pipeline or both. Meanwhile, under a fair amount of political pressure, water supply managers scrambled to deliver enough water to supply peak demands. One respondent gravely described the seriousness of the situation, stating, "I spent many a Friday night down at the pumping station hoping like hell somebody would turn their tap off". It is likely that the water system had very little resiliency at this time, and it is a wonder that there were no breaks in service. It was at this time that the water rate study was commissioned to try to find a method for curbing peak demands.

Virtually nothing was achieved as a result of the water rate study. For one thing, as stated so diplomatically by one participant, "the Region went into the study with great expectations, which were probably not shared equally by the area municipalities". Indeed, the fact that water supply is controlled in a two-tier system was mentioned as a barrier by three of the interview participants due to the fact that while the Region of Waterloo desires to reduce water consumption in order to defer water infrastructure expansion, the urban municipalities need revenue to cover their fixed costs (e.g., operation, maintenance, etc.). These directly opposing views conspire to form a barrier to the implementation of conservation-based water pricing, and are explored further below.

5.3.10 Water Management Outcomes

The narration given through the course of the Phase II interviews painted a dire picture, but clearly something happened to allow the Region to cope with the supply problems that were being encountered 20 years ago. There are three reasons. First, the Mannheim water scheme was constructed and put online, thereby giving the Region of Waterloo a surface water supply option. Other supply measures, such as the Aquifer Storage and Recovery projects, have also been constructed. Second, many non-price programs were introduced or strengthened.[8] For example, one respondent helped to develop the toilet replacement program, and also attributed great water savings to Regional bylaws that prohibited the use of cooling water on once-through industrial processes. Third, the fact that many industries have closed in the Region of Waterloo has allowed the Region to further defer infrastructure expansion. Altogether, these three reasons allowed the Region to avoid the use of pricing programs to curb water demand.

5.3.11 The Walkerton Influence

Three of five respondents explicitly mentioned the Walkerton tragedy as a catalyst for change to water supply systems in Ontario. On this topic, it is worth quoting one respondent at length:

> Some of the legislative and regulatory changes that have evolved since Walkerton, in my opinion, will serve the water industry and the public very well. The movement to full cost recovery, financial reporting, [and the] quality control processes… being required will collectively make a huge contribution towards better managing water and wastewater systems. Full

[8] The Mannheim water supply scheme and the Region's non-price programs are ignobly connected. According to one respondent, shortly after the Mannheim project was proposed, the Waterloo Public Interest Research Group (WPIRG) threatened to call for a full environmental assessment on the project, which would have set it back at least two years. The Region avoided this delay by allocating funds for a Regional Water Conservation Coordinator, thus assuaging the outrage of the WPIRG.

> cost recovery and life cycle costing principles will avoid the short-sighted, short-term focus of both managers and elected representatives in the future. Many municipally operated water systems in Ontario have already started long term plans that will embrace and implement these principles. Long-term infrastructure studies and sustainable funding objectives are now the driving force for managing water systems and not keeping water and sewer rates as low as possible. That option has been removed through recent legislative and regulatory changes… In my view, there are now fewer barriers than ever to implement creative water rates – be they seasonal or otherwise. Such barriers may now reside more in the area of metering infrastructure and billing periods.

Thus, even though water rate changes were not implemented in the Region of Waterloo even after an extensive study on the subject, the time may be ripe to again pursue this possibility.

5.3.12 Summary of Phase II Interview Findings

Six of the barrier categories from the Phase II interviews overlapped with the list from the literature review. Another two (complexity and two-tiered water supply) are new. The Region was able to circumvent the use of conservation-based water pricing through a combination of supply infrastructure expansion, non-price conservation programs, and a shrinking industry sector. Although seasonal water rates or other water rates have not been implemented, it is possible that the atmosphere resulting from the Walkerton tragedy is now more amenable to these possibilities.

5.4 Results from Phase III Interviews

The purpose of the third round of interviews was to determine the contemporary barriers to implementing residential seasonal water rates in the Region of Waterloo. This set of interviews used a question schedule, but participants were asked to share their thoughts as they had them, thereby making the interviews semi-structured. The resulting responses are categorized in the same way as for

Phase II interviews, divided into eleven barrier categories plus an additional pertinent non-barrier section on notable commonalities. Of the eleven barrier categories, nine were identified in either the literature review or the second phase of interviews, therefore leaving two new categories. The nine overlapping barrier categories will be summarized first, followed by the two new barrier categories. Following this, a couple of non-barrier commonalities will be noted.

It will be noted the results herein do not explicitly give respondents' answers for the individual questions. For example, for the question, "Are you familiar with the idea of "seasonal water rates"", it is not considered important to report answer frequencies, since the purpose of this question was to set the topic of conservation with the "An Argument for Seasonal Rates" document.

5.4.1 Phase III Respondents

A total of 10 people were interviewed for this phase. Four Regional Councillors plus the Regional Chair, all of whom sit on the Water Efficiency Advisory Committee, represented the political view of the pertinent issues. A senior level employee whose job title was omitted by request and the Manager of Finance and Administration represented the Region's Water Services department. From Cambridge, the Manager of Operations Compliance for the Public Works Department was interviewed. From Kitchener, the Manager of Operations for Kitchener Utilities was interviewed. Finally, the Director of Water Services represented the City of Waterloo.

Respondents have held their positions for anywhere from 4 to 36 years, with the average being 13 years. All respondents were familiar with the idea of seasonal water rates.

5.4.2 Attitudes and Perceptions

Three respondents mentioned public perception as a barrier to implementing seasonal rates. One pointed to the "myth of abundance", stating, "There is still a generation or two out there who are having a hard time grasping the concept that water is kind of a finite resource, and needs to be conserved". Another respondent believed this barrier was part of any change that comes with water demand management strategies. Speaking of the Region's outdoor water use bylaw, this respondent said, "I know that when we implemented the water ban, … of course you meet with resistance, and it's a process that you have to go through". Two of these three respondents added the fact that education would have to be an integral part of the implementation of something like a seasonal water rate, since the idea of "peak demand" and its importance is not necessarily intuitive, but can easily be explained to "reasonable people".

Interestingly, one respondent specifically mentioned his or her belief that perception is *not* a barrier, at least in the Region of Waterloo: "Generally speaking, I believe it would be socially acceptable. I don't think we'd get a lot of pushback."

5.4.3 Organization, Management, and Administration

Speaking about the possibility of perhaps changing water rate structures in his or her municipality, one respondent stated, "all billing options are going to be put on the table. I'm assuming we'll probably stick with the present billing system that's in place now". In other words, the inertia of volumetric billing in this particular urban municipality is enough to prevent the implementation of conservation-based rates.

Most seasonal rates would require two administrative changes. First, as reported by three respondents, residential and ICI (industrial, commercial, and institutional) accounts would have to be separated, since seasonal rates should (according to these respondents) target only residential users in order to keep industrial and commercial rates competitive. Second, one participant noted that each residential bill would have to be determined separately, since different households could have different base rates as determined by their water use over the winter period. As mentioned by yet another respondent, these two changes imply alterations to billing, which is virtually all computer-programmed. The changes to residential billing procedures and the reprogramming of computer systems are not trivial tasks, and therefore act as administrative barriers.

5.4.4 Financial

The four respondents who pointed to financial barriers worked more closely to the financial aspect of water services than the other respondents. One is the Manager of Finance and Administration for the Region, while the other three represent the three urban municipalities. Their concerns can be divided into two parts.

First, what was called "fiscal viability" in the literature review was of utmost importance to these four respondents. As one municipal representative put it, "We need revenue. From the city's perspective, revenue drives everything we do". In fact, this same respondent is somewhat irked by conservation programs in general:

> I joke to people that I want to bring back the 13-litre flush toilet, have a campaign for that. I wouldn't mind seeing swarms of locusts and a drought come through. We're revenue driven. As I said, we need money.

All four respondents added the fact that most of their costs are fixed, and were somewhat worried that conservation-based rates such as a seasonal rate could undermine what is already a precarious situation.[9]

The second financial barrier, mentioned by one respondent, was the fact that seasonal rate structures can lead to a revenue surplus in some years. While this might be considered a boon since water utilities already use reserve fund accounts, it opposes the public water utility's conventional mandate to remain

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[9] Three of the four respondents explained to the researcher that their water revenues had been dropping in recent times. This year, one municipality was at June already about $340 000 under what was considered to be conservative estimates.

revenue neutral. Thus, the possibility of a revenue surplus is a barrier that needs consideration.

5.4.5 Data and Informational

One respondent did not go as far as to call this a barrier, but stated, "what I would *love* is to have real time data to be able to charge real time usage." Thus, as electricity utilities move to "smartmetering", so too should the water sector. A lack of precise usage data may be seen as standing as a barrier to seasonal water rate implementation.

5.4.6 Policy and Governance

Two participants mentioned in passing that water rate structure changes require council approval, making the process inherently political. For example, one participant, a water management professional, suggested that the inertia of the uniform rate structure that has been used for so long in his or her municipality might hinder the approval of a new rate structure from council. Additionally, one councillor said, "if [the Region of Waterloo] was one-tier, there would still be some [resistance] on the part of some councillors from a political perspective to charging two different rates". This comment suggests that most other thoughts on political barriers might be grouped into the "two-tiered water supply system" barrier (5.4.10).

5.4.7 Possible Inefficacy of Price Programs

Three respondents noted the possible inefficacy of seasonal water rates as a barrier. As noted by one respondent, "unless you really, really significantly increase the price of your water in the summer, people don't care, or those who can afford it will happily pay it". The reasoning is that water demand is assumed to be quite inelastic (see section 2.3.11.b on "Elasticity").

5.4.8 Equity

Four respondents saw equity to be an important issue in water rate setting, implying the issue to be a barrier. One respondent stated he or she had a "fundamental, philosophical aversion" to "user pay" programs, believing that social programs should be universal in nature. This participant added that he or she had many children, thereby influencing the expressed sentiment.

5.4.9 Inherent Problems of Economic Instruments

The barrier of inherent problems can be divided into two parts. First, when referring to a previous discussion about water rate structure changes, one respondent believed these sort of initiatives ignore the fundamental social changes that are required for a successful environmental campaign: "if it just costs more, then people would use it and it wouldn't have the same kind of social impact as actually going in and building new policies and giving incentives for people to follow those policies."

Second, if a conservation-based water pricing program was very successful, it is possible that water rates would have to be raised in order to cover the fixed costs incurred by any given water utility. In this hypothetical positive feedback loop, conservation begets conservation, and prices thus spin out of control. Two participants mentioned this quirky idea. However, such a scenario is only possible if population is considered static. That is, a growing population may add to a utility's revenues without adversely affecting the fixed costs associated with a municipal water system.

5.4.10 Two-Tiered Water Supply

Six participants cited the two-tier nature of water provision in the Region of Waterloo as a barrier to the implementation of seasonal water rates. One of these respondents explained that the Region and the area municipalities have different motivations when it comes to conservation:

> [We at the Region] build the infrastructure… and so we have obviously a great motivation to reduce water consumption, certainly on the peak side. The area municipalities though don't have that same motivation. Their costs are probably not as peaky as ours are, and so for them, although they

> conceptually agree with the concept, the reality is we're asking them to reduce their revenues for our benefit.

This sentiment was echoed by one of the municipal respondents: "At this point, we are not charged with managing the system that would benefit the most from seasonal rates."

Additionally, two respondents argued that there would have to be agreement among all seven area municipalities before seasonal rates could be implemented.

Finally, one respondent made a nuanced observation. This respondent pointed to the section in "An Argument for Seasonal Rates" (which was provided to all respondents) where it was stated that it would not matter how the area municipalities chose to deal with wholesale peak rates handed down from the Region. The respondent claimed that it *does* matter how the wholesale peak rates are dealt with, since it would be possible for area municipalities to blend their costs of buying water into price changes for the whole year, thus increasing prices to consumers year round. As stated by the respondent: "So then what's the effect of what we've done? All we've done is jacked up the rates; we haven't affected any behaviour." Thus, it seems that some respondents believe that area municipalities would have to agree to use seasonal rates for their customers if they themselves were subjected to wholesale seasonal rates from the Region.

5.4.11 Timing

Any change as inherently political as changes to water rate structures requires proper timing, something five respondents suggested is currently lacking. Quoting the facts that per capita water use rates are very low in the Region of Waterloo and that demand has been tapering off in recent years, these respondents saw no need for seasonal rates to be implemented at the moment. Thus, timing can act as a barrier to the implementation of seasonal water rates.

Moreover, while the implementation of a water rate *structure* (i.e., seasonal rate) was the main topic of the Phase III interviews, four participants mentioned the fact that water rate *prices* themselves have been going up in recent years. These price increases exist partly as a result of provincial legislation (see section 3.5), and the increased revenues that have accompanied the price hikes have gone towards capital projects to *maintain*, as opposed to *expand*, water infrastructure. One respondent noted that the price increases may have resulted in conservation: "A fallout could be maybe some people are saying, hey, this is costing more, I'm not going to use as much. But that wasn't the reason [for raising prices]; the reason was to fix infrastructure." Nonetheless, one savvy respondent noted that as a result of recent price increases, now is not a good time to implement seasonal rates, which may be viewed as simply a cash grab.

Interestingly, three respondents saw the implementation of seasonal water rates as a matter of *when* as opposed to *if*. One councillor went as far as to say that the topic may be discussed in council as soon as this term.

5.4.12 Non-Price Conservation Programs

Most participants digressed from the topic of seasonal water rates to discuss the other water management options being adopted in the Region of Waterloo. For example, three respondents spoke about the toilet replacement program. Additionally, eight participants gave the outdoor water use bylaw as an example of an effective non-price conservation program, despite the fact that there is no empirical evidence for its efficacy. As one participant stated: "I think the once-a-week lawn watering bylaw that we've put in … we'll never know, because we'll never be able to measure it, but I have to think that it's been way more effective than any rate study could have been because it's a bylaw."[10]

Four respondents praised the Region's use of a "balanced approach" to water management, combining supply and demand management. One of these

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[10] Cryptically, this same respondent shortly thereafter said, "It's very effective, it's very effective. We've really, really seen the results in terms of peaking. It's been very effective."

respondents referred to the Region's Aquifer Storage and Recovery (ASR; see section 3.3) as a way to "attack" summer peaks, since more water can be stored from the Grand River when it is seasonally available in the spring.

Overall, non-price conservation programs were viewed as effective. As stated by one participant:

> I think that in summary, we've been doing our master planning on water efficiency for some time, we have a good history of it, we've had a good history of very successful programs in terms of meeting our targets or exceeding them. I think through good education and good incentive programs you can be very effective in being a very sustainable community, and that's what we're seeing.

Thus, taken together, non-price water conservation programs stand as a barrier to the implementation of seasonal water rates, since the latter may be deemed unnecessary.

5.4.13 Other Notable Commonalities

Two commonalities from the Phase III interview data are not barriers, but are worth noting. First, three respondents, all of them councillors, expressed their wishes to defer indefinitely the construction of the Great Lakes displacement pipeline. Even so, one of these respondents noted the difficulty of dispensing with the idea completely:

> Our objective, at least my objective, politically is to put off that pipeline indefinitely, but I don't want to take it out of the official plan. I want it there, because I think to take it out of the official plan and to stop any kind of planning for it is really almost irresponsible.

Thus, the pipeline may be considered part of the "balanced approach" adopted by the Region of Waterloo.

Second, in a large part due to inflow and infiltration (I&I) issues, wastewater is a hot topic in the Region of Waterloo, as mentioned by three respondents. The main issue is that the area municipalities are charged by the Region for the entire volume of water that goes to the wastewater treatment plants. I&I refers to the inundation of stormwater in sanitary piping caused by combined sanitary and storm pipes, or by breakages in both of the two systems. Because of I&I, the municipalities in the Region of Waterloo do not receive revenue for all of the water they must pay to have treated. One respondent put it thusly: "Just this year I hate seeing rain. When rain comes it means no one's buying water to water their lawn, and then I get kicked in the butt [because] now I've got extra costs on my sanitary side." So, wastewater revenue issues may act an impediment to the implementation of seasonal rates if these rates are viewed as possibly decreasing general water revenue.

5.4.14 Summary of Phase III Interview Findings

Eleven barrier categories were identified in the Phase III interviews, nine of which had been identified earlier in either the literature review or the second phase of interviews. The two new categories are "timing" and "non-price programs". Additionally, a couple of notable commonalities were observed: the political desire to defer the Great Lakes displacement pipeline, and issues pertaining to wastewater.

5.5 Summary of Barrier Categories

For the purposes of quick reference, table 5.1 shows the fourteen barrier categories determined through the course of this research, and shows which phase of research identified each category.

Barrier Category	Literature Review	Phase II Interviews	Phase III Interviews
Attitudes and Perceptions	X	X	X
Organization, Management, and Administration	X	X	X
Financial	X	X	X
Data and Informational	X		X
Policy and Governance	X	X	X
Possible Inefficacy of Price Programs	X	X	X
Residential Water Billing	X		
Equity	X	X	X
Inherent Problems of Economic Instr.	X		X
Conflicting Definitions	X		
Complexity		X	
Two-Tiered Water Supply		X	X
Timing			X
Non-Price Programs			X

Table 5.1 – Summary of barrier categories from the literature review and the second and third phases of interviews.

Chapter 6 – Discussion

6.1 Introduction

Based on the literature review and the second and third phases of interviews, a set of barriers relating to the implementation of seasonal water rates in the Region of Waterloo has been assembled. A stand-alone list, however, is not entirely useful. Thus, the purpose of this chapter is to discuss the different barrier categories to determine the severity of each of them.

6.2 Barrier Severities

6.2.1 Attitudes and Perceptions

Attitudes and perceptions embody the thoughts, whether correct or false, of individuals. For example, the "myth of abundance" was encountered in both the literature review and the third phase of interviews. This barrier category can be pessimistically argued as unmanageable if attitudes and perceptions are viewed as intractable, while the optimist would point to their mutability. In general, the inertia of the status quo is embedded in the attitudes and perceptions of water management professionals and elected council members such that making changes to water rate structures is difficult. Nonetheless, just as one Phase III respondent suggested that the idea of "peak demand" could be explained to reasonable people, the expounding of the potential for seasonal water rates to decrease peak demand could be used to slow or alter the inertia of hesitant attitudes and perceptions.

6.2.2 Organization, Management, and Administration

Like "attitudes and perceptions", this barrier category is an issue of the inertia of the status quo within a water service organization broadly defined. However, there was a perceived difference in the organizational barriers as understood by water management professionals and Regional Council members. Whereas all five councillors interviewed in Phase III implicitly or explicitly supported the implementation of seasonal water rates, only one of the five management professionals voiced his or her support. This discrepancy is most likely due to the fact that the management professionals would be the ones who would actually have to implement the rate changes in the messy real world. The hesitancy expressed by management suggests that organizational barriers are in actuality stronger than given credit for by council members.

Although the literature review noted the issue of fragmented departments within a water services organization, the data collected from the interviews cannot speak to this issue. However, the barriers of reactive management and a lack of long-term vision were uncovered in the Phase II interviews.

It is not clear how to overcome the barrier of organizational inertia, especially since the concept is even more nebulous than the "attitudes and perceptions" of individuals. It is reasonable to suggest that, as before, an explanation as to how seasonal water rates can potentially decrease peak demand would be helpful if disseminated throughout an organization. Nonetheless, organizational barriers may be reduced but likely cannot be fully eliminated.

6.2.3 Financial

There are three major parts to the financial barrier category. First and most importantly is fiscal viability. Every respondent who worked closely with water finances in the Phase III interviews explained that, due to the fixed costs that are inherent to any water system, incoming water revenue is essential. Thus, a *conservation*-based water rate structure such as a seasonal rate is fundamentally at odds with revenue priorities. Second, given that water utilities have a mandate to break even, the possibility of excess revenue is another problem. The first issue is more serious than the second since it relates to the ongoing viability of the water utility. Given that a seasonal rate structure can be designed to target only residential use in excess of winter average, it is reasonable to suggest that the cost of a drop in revenue might be more than outweighed by the benefits from reducing peak demands. However, the third major aspect of the financial barrier category, the cost of implementing a seasonal rate structure, would doubtlessly affect the cost/benefit ratio.

All three of these issues can be addressed in some way. The severity of the first issue may be determined through the use of an empirical study. Moreover, the continued growth of the Region counteracts the possibility insufficient revenues. In this sense, population growth allows for a greater opportunity for conservation-based water rates. For the second issue, altered and transparent accounting procedures could be used to explain how excess revenue is distributed back to users or accrued for future water projects. Alternatively, both of these problems can simultaneously be overcome if a rate is designed to make sure revenues are properly met in an *average* year. That is, excess revenues are stored for years when revenue requirements are not met. Finally, cost of implementation will depend on how a seasonal rate is designed, so speculation of its effect here is not useful.

6.2.4 Data and Information

A paucity of data and information stands as a barrier depending on the level of sophistication desired for a seasonal water rate. For example, a simple seasonal rate could be implemented based solely on the amount of water used in the summer compared to the winter for each residential customer. The necessary data exist, but decisions would need to be made as to how data are delineated (i.e., what dates constitute the "winter period"?). The fact that sufficient data exist is perhaps why only one respondent expressed his or her desire for real-time water usage data, which are not required for the implementation of a simple seasonal rate.

6.2.5 Policy and Governance

Political and governance barriers can be considered to be the counterpart to organizational barriers. Whereas the latter seems to apply more to water management professionals, the former would obviously apply to council members. A lack of political will was attributed as one of the main barriers for the Region's decision not to implement new water rate structures in 1989, but since no council members were asked about the political atmosphere in 1989, the severity of this barrier was not verified.

Regarding the contemporary political atmosphere, political difficulty was mentioned only in passing in Phase III interviews, and not by councillors. As stated earlier, all interviewed councillors implicitly or explicitly endorsed the use of seasonal rate structures. So, where mentioned, it can be argued that political barriers are more rhetorical than anything else. In other words, it may be too easy to state "politics" as a hindrance to the implementation of seasonal rates, since the issues that may be encompassed as being "political" can be defined more precisely (e.g., the importance of proper timing for the implementation of a seasonal rate).

6.2.6 Possible Inefficacy of Price Programs

The effect of a seasonal water rate depends, among other things, on the percent change in price and the elasticity of discretionary, seasonal water use. Therefore, the speculative nature of hypothetical percent changes along with the lack of consensus on elasticity suggest that this barrier can be overcome through the act of precisely defining terms, the gathering of empirical data, and thoughtful discussion.

6.2.7 Residential Water Billing

The infrequent and *ex post facto* nature of residential water billing is a barrier since the price signals necessary to effect change in residential water users may not be sent at appropriate times. Given that only one person (in Phase I interviews) mentioned it as a barrier, it seems that few respondents view the nature of residential water billing as a problem. Without empirical evidence of the effect (or lack thereof) of residential water billing, it is difficult to speculate the magnitude of the severity of this barrier.

6.2.8 Equity

The issue of equity or fairness is often about *intra*-generational issues. Given the fact that peak demands drive infrastructure expansion and that future generations will have to pay for the bulk of new supply projects, any mechanism that can lower peak demand must be viewed as affecting *inter*-generational equity. Thus, the equity "barrier" may be specious. Without thoughtful discussion, the issue of equity becomes a rhetorical weapon for those who oppose changes to water rate structures. In fact, it is quite impossible to determine whether the argument for "equity" or "affordability" is really about not adversely affecting certain socioeconomic residential groups, or simply rhetoric for staying "economically competitive" through the act of keeping water prices low in order to attract and retain commercial and industrial enterprises to a region. Thus, it is important to reiterate that seasonal rate structures can be implemented for *residential* users only, rendering the argument for "competitive pricing" moot.

6.2.9 Inherent Problems of Economic Instruments

Inherent problems of economic instruments are troublesome but not intractable. The concept of "water as an economic good" is a difficult one (see section 2.3.10), but it does not follow that the concept should be ignored. One respondent in the third phase of interviews expressed the opinion that pricing programs by their very nature do not have the same social impact as non-price programs, meaning that pricing programs that coerce behavioural change are not as desirable as, for example, educational programs that move users to change their behaviour of their own accord. Despite this sentiment, it seems unreasonable and even imprudent to overlook the use of price programs if they have the potential to curb peak demand. Recognizing the need to use pricing programs in concert with non-price programs may help to reduce the perceived inherent problems of price programs.

6.2.10 Conflicting Definitions

The conflicting definitions described in section 2.3.11 will stand as barriers only if they are not carefully clarified at the outset of a given pricing initiative. There are examples where definitions are carefully constructed, as in the case of the definition of "full cost" in Ontario's *Sustainable Water and Sewage Systems Act*.

6.2.11 Complexity

Mentioned only in the second phase of interviews, complexity may simply be a matter of perspective. Given that there are specific methods available for seasonal rate implementation, it is possible to follow the leads of other utilities. Thus, what might seem complex at the outset may become simplified upon following examples.

6.2.12 Two-Tiered Water Supply

Many respondents mentioned the Region's two-tiered water supply as a barrier to the implementation of seasonal water rates. At face value, this appears to be a serious barrier. Indeed, while the Region is interested in conservation for the sake of deferring infrastructure expansion, the area municipalities need the revenue received from selling water. Additionally, if the Region became serious about implementing wholesale seasonal water rates, it would need the area municipalities to agree to also use seasonal rates because otherwise, as mentioned in section 5.4.10, the municipalities could increase rates over the whole year, thus not effectively targeting seasonal peaks. However, this perception ignores the possibility that some area municipalities might choose to use non-economic approaches to facilitate behavioural change and peak reduction; while economic approaches may enhance behavioural change, peak reduction can occur in other ways, or in concert with price programs.

The two-tiered water supply barrier is worth discussing further. Consider a scenario where the Region of Waterloo moves to a one-tier supply system. What changes would take place? The Region would take over all systems, meaning it would be at liberty to implement seasonal rates as it sees fit. *But the other barriers that hinder the implementation of seasonal rates would still exist*. The Region would have a large magnitude of fixed costs, and would therefore need the revenue from water sales, which is the same problem described by municipal respondents. In other words, the only difference would be a change to who is in charge of billing residential customers. If anything, it is likely that a one-tier regime would imply a *reduction* in conservation programs, since the Region would have more incentive to increase revenues through selling more water. Thus, the most pressing present day two-tier barrier is the perception that all municipalities would have to agree to use seasonal rates for their residential customers if the Region introduced wholesale seasonal rates, even though non-price programs might be used to the same effect.

6.2.13 Timing

Timing is a barrier for which there is little control. As long as water rates continue to increase by large percentages in the Region of Waterloo and the rest of Ontario, it may be difficult to justify the implementation of seasonal water rates. Moreover, five respondents noted the low per capita water use in the Region of Waterloo at this time (even though seasonal water rates are used to decrease *peak* demand, not average demand), suggesting that rate structure changes are not urgent just yet. Even so, a number of respondents pointed to the fact that the implementation of seasonal rates is more a question of *when* as opposed to *if*, suggesting that the timing barrier is ephemeral.

6.2.14 Non-Price Programs

Given the inherent problems of pricing programs, it is not surprising that the use of non-price programs is popular and quoted as a reason for not implementing seasonal rates. Eventually, however, non-price program saturation will peak, perhaps encouraging the consideration of pricing programs in concert with non-price programs.

The idea that the Region of Waterloo is currently using a "balanced approach" to water management through a combination of supply and demand management is only partially true. From section 3.6, it is clear that much more money per unit of water supplied (or saved, in the case of conservation programs) will be allocated to supply management than demand management in the Region. Thus, the idea of "balance" is mostly rhetorical.

6.3 Summary

Regarding the implementation of residential seasonal water rates in the Region of Waterloo, six of the above barrier categories (data and information, policy and governance, equity, conflicting definitions, complexity, and timing) are not severe. The other eight barriers can be addressed in three ways.

First, the barrier categories of "attitudes and perceptions" and "organization, management, and administration" might be addressed by explaining to council members and water management figures the potential for seasonal rates to curb peak demand. A report written to explain the ideas that underline and help to justify the use of seasonal rates could be used, although a two-way dialogue between seasonal rate proponents and others (should they be against the idea or indifferent) would likely be more effective. The requirement to expound seasonal rates suggests a need for one or more persons to champion the idea. However, given the inertia of the status quo, the dissemination of the idea of seasonal rates will remain difficult.

Second, the process of carefully designing a seasonal rate structure can be used to address two of the three aspects of the "financial" barrier category, along with the "inherent problems of economic instruments" and "non-price programs" barrier categories. For the two "financial" aspects, the potential for excess revenue can be addressed with transparent accounting procedures built into the design of a seasonal rate. The problem of implementation costs might also be accounted for depending on the design of the rate.

One rate design possibility is to aggressively promote rainwater capture for outdoor water uses while implementing a seasonal rate, suggesting the need for non-price programs to be implemented in concert with pricing programs. Indeed, inherent problems of economic instruments can be lessened if pricing programs are designed to run in concert with non-price programs. Concurrent design also reduces the barrier of the perception that "non-price programs" negate the need for new rate structures. If desired, the entire rate structure might be "softened" by allotting some percentage over the winter average for "reasonable" seasonal use (e.g., water for a vegetable garden) so that only those users with particularly discretionary demands (e.g., excess lawn irrigation, swimming pool filling) are targeted.

Third, and related to the process of carefully designing a seasonal rate structure, is the need to collect empirical data through the use of a pilot study. Upon finishing the design of a seasonal rate structure that may also require new non-price program initiatives (e.g., aggressive rainwater harvesting), a sample in the Region of Waterloo or elsewhere could be chosen to test the outcomes of the new rate. To be prudent, a control sample could be chosen to account for the counterfactual outcome. As the data are collected, the severity of the remaining barrier categories could be gauged. The issue of revenue viability (the remaining issue from the "financial" barrier category) could be reviewed by determining how or if revenue incomes change based on the implementation of the rate compared to no implementation. In the same way, the "possible inefficacy of price programs" could be checked against the data. If either the existing method for "residential water billing" remained unchanged or a new billing method was introduced (e.g., more frequent billing), study participants could be questioned about their bill's efficacy at modifying their behaviour. Overall, evidence collected from an empirical study would clarify the severity of these three barriers.

The final barrier category that needs to be addressed is the issue of the Region of Waterloo running a two-tiered water supply system. The three strategies suggested above could be used in combination to get the seven municipalities in the Region to agree to seasonal rate implementation. For example, if the design processes and the collection of empirical data fare well for the implementation of seasonal rates, then it would become much easier to discuss the nature of this pricing program with the individual municipalities. The Region would have to be the tier that champions seasonal rates since the current perception is that the Region would benefit more from their implementation than the municipalities. The reality of course is that if the Region has to expand their water supplies, the municipalities will be affected by increased wholesale water rates, which will be passed on to residential users. Exacerbating the supply expansion protocol is the fact that supply projects are becoming more expensive (see section 3.6). So, it is in the municipalities' best interests to take part in seasonal rate discussions, design, and trials.

In sum, while some barrier categories can be relegated to a less severe standing, the remaining ones can be addressed by: expounding the potential for seasonal water rates to curb peak demand to the people who will be most involved with their implementation; taking the time to carefully design a rate study to be administered in concert with non-price programs, and; implementing the designed rate structure for a sample population in the Region of Waterloo (i.e., conducting a pilot study) in order to compare the collected information with the data collected from a control group. Only after taking these steps to address the barriers encountered through the course of this research would it be possible to make conclusive decisions about the efficacy and desirability of a seasonal rate structure in the Region of Waterloo.

Chapter 7 – Conclusions and Recommendations

7.1 Summary

Through the course of a literature review and the second and third phases of interviews, a list of fourteen barriers pertaining to the implementation of seasonal water rates in the Region of Waterloo was established. Six of these barriers are not severe, and the remaining eight can be addressed through the use of explanation and discussion, careful design processes, and the collection of empirical evidence. Moreover, some barriers of import can be applied generally to other public water utilities in Ontario.

7.2 The Region of Waterloo

The two-tiered water supply system is a barrier category specific to the Region of Waterloo and other two-tiered municipalities. Despite the fact that many respondents viewed it as a serious barrier, upon closer inspection it appears benign. The Region of Waterloo and its municipalities are inextricably linked; the actions the Region takes affect all of its constituent components. If the Region can help defer the construction of costly (both financially and ecologically) supply projects like the Great Lakes displacement pipeline through seasonal rate initiatives, then it is the municipalities' best interests to cooperate.

This research has not determined whether or not seasonal rates would be effective at reducing peak demand. There are many questions and barriers affecting seasonal rate implementation, but the underlying principle is simple: targeting those users that contribute most to peak demand can help to curb it, thereby deferring the need for supply expansion. Since the Region of Waterloo prides itself as being a leader in water conservation efforts, it should seriously consider furthering its understanding of the utility of seasonal water rates.

7.3 Ontario

Since many communities in southwestern Ontario are growing quickly, especially in the Greater Golden Horseshoe, it may be prudent for them to also consider the implementation of seasonal water rates. Most of the barriers encountered through this research can be applied to other water utilities in this geographical area. For example, certain barriers such as equity, possible inefficacy of price programs, and inherent problems of economic instruments transcend the geographical region to which they apply. Others such as attitudes and perception, data and informational, etc. may be applied to other regions, but this cannot be stated with certainty. Overall, the important point to note is that not all barriers are equal, and none are insurmountable. As such, it is always worth exploring new methods for conserving water.

Additionally, as the Walkerton tragedy continues to influence provincial legislation, regions throughout the province may be required to alter their rate setting practices in one way or another. As such, the time may be ripe to implement unconventional pricing methods. Seasonal rates may also help utilities to become more economically efficient by pricing their water closer to the long-run marginal cost of providing it, as recommended in literature targeted towards public water utilities throughout the province (e.g., Swain et al. 2005).

7.4 Whither the Water Soft Path?

One purpose of this research was to begin establishing an understanding of how to use seasonal water rates as an incremental step towards a full adoption of the water soft path (WSP) principles. Recall that if the concept of "second-order scarcity" is adopted, economic instruments can be used to help make water use more efficient. This notion stands in contrast to the adoption of the concept of "first-order scarcity", which implies the perpetual expansion of supply resources to meet demands. The implementation of seasonal water rates is one method for making water use more economically efficient, since it can be used to price discretionary water use at a rate that is closer to the long-run marginal cost than would otherwise be possible using other pricing methods.

If seasonal rates are imposed, a spectrum of scenarios is possible. At one end of the spectrum, residents continue to use water for seasonal purposes, and the utility brings in the revenue that will be necessary to expand water supplies in the future as populations and demands grow. At the other end of the spectrum, the rates are enough to discourage residents from water use for seasonal purposes, thus substantially reducing or eliminating seasonal peaks. In this way, the main driver for infrastructure expansion is eliminated, and supply projects are deferred.

Clearly these are idealized examples. Nonetheless, it is obvious that within a WSP framework the second scenario is desirable. But is this an incremental step towards the adoption of the WSP? Yes and no. Yes in that seasonal rates address three of the four principles of the WSP: seasonal rates suggest discretionary water use is a service, not a resource, and their use would mean that ecological systems are implicitly (but temporarily) safeguarded through the deferment of new supply projects. Additionally, seasonal rates speak to the idea of conserving quantities of water (specifically, peak demand water), and implicitly touch upon the idea of conserving quality if it is accepted that it might be necessary to implement something like a rainwater harvesting program in concert with seasonal rates. What is missing is the idea of "backcasting": envisioning a desirable future, and determining a way of achieving goals necessary to make that future a reality. As such, the WSP is a normative concept; it requires a paradigm shift in the way water is managed and conceptualized since it is not enough to simply project forecasts of water management practices into the future. So, in order to fit the use of seasonal water rates into the WSP concept, it is necessary to choose explicit goals for the future with the understanding that seasonal water rate implementation stands as one method for achieving said goals. For example, the indefinite deferral of the Great Lakes displacement pipeline could stand as an explicit goal. It would then become immediately clearer why the implementation of seasonal rates might be important, and how they fit into the WSP concept.

Water management professionals and council members alike are loath to explicitly state a goal to indefinitely defer the pipeline because the Region of Waterloo, like any other region in a modern capitalist economy, believes it is dependent on growth for its viability. This economic growth is exacerbated by the fact that the Province of Ontario has mandated large population increases for the Region. Again, the issue of "irreconcilable priorities" takes precedence: no matter what agenda is adopted for water services in the Region of Waterloo, the perception exists that infrastructure expansion will be necessary at some point in the future. The Great Lakes displacement pipeline is viewed as one option among many; it just happens to be a very expensive and large-scale possibility. Just as some Regional councillors saw the implementation of seasonal water rates of a matter of *when* and not *if*, there is a perception that it is similarly a matter of time before the pipeline is built. The need for "backcasting" becomes clear: without one or more explicit goals to seek, the status quo and the mandates handed down from the province prevail, leading to the possible manifestation of the Great Lakes displacement pipeline.

It is now possible to understand how seasonal water rates can address some of Gibson's sustainability criteria (2005). In a similar way that three of the four WSP principles are addressed, seasonal water rates address some of Gibson's criteria. First, socio-ecological integrity is addressed through the possibility for seasonal rates to help defer expansion of water supply projects, thereby drawing less water from the ecosystem. Second, the adoption of "user pay" principles means that intragenerational equity issues are considered. Third, if explicit goals are made to indefinitely defer the pipeline, intergenerational concerns are addressed, since it is the next generation that would have to pay for the brunt of the pipeline's construction and operation. Fourth, efficiency is increased by “reducing extractive damage” (p. 117), again through the use of project deferral. Finally, immediate and long-term goals are integrated by targeting those responsible for peak demand in the short-term, and again, deferring project expansion in the long-term. The other three criteria (livelihood sufficiency and opportunity; socio-ecological civility and democratic governance; and precaution and adaptation) are not addressed. Nonetheless, since “sustainability” is more of a process than an end, the act of implementing seasonal rates stands as one method for the consideration of five of Gibson’s sustainability criteria.

In sum, seasonal water rates can be used as an incremental step towards the adoption of the WSP and other wide-reaching sustainability initiatives, but not without first envisioning a desirable and sustainable future.

7.5 Recommendations

Two possibilities for research tracts are offered. The first is smaller in scale and relates directly to the implementation of seasonal water rates. The second is larger in scale and much more conceptual.

7.5.1 Implementing Seasonal Water Rates

As suggested in the summary to Chapter 6, one of the best ways to further understand the nature of seasonal rates and their effects is to implement a pilot study using two samples (one test, one control) in a water utility such as the Region of Waterloo or another region. As the study was already described, the suggestions will not be repeated here. However, it is worth adding the need to account for wastewater issues, which have largely so far gone beyond the scope of this paper. Only by incorporating wastewater concerns is it possible to gain a good understanding of the issues surrounding the implementation of seasonal water rates.

7.5.2 Re-conceptualizing Water

As stated earlier, the water soft path requires one to re-conceptualize water management, and the idea of "water" itself.[11] But the WSP cannot exist in a vacuum; for an ongoing process of sustainability reform to take place, it is necessary for humans to rethink many concepts that are normally taken for granted. For example, as stated above, in a conventional economic framework, water supply infrastructure expansion seems inevitable. But are there alternatives to this scenario? "Interdisciplines" like ecological economics have shown that a given economic system must be defined within the boundaries of a natural system, but the application of ecological economics is difficult. Additionally, water policy is closely linked to energy and food policy, and both sectors are in need of rethinking on a grand scale. The research being suggested is related to the re-conceptualization of "water" and the "environment" at large. Clearly this is a daunting suggestion, but perhaps it can stand as a lifelong pursuit instead of a specific research project.

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[11] See Hamlin (2000) for an example of how conceptions of "water" and "waters" have changed over the past few centuries.

Appendix

Interview Questions – Phase I

Note: all questions should be considered to begin with "In your professional opinion…"

1. What are the indicators or drivers used in your utility to determine when supply capacity must be increased?
2. What rate structure does your utility use to charge for water?
3. How effective is this rate structure at reducing peak demand?
4. Who plays the biggest role in decision-making regarding your utility's practices?
5. Do any rate structures exist that might be useful for reducing peak demand (or whatever driver is identified in question 1)?
6. Are there any rate structures that you think your utility should consider implementing? Alternatively, are there any rate structures that you think your utility should NOT or NEVER consider implementing? Why or why not?

Interview Questions – Phase II

1. What was the title of the position you held when working for the Region of Waterloo in 1989?
2. Do you recall a document entitled *Development of a Plan for Equitable and Effective Water Rates in the Region of Waterloo* submitted by the consultancy group Stevenson Kellogg Ernst & Whinney in September of 1989?
3. Do you recall any of the recommendations from this document?
4. What narrative would you give to explain the events leading up to September 1989, and the events that occurred after September 1989 regarding water rates in the Region of Waterloo?
5. According to my research, the Region of Waterloo implemented none of these recommendations (at least as a result of the document). In your professional opinion, why do you think this was so?
6. In retrospect, are there any other specific barriers that prevented the implementation of the document's recommendations? (If prompting is needed: "These could be political, administrative, financial, etc.")
7. Are there any barriers specific to the implementation of seasonal water rates that come to mind based on your professional experiences?

Interview Questions – Phase III

1. What is your job title?
2. How long have you held this position?
3. Are you familiar with the idea of "seasonal water rates"? (Either yes or no, ask respondent to read "An Argument for Seasonal Rates".)
4. Do you now, or have you ever considered the implementation of seasonal water rates to be a good idea in the Region of Waterloo? Why or why not?
5. Have there been any discussions within your council/department about seasonal water rates, or water rate changes in general? If so, what was the nature of those discussions, and what came of them?
6. As you see it, what are the principal barriers to the implementation of seasonal wholesale water rates in the Region of Waterloo?
7. According to documentation available from the Region of Waterloo, it will cost the Region about $1200/1000 litres/day to provide "new" water using water efficiency measures by 2015, whereas new groundwater supplies and the proposed pipeline from Lake Erie would cost $2000 and $2500/1000 litres/day, respectively. Given that water efficiency measures are generally much cheaper than new supply measures, should the Region be investing more in water efficiency? Why or why not? (Provided respondent with a copy of "Approximate Costs of Different Water Strategies".)
8. Do you have any other thoughts about seasonal water rates in general?

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