APPROACHES TO WATER PRICING IN LOCAL GOVERNMENT:

FOUR NEW ZEALAND CASE STUDIES

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We have acted as if water were like air - free,
so omnipresent as to exist beyond our conscious thought;
so unquestionably necessary to life on this planet
that it would be foolish to spend any time
or energy thinking about it.
~ Fred Powledge "Water" (1982)

ABSTRACT

This thesis is an examination of water pricing techniques adopted by territorial authorities in New Zealand. The overall goal is to determine if current pricing mechanisms for the residential supply of water encourage conservation of the resource. This thesis examines some international conservation techniques, and evaluates them with reference to selected case studies in New Zealand.

Four case-studies were carried out in an attempt to understand the effectiveness of water pricing in New Zealand. These were Christchurch City Council, Hamilton City Council, Palmerston North City Council and Tauranga District Council. Questionnaires were sent to the water supply managers of each of the territorial authorities and interviews were carried out with these people to investigate water conservation issues in their districts.

The research findings show that all four territorial authorities have problems with meeting the peak demands of water consumption. Therefore, various bans and restrictions are in place across many areas at different times of the year. Although water conservation is an issue in the regional and district plans for each of these territorial authorities, measures to reduce consumption at peak times have been relatively unsuccessful. All of the territorial authorities under-price the supply of water and barely meet operational costs. Currently, there is no consideration of a rate that would *penalise* consumers for the overuse of water.

The international literature indicates that once a suitable pricing framework is established, water meters are the best tool for effectively reducing consumption. Although water meters are installed in two of the four cases, they are not being effectively utilised to promote conservation and reduce demand. For those territorial authorities not using water meters, a review of current conservation programmes is recommended. The current pricing structure is not proving to be sufficient in reducing either peak demand, or minimising water wastage.

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Chapter One

Introduction

This thesis examines the issue of water pricing for conservation at a territorial authority level of government in New Zealand. Identifying the need to conserve water is relatively straightforward, but identifying and implementing suitable methods to achieve conservation is problematic. Water pricing for the purpose of achieving conservation objectives is already occurring overseas, and some of these techniques are gradually reaching New Zealand. This research identifies and examines these techniques and gives an indication of their suitability as conservation pricing mechanisms. An examination of international developments of conservation pricing mechanisms is undertaken. A comparative analysis of four case studies is used to expose the degree to which water pricing influences water consumption and encourages water conservation within the territorial districts of these four authorities.

A theme fundamental to current views of environmental management is that environmental issues in general, and water issues in particular, should not be considered in isolation. To be properly appreciated they must be viewed in as broad a context as possible. This means that water must be examined not only in its role as essential to all life systems, but also in its indispensable role to most human activities and socio-economic development. A holistic approach to managing resource and development issues is now regarded as essential [1].

Reports carried out by the Organisation for Economic Co-operation and Development (OECD) illustrate that the inefficient use of water resources has significant environmental impacts [2]. Artificially low water prices and other

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[1] Raftelis, G.A (1993): *Comprehensive Guide to Water and Wastewater Finance and Pricing*. (2 ed.) Lewis Publishers, USA.

[2] Herrington, P. (1987): Pricing of Water Services. Organisation for Economic Co-operation and Development, Pans, pg. 13-17.

policies encourage overuse of water which leads, for example, to the construction of unnecessary water storage facilities with high capital input. Low prices can lead to excessive use of water for irrigation purposes, resulting in increased nitrate, phosphate and pesticide contamination of aquifers, and increased soil degradation through compaction and salination. Inefficient water pricing in industrial applications can also lead to the excessive use of water for diluting effluents to meet legal concentration standards. This may also increase the difficulty of eventual pollutant removal (Herrington, 1987).

Global Resource Scarcity

Global scarcity of resources (including water) is a topic of concern in many international forums. Global threats, such as the depletion of the ozone layer through the excessive use of chlorofluorocarbons (CFCS), the possibility of global warming through the excess emission of "greenhouse gases", loss of the world's biological diversity and the loss of uniquely wonderful, not to mention crucial assets such as tropical rainforests, are internationally widespread (Pearce, 1991)[3]. Furthermore, the problem of desertification from warmer temperatures, water shortages and droughts hinder development in regions in South America and Africa where food crops are failing as the search for water becomes desperate (Clarke, 1991) [4].

Measures to address these issues of natural resource management and global warming have been discussed since well before the Brundtland Report in 1987 [5]. However, the view that environmental conservation "matters" for sustainable development in the poor world received its most popular exposition through that report:

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[3] Pearce, D., Barbier, E., Markandya, A., Barrett, S., Turner, R.K., and Swanson, T., (1991): *Blueprint 2: Greening the World Economy.* Earthscan Publications, London.
[4] Clarke, R., (1991): *Water: The International Crisis.* Earthscan Publications, London.
[5] World Commission on Environment and Development (1987): *Our Common Future "The Brundtland Report",* Oxford University Press.

> Failures to manage the environment and sustain development threaten to overwhelm all countries. Environment and development are not separate challenges; they are inexorably linked. Development cannot subsist upon a deteriorating environmental resource base; the environment cannot be protected when growth leaves out of account the cost of environmental destruction.
>
> (World Commission on Environment and Development, 1987, p.37).

One measure suggested by Pearce et al. (1991) is the design of an incentive system, which conserves a scarce resource, yet removes or modifies the underlying factors giving rise to environmental loss. In other words, designing policies without looking at the causes of environmental degradation is a high-risk and probably self-defeating approach.

Although there is a great deal of scientific uncertainty surrounding these global problems, consideration of these issues at an international scale is necessary. As Pearce points out first, the scale of the problems could be very large, perhaps of an order that would merit terms like 'catastrophe'. Secondly, if induced warming occurs, it will be irreversible. If future generations do not like a warmed-up world, there is little they can do about it. Thirdly, as mentioned, the consequences are uncertain. It is this *combination* of features that justifies precautionary action now, rather than later.

Water Scarcity

There are about 1360 million cubic kilometres of water on Earth. More than 97 per cent of this water is in the oceans. The rest, about 37 million cubic kilometres is fresh water, but most of that is of little use since it is locked in ice-caps and glaciers. Current estimates are that about 8 million cubic kilometres are stored in relatively inaccessible groundwater, and about 0.126 million cubic kilometres are contained in lakes and streams.

In the coming decades, it is inevitable that population growth will push many developing nations in conditions of chronic water scarcity; others will actually

cross the "water barrier" (less than 100 litres per capita). For them, plans for development will be governed, and probably limited, by issues of water supply and management (Clarke, 1991). In the words of the Global 2000 Report [6] to the United States President:

> By the year 2000 population growth ... will cause at least a doubling in the demand for water in nearly half the countries of the world ... Much of the increased pressure will occur in developing countries when, if improved standards of living are to be realised, water requirements will expand several times. Unfortunately, it is precisely those countries that are least able, both financially and technically, to deal with the problem.
>
> (Clarke, 1991, 34).

These reports illustrate the urgency of the issue of environmental degradation and the need to adopt the appropriate measures to address these problems, whether they be the formulation of new environmental policies, or the development of economic instruments and the advancement of scientific research. The onus is now on every signatory to each international forum to take action, whether it be reducing fishing quotas in international waters, to producing sustainable environmental legislation with realistic goals.

Population Growth

A key question is whether water resources will stretch to accommodate the heavy demands from population groups. Population growth rates on the global scale are now attributed not so much by changing birth rates (which are in most regions slowly declining) but by increasing longevity, particularly in developing countries[7]. The United Nations predicts that between 1995 and 2025, the world's urban population will double to more than five billion, a staggering 90 per cent of

[6] US Council on Environmental Quality and the Department of State, (1980), Gerald O. Barney (Director): *The Global 2000 Report to the President: entering the 21st Century.* US Government Printing Office, Washington DC.

[7] UN-DIESA (1991): *Current Trends and Policies in the World Economy.* World Economic Survey, 1991, New York.

this increase will be in the developing countries [8]. Moreover, by the year 2015, there will be 28 megacities, with populations in excess of 10 million [9].

The expected doubling of the global population within 50 years will have far reaching impacts on natural resources. Demands on the resource base will also increase as societies attain higher standards of living. At present the average individual in Western Europe, or North America consumes some 30-40 times as much as their counterpart person in the least developed world. If and when living standards rise in other parts of the world, so too, will demands for natural resources (Raftelis, 1993). Clearly such patterns of natural resource consumption cannot be sustained.

Water Principles

At the Rio de Janeiro International Conference on Water and the Environment (ICWE) in 1992, three main principles emerged that need to be applied in taking action to achieve integrated water resources development and management [10]. These principles are fundamental to the preservation of this natural resource, and are outlined as follows:

1. ***Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.***

Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or groundwater aquifer.

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[8] United Nations Population Division, (1995): World Urbanisation Prospects: The 1994 Revision (UN, New York, 1995), pp.86-101.
[9] Leong, K.C. (1996): *Partnerships in Sustainable Development.* Paper presented at the 15th EAROPH World Planning Congress. Auckland, New Zealand. September 1996.
[10] ICWE (1996): International Conference on Water and the Environment, *Principles of Water Management.* In Raftelis, 1993, pp. 43-44.

2. ***Water development and management should be based on a participatory approach, involving users, planners and policy makers at all levels.***

The participatory approach involves raising awareness of the importance of water among policy makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects.

3. ***Water has an economic value in all its competing uses and should be recognised as an economic good.***

Within this principle, it is essential to recognise the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognise the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic commodity is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

Raising the price of water to better reflect its true cost is one of the most important steps leaders of any city can take. Proper pricing gives consumers an accurate signal about just how costly water is, and allows them to respond accordingly [11]. Moreover, the essential element in a *user pays* principle is that an *incentive* is provided for the user to economise in the use of the service or natural resource. This principle requires water authorities to take into account economic efficiency in the formulation of pricing structures and determination of tariff levels. They should also take account of environmental considerations and the need to raise sufficient revenue to cover costs (Herrington, 1987, 17). As has been discussed, the global water resource has increasing demands placed on it as the population grows at an alarming rate.

[11] Postel, S., (1992): *The Last Oasis; Facing Water Scarcity.* Earthscan Ltd. London. Pg. 155.

The wise and efficient use of all natural resources is now being called for at an international level. New Zealand is a signatory to many international declarations, including *Agenda 21,* a global partnership for sustainable development to integrate environment and development concerns to lead to the fulfilment of basic needs and a safer more prosperous future [12].

Water is an indispensable resource that needs to be managed at a rate that will prove sustainable for future generations. But just how are New Zealand territorial authorities, responsible for the supply of water dealing with such an internationally significant issue?

Research Goal and Approach

The aim of this thesis is to examine how territorial authorities in New Zealand are achieving water conservation. In developing this understanding, conservation techniques used by four territorial authorities will be examined, along with their current pricing structures adopted by these territorial authorities. The territorial authorities that participated in the research are; Christchurch City Council, Hamilton City Council, Palmerston North City Council, and Tauranga District Council.

The research goal is to determine whether water pricing techniques adopted by territorial authorities encourage conservation of the residential use of the water resource. The objectives taken to achieve this goal are as follows:

[12] UNCED (1992): Our Common Future. Agenda 21 and the Brundtland Report (1987) The United Nations Conference on Environment and Development (UNCED) met at Rio de Janeiro in June 1992, and reaffirmed the declaration of the United Nations Conference on the Human Environment, adopted in Stockholm in 1972, and sought to build upon it with the goal of establishing a new and equitable global partnership through the creation of new levels of co-operation among states, key sectors of societies and people. Furthermore, it is about working towards international agreements which respect the interests of all and protect the integrity of the global environment, and developmental system.

1. To examine the international literature on water scarcity to identify present day water pricing mechanisms for achieving conservation.

2. To examine the New Zealand organisational arrangements for water management allocation.

3. To determine how selected territorial authorities effectively reduce water consumption when there are shortages in the supply.

4. To analyse the water pricing structures adopted by the territorial authorities, and compare their effectiveness based on a checklist of conservation characteristics.

5. To identify the most appropriate pricing structure for each territorial authority interviewed, based on the characteristics of the authority's water supply and the community it serves.

Structure of the Thesis

The structure of this thesis is built upon progressively in each chapter. Chapter Two begins with an overview of the international context for water management. It draws on insights from overseas literature, and recent international developments in the management of water resources. Initially, the chapter focuses on water pricing and international policies governing water pricing mechanisms. Attention is given to the need for water conservation, and how this issue is being dealt with at an international level. Recent literature on conservation pricing and water scarcity is drawn on. The focus then shifts to the current approach to charging for residential water consumption in New Zealand, with attention on conservation techniques, and relevant legislation requirements. Radical state restructuring was undertaken in New Zealand between 1984 and 1990, and the institutional structure and reform undertaken during this period in

relation to water management is reviewed. An overview of the regulatory framework of water management in New Zealand is given.

Chapter Three outlines the empirical research component of this study. The research questions, design and methodology, and research framework are presented. The four case study councils are introduced, along with a discussion of their existing water consumption practices, and historical approaches to water use. The case studies are undertaken as a means of a comparative analysis among four territorial authorities. The information for the analysis was gathered from international literature on pricing mechanisms, reports from the participating territorial authorities, and from the questionnaires carried out in the interviews with staff in each of the four councils.

Chapter Four presents the results and findings of the interviews. These findings are analysed in light of criteria for conservation pricing as presented in Chapter Two. The characteristics of the communities in the four cases are compared, and components of their water supply structure are examined. A matrix illustrates key points to be considered when choosing a conservation rate.

Chapter Five collates the findings of the four case-studies. Conclusions are drawn to determine if conservation techniques adopted by territorial authorities are effective in reducing consumption in the long term. The effectiveness of each of these pricing mechanisms is indicated, as a means of reducing consumption and increasing the public awareness of the need to conserve water. An indication of the suitable conservation rates for each case are given at the end of the Chapter.

Chapter Two

International and National Contexts for Pricing Water

Chapter Two reviews the literature about water pricing in the international context, with a particular focus on conservation pricing techniques that are presently being adopted around the world, and gradually in New Zealand. This chapter initially draws on contributions from overseas literature, and recent international developments in the management of water resources. It then examines the statutory framework and regulatory regime for the management of the supply of water in New Zealand.

International Pricing Policies

One of the central themes in environmental economics is the need to place appropriate values on the services provided by the natural environment. The central problem is that many of these services are provided 'free'. They have a zero price, simply because no market place exists in which their true values can be revealed through the acts of buying and selling. Examples of environmental services might include a fine view, the water purification and storm protection functions of coastal wetlands, or the biological diversity within a tropical rainforest.

The theory of supply and demand suggests that if something is provided at a zero price, more of it will be demanded than if there was a positive price. The danger is that this greater level of demand will be unrelated to the capacity of the relevant natural environments to meet the demand. The important principle is that resources and environments serve economic functions and have positive

economic value. To treat them as if they have zero value is seriously to risk overusing the resource (Pearce, Markandya and Barbier, 1989) [13].

Various water pricing policies have been designed in a number of countries, with the simplest being flat-rate tariffs, (where water fees are not directly related to quantities of water used) and average cost pricing. Other pricing policies include declining-block or progressive-block tariffs, where succeeding blocks of units of water are sold at lower and higher prices respectively. A two-part tariff is another pricing example which includes a fixed component, often varying according to some of the characteristics of the user and a variable component, based on average-cost pricing in the form of a single volumetric charge (Herrington, 1987) [14].

The increasing block tariff structure has been advocated as a form of conservation pricing. This structure is based on the assumption that an increasing incremental cost is associated with the expansion of water systems. This pricing structure however, has deficiencies, similar to those of the declining-block tariff, (i.e., it has no direct relationship with opportunity costs of water, nor with the value of water). The structure often leads to cross-subsidisation, with large users subsidising small users.

A traditional under-pricing approach to water has been adopted in the past by a number of water agencies. Spulber and Sabbaghi (1994) [15] suggest this has been mainly due to three practices:

- The use of historical accounting rather than economic costs in the pricing policies.

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[13] Pearce, D., Markandya, A., and Barbier. E., (1989): *Blueprint For a Green Economy.* Earthscan Publications, London.

[14] Herrington, P. (1987): *Pricing of Water Services.* Organisation for Economic Co-operation and Development, Pans. pg. 17.

[15] Spulber, N., and Sabbaghi, A., (1994): *Economics of Water Resources: From Regulation to Privatisation.* Kluwer Academic Publishers. London. pg. 225.

- The use of average cost rather than marginal cost as the primary pricing standard in the context of increasing real unit costs of water supply.
- Consumer pressure combined with the government policies on pricing.

Spulber and Sabbaghi further suggest the problem of water being treated as a single commodity, as a serious shortcoming of the management of water. Instead, they emphasise the 'quality differentiation of water output' in the market and consider it as an important strategy towards more efficient allocation of water resources. When designing allocative efficiency objectives consideration should be given to a pricing system which is responsive to supply and demand variations (such as climatic variations of drought, heavy rains, seasonal variation), by the time of day, day of week, season of the year, degree of water shortage and also by the extent of simultaneous demand by other consumers.

Peak Load Pricing

Climatic changes, demand for water services, particularly for agricultural, recreational and domestic purposes, follows a periodical cycle. For instance, residential water use, particularly for outdoor purposes, such as gardening, watering lawns, washing cars or filling swimming pools, exhibits a marked seasonal pattern.

A peak-load pricing model was originally developed by Boiteux (1949), Steiner (1957), and Panzar (1976). Peak-load pricing arises when a utility's product is economically non-storable and demand fluctuates over time. These circumstances can result in non-uniform utilisation of peak capacity. Thus using a peak-load pricing policy to discourage consumption in peak periods and encourage off-peak consumption can improve utilisation of the product (i.e., electricity). Higher prices during periods of peak demand will discourage use and save costly capacity. On the other hand, when demands are low, lower prices might

encourage otherwise idle capacity. Therefore the evaluation of a trade-off between ultilisation gains and consumer welfare is the central issue of the peak-load pricing theory (Spulber, 1994, 237). This technique is similar to the seasonal conservation structure, as will now be expanded.

Conservation Pricing

Conservation can be defined as the management of natural resources in such a way as to assure the production of maximum sustainable yields for present and future generations [16]. Furthermore, conserving a resource means maximising its efficient use while minimising the transaction costs entailed in its management. This is accomplished by limiting exploitation to a level sustainable by the resource's natural processes of recuperation.

During the past decade, there have been a number of emerging trends and issues surrounding conservation, sustainable development, and in particular the efficient use of water. The economics of water resources are leading utility providers to evaluate whether the present pricing structures are responsive to current needs (Raftelis, 1993) [17]. Raftelis examines the development of conservation rates as an alternative to the traditional rate structures. In almost every case of water conservation, successful efforts to curb domestic water use permanently, will include some combination of economic incentive (deferral of the capital cost of enlarging the pump capacity), regulations (legal framework), and public outreach to promote the use of water saving technologies and behaviour (education kits and greater community awareness) [18].

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[16] Feldman, D.L. (1991): *Water Resources Management: In search of an Environmental Ethic.* John Hopkins University Press. London.
[17] Raftelis, G., (1993): *Comprehensive Guide to Water and Wastewater Finance Pricing.* (2nd ed.), Lewis Publications, USA. pp. 202-228.
[18] Postel, S., (1992): *The Last Oasis; Facing Water Scarcity.* Earthscan Ltd., London, pg. 155.

As consumable water becomes increasingly scarce, these conservation measures often emerge as the least costly, and most environmentally sound way of meeting community water needs when compared with traditional engineering approaches which focus on expanding the supply. Table 2.1 illustrates the point that raising the price of water to better reflect its true cost is one of the most important steps to curb domestic water use, in areas where water shortages are an ever increasing problem. Proper pricing conveys an accurate signal to consumers about just how costly water is, and allows them to respond accordingly [19]. In fact, studies in a number of countries including Australia, Canada, USA and Israel suggest that household water use drops 3-7 percent with a 10 percent increase in water prices[20].

Growing concern about the future of potable water resources highlights a number of factors in the development of conservation rates and the characteristics of their communities. These factors include;

- Supply and demand imbalances, experienced especially in high-growth regions,
- Rising costs of water supply pumping, treatment, transmission and distribution facilities,
- Growing regulatory concern about resource preservation through waste minimisation and pollution prevention (Raftelis, 1993).

Increasingly, utility managers throughout the world are viewing conservation pricing as a demand management technique to promote the preservation and efficient use of water resources and to delay or eliminate the need for costly investment facilities.

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[19] Proper pricing of a water resource includes the cost of depleting the natural resource, the opportunity cost of using the water, the cost of operating, maintaining and replacing the supply system and the opportunity cost of capital (Raftelis, 1993, pg. 219).

[20] Bhatia, R., and Falkenmark, M., (1992): *Water Resource Policies and the Urban Poor: Innovative Approaches and Policy Imperatives*. Prepared for the International Conference on Water and the Environment; Development Issues for the 21st Century, Dublin, Ireland, January 26-31.

Table 2.1 Characteristics of four rates suited for conservation purposes.

Conservation Rate/ Characteristics	Advantages	Disadvantages
Uniform Rates • Assesses the same charge to all customer classes, at all levels of consumption. • Conservation may be achieved by charging certain classes more than their cost of service.	• Simply designed. • Growing in popularity. • Useful as transition to more progressive conservation rate structure. • Easy to implement, administer, update. • Understandable/accepted by most customers.	• Only marginally achieves conservation objectives. • Inconsistent with cost of service. • Substantial economic impact on large volume users when changing from a declining block rate structure.
Inverted Block Rates • Prices water at increasingly higher rates as consumption increases. • Price of water for essential use is less than discretionary use. • Essential use may be priced below cost of service to reward users who are responsive to conservation initiatives.	• Highly conservation oriented. • Growing in popularity, particularly in water scarce areas. • Structured to reflect attributes of marginal-cost pricing.	• May be complicated to implement if existing structure does not allow for simple conversion to inverted rates. • May be inconsistent with service rates. • Pose difficulties in developing block cutoffs and unit rates. • May have substantial impact on high volume users when moving from another rate structure.
Marginal-Cost Rates • Sets rates equal to the cost of providing the next unit(s) of service (e.g. installing a larger pump station for increased demand). • Price includes cost of depleting the resource, opportunity cost of capital and of using water, and operating, maintaining, replacing the system.	• May be very simply designed. • Designed to 'reward' efficient water users. • Promotes water conservation efficiently. • Provides source of funding for conservation programmes or rate stabilisation fund. • More financially sufficient than 'average cost' rates.	• Difficult to develop, explain, understand. • Significant impact on high volume users. • Generates large surpluses which may be legally disallowed. • Less predictable impact on demand/revenue.
Seasonal Rates • Significant fluctuations on usage over the year. • Facilities designed to meet peak demand. • Large proportion of capacity remains idle during 'off season'. • Shifts demand from peak to off peak periods. • Frequent meter reading- billing to communicate changes in pricing.	• Generally understood and accepted by customers. • Increasing popularity in areas where average and maximum demands are significant. • Strongly conservation oriented by efficiently using facilities during the season and non season. • Based on cost of service allocation.	• Sensitive to differences in climatic conditions between season and non season. • Less predictable impact on demand/revenue. • Highly dependent upon frequency of billing cycle. • Substantial impact on high volume customers when moving from another rate structure.

(Source: New Zealand Business Round Table, 1995; Raftelis, 1993)

Table 2.1 identifies the four most used conservation rates and their characteristics. It further highlights the advantages and disadvantages of each technique, which in turn suggests the type of community for which the structure

would be most suited to. The issue being dealt with here is domestic/residential water consumption, and does not include consideration of commercial or industrial use.

The first is the *Uniform rate*, which, in New Zealand is more commonly termed the Uniform Annual Charge (or UAC). It is designed very simply and is easy to implement as it is based on a flat tariff for all residential consumers. It may be based on land capital value, as is commonly the case in New Zealand, however, this rate only marginally achieves conservation objectives because it may be inconsistent with the cost of service characteristics among classes of customers. Because the uniform rate is a flat charge regardless of water consumption, there is no penalty for excessive use.

The second is the *Inverted Block rate*, which sets a base rate. Water use is charged incrementally for each additional unit consumed over and above a given threshold. This technique is extremely effective at achieving conservation. However, it may be difficult to implement if the existing system does not allow for conversion to inverted rates. This may be due to the lack of available infrastructure such as water meters.

The third is the *Marginal Cost rate*, which adopts a price structure that is equivalent to the cost of supplying a new treatment plant, or finding another source of water to cover the next increase in supply. This technique is favoured by economists as it indicates the true value of upgrading the supply, with the effect of making consumers aware of their cost. The follow on effect is consequently a reduction in consumption to delay this future cost. This technique is, however, somewhat difficult to develop and explain to the public, as it involves complex technical terms and concepts.

The fourth and final rate suggested in the Table, is designed on a *Seasonal* basis. This rate is suited to communities that experience seasonal fluctuations in water

consumption. It is growing in popularity and is relatively easy to understand. However, the supply must have the capacity to meet peak demand.

Characteristics of communities suited for conservation pricing

The philosophy of conserving natural resources is often found where communities have strong tertiary education influences (i.e., neighbouring polytechnic and university centres). Where water resources are scarce or the council seeks increased community awareness of the efficient use of the resource, conservation rates may be used to allocate use more efficiently among consumers. Such techniques have been adopted overseas, and these typical community factors may include the following:

- Communities or districts who rely on groundwater aquifers, or river/reservoir sources for their water supply.
- Communities where there are supply and demand imbalances, experienced especially in high-growth regions.
- Communities where there are rising costs of water supply pumping, treatment, transmission and distribution facilities.
- Communities where there is growing regulatory concern about resource preservation through waste minimisation and pollution prevention.
- Communities where conservation rates would be competitive with adjacent or similar communities.
- Communities where conservation rates would be acceptable by utility customers.

These conservation characteristics form the basis of the matrix from which the four case studies will be evaluated (refer to Figure 4.9 in Chapter 4).

Conservation rates often provide fresh alternatives to traditional pricing structures by enabling consumers to see the benefits they are achieving by conserving

water. However, not all types of conservation rates would apply in all situations, because each rate has certain factors that must be fulfilled to enable its complete implementation. It is important to identify the characteristics of the community in light of the acceptability of the structure to ratepayers and the feasibility of the specific structure within the district. If the current water supply cannot meet peak capacity, then the seasonal conservation rate structure is not recommended.

Serious consideration should be given to the implementation of at least one type of conservation pricing structure, preferably the most suitable one, in order to recover the cost of depleting a finite resource, be it a groundwater aquifer, or maintaining minimum low-flow levels in a river/reservoir catchment. The sooner the structures are implemented, the sooner consumers will settle into a pattern of consumption that will be more easily controlled with the growth of the area. This also enables future predictions of consumption to be made in a more reliable fashion.

Context for Water Management in New Zealand

Of critical importance for the implementation of water pricing mechanisms, is the institutional context within which the water supply authority operates. In New Zealand, significant changes have taken place which affect how territorial authorities operate, including the delivery of services such as water supply.

A radical programme of state restructuring was undertaken by the fourth Labour Government between 1984 and 1990. Labour's reforms were motivated by a concern to establish structures and procedures that would contribute to, rather than impede, organisational efficiency and effectiveness [21]. A central feature of the Labour Government changes was the separation of the provision of policy advice from the provision of services (and from regulatory or review functions).

[21] Boston, J., Martin, J., Pallot, J., and Walsh, P., (1991): *Reshaping the State: New Zealand's Bureaucratic Revolution*. Oxford University Press, Auckland, New Zealand.

The chief rationale for embracing the functional approach lies in the argument that it reduces the potential for the policy advisors to be 'captured' by those delivering the services that the government has purchased. As the Strategos Report on Defence [22] puts it:

> "This principle does not preclude ongoing feedback to the Policy agency, but tries to prevent advice being tailored to meet the needs of the operational agency rather than the needs of the consumer of the service."
> (Strategos Consultng Ltd, 1989, 76).

Other reasons for the separation include; cost effectiveness, responsiveness to clients, contestability in the provision of services, the desire to encourage public participation, and the quest for delivery mechanisms that give expression to different cultural values or practices.

The formal structure of local government, including the health and education sectors, had changed little in the 110 years following the breakdown of the provinces in 1876 (McKinlay, 1990, 8) [23]. The country consisted of some 22 regions, more than 200 territorial authorities, (there were among some 60 local authorities in the greater Auckland region) and a substantial number of special purpose boards; such as *inter alia* rabbit boards, catchment boards and harbour boards.

With the complex number of authority boards operating throughout the country, central government often by-passed the existing local government channels, and established new agencies to carry out new functions. This reinforced the perception that local government did not constitute a universally credible

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[22] Strategos Consulting Ltd. (1989): New Zealand Defence: Resource Management Review, 1988, Wellington, Government Printer.

[23] In the conditions of the time, their continuing existence did not fit well into the merging patterns of development. On the one hand, development demanded a body capable of commanding substantial financial and other resources if it was to attract investment and settlers to a sparsely populated country. Individual provincial governments lacked the scale required for this. McKinlay, P. (ed.), (1990): *Redistribution of Power?: Devolution in New Zealand.* Victoria University Press, New Zealand.

alternate level of government with which the responsibilities of government could be shared [24].

Martin and Harper (1988) indicate that these new agencies exercising powers devolved by central government and spending public money, did not reflect only a lack of faith in territorial local government; they represented a movement of opinion in favour of increased devolution directly to the community. The fourth Labour government overcame its doubts about the reform of local institutions, as the perceived success in venturing into other 'no-go areas' such as agriculture subsidies and indirect taxation lay the foundation for future devolution.

The local government reorganisation that came into effect on 1 November 1989 opened the door for regional and territorial authorities to decide whether to continue traditional functions (service delivery and public works) or to transfer these functions to Local Authority Trading Enterprises.

Other alternatives were for the regional or territorial authority to consider contracting out functions to another authority or to private enterprise, or to enter a joint venture agreement [25]. Palmer explains that part 34B of the Local Government Act 1974 (as amended 1989) required all local government authorities conducting passenger transport operations to establish a passenger transport company by 1 July 1991.

A number of LATE's were formed for carrying out road maintenance and services, and this function extended as far as the supply of water.
Bush (1995) [26] indicates that council departments were frequently being supplanted by business units, with thirteen such shifts occurring in 1993/94.

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[24] Elwood, B., *Local Government Reform: Implications of and Opportunities provided by Devolution*, **in** Martin, J., and Harper, J. (1988), (eds.): *Devolution and Accountability*, Wellington, Government Press Books.
[25] Palmer, G. (1991): *Local Authority Trading Enterprises - The Options*. NZ Local Government Journal, 1991, issue: p. 6.
[26] Bush, G., (1995): *Local Government and Politics in New Zealand* (2nd ed.) Auckland University Press.

Ring fenced as a self contained business, they could contract to deliver services to other departments. He further states that "essential to the concept were the business unit accepting 'ownership' of its resources and managing them as an auditable independent business. At the start of 1994 the Controller and Auditor-General undertook a detailed investigation of the governance arrangements in six territorial authorities and two regional councils, which among them, operated nine business units. While satisfaction was expressed about the adequacy of control over operations, uncertainty about potentially conflicting roles and objectives was also noted (Bush, 1995, 218).

In terms of regional and local government restructuring, the following of relevance to this research, was achieved as a result of the reforms:

- Provision was made for trading activities to be 'corporatised' and formed into Local Authority Trading Enterprises (LATE's) at the option of authorities, except in the case of certain national interest activities, notably airports, seaports, electricity and gas, and public passenger transport. A number of territorial authorities have traded out the supply of water, including Tasman District, Wairoa District, and South Taranaki District Councils.
- New accountability procedures were required (Part XII of the Local Government Amendment Act 1989), including the adoption of accrual accounting and objective-led corporate planning processes encompassing a requirement for public input.

Regulatory Framework for Water Management

These reforms have a significant impact on the management of water, through provisions for increased accountability and efficiency of services. Regional councils have synthesised the functions of catchment boards, united councils and harbour boards.

The main legislative regime concerning the water industry and its service providers includes the Resource Management Act (1991), the Local Government Act (1974) and its amendments of 1989 and 1996, the Rating Powers Act (1988), the Rating Rebate Act (1973), and the Health Act (1956).

The responsibility for water management and allocation lies with regional councils. Section 30 of the RMA states the requirements and aspects of water management that regional councils are required to consider. Water quality and quantity, and catchment management plans have been written by a number of regional councils which set out regional objectives for, *inter alia*, the maintenance and enhancement of water quality in rivers and catchments and surrounding land use practices (s.65) [27]. These plans identify issues relevant to the region, and state objectives, policies, methods and rules. This sets the planning framework when seeking resource consents for the use and discharge of water.

The functions of regional councils in relation to the management of water are shown in the following table:

Table 2.2 The Functions of Regional Councils regarding the Control of Water.

Section : 30 (c) (ii)	The maintenance and enhancement of water quality of water in water bodies and coastal water
(iii)	The maintenance of the quantity of water in water bodies and coastal water
(d) (iii)	The taking, use, damming and diversion of water
(iv)	Discharges of contaminants into or onto land, air or water and discharges of water into water
(vii)	Activities in relation to the surface of water
(e) (i)	The setting of any maximum or minimum levels or flows of water
(ii)	The control of the range, or rate of change, of levels or flows of water
(f)	The control of discharges of contaminants into or onto land, air, or water and discharges of water into water
(g) (ii)	The maintenance and enhancement of the quality of water in that water body
(iii)	The maintenance of the quantity of water in that water body

[27] Water plans have been prepared by Bay of Plenty, Canterbury, Manawatu~Wanganui, and Waikato Regional Councils.

The preparation of water management plans is not a mandatory requirement, although many regional councils are preparing these. Regional councils allocate the use of water on the basis of permits which are sought by applicants through the resource consent process. In making decisions on applications for water permits, councils take account of objectives, policies, methods and rules in their planning documents.

Territorial authorities, on the other hand, have the control of (*inter alia*) any effects of activities in relation to the surface water in rivers and lakes (s.31e). Territorial authorities (or any other body such as a LATE empowered under the RMA and Local Government Act 1974, to provide water to residential, industrial and commercial consumers) require consents from the regional council to take water from any source to supply their district.

The Local Government Act empowers territorial authorities to construct or purchase waterworks for the supply of water, and to provide drainage and disposal of effluent, s 375 - 392. The Act sets out the requirements to ensure local authority businesses are accountable. The Act details the purposes, functions, and processes of local government; including their social and economic responsibilities. This mandate is set out in s.37K of the Act. The level of involvement by local government, particularly the setting of annual policies and objectives and the commitment of financial resources to functions, are subject to annual planning processes under the LGA. Annual plans complement these strategic plans by developing the agenda and timetable of activities that achieve long-term objectives. They also provide a yearly opportunity for review and adjustment. Accountability to the community through the consultative process is a very important part of this [28]. The Ministry for the Environment believes that Agenda 21 may provide a link between this annual planning process

[28] Ministry for the Environment (1994): *Taking up the Challenge of Agenda 21*: A guide for Local Government. Government Printing Office. Wellington. Pg. 13.

and the comprehensive longer-term strategic plans that many local authorities have initiated.

When used in conjunction with the Resource Management Act, the Local Government Act can be a powerful tool for achieving conservation of potable residential water at the source. The local level of implementation of the RMA requires territorial authorities to state objectives and policies in their district plans with regard to the use of resources in their district. Within the statutory framework of the Local Government Act, the implementation of conservation pricing mechanisms can be achieved by several mechanisms. These include the use of regulatory water metering, bylaws to enforce certain bans and restrictions or non regulatory means such as public awareness campaigns, educational means, and the promotion of water conservation through pamphlets, and household information to reduce water consumption (as used extensively and effectively in Christchurch City).

Although most territorial authorities provide the water supply service for their residents, several statutes define the boundaries for water pricing and the management of the supply of water in New Zealand.

Territorial authorities provide the rating structure under the provisions of the Rating Powers Act (1988). This Act allows regional and territorial authorities to rate water and land charges at differential levels among different users. This power, enables councils to divert from the traditional 'uniform' rate of water pricing which is not particularly responsive to conservation pricing initiatives. Other water consumption charges may include a capital value system where water rates are based on land valuation, or a metered rate as experienced by industry and commercial water users.

The Rating Rebate Act (1973) allows for the provision of waivers and to reduce land and water rates. It also allows for the imposition of extra fees and levies for

special services, for example the cost of the supplying water. This provision applies to schools, libraries and universities.

The Health Act (1956), under s. 25, allows the Ministry of Health to require a local authority to provide water and sewerage works. New guidelines established by the Ministry in 1995 set a number of minimum standards for potable water quality in order to be acceptable for drinking [29].

Approximately 87 percent of the national population is supplied by public water supply systems, with the rest relying on an independent domestic supply (private provision, rainwater, bores etc.) [30]. The local level is the most effective level to achieve any measure of conservation, as it is here at the tap, that territorial authorities can enforce restrictions on use, and control the amount of water supplied. If the district is effectively metered and conservation rates apply, the consumer too, can decide the degree to which 'extra' household water is used, and adjust their consumption accordingly.

There are many monitoring requirements and health standards to be met in respect of such drinking water by any service providers (LATE's, territorial authorities, regional councils or unitary authorities). Other associated implications of the supply of water may be related to the continuity of that supply, and the encouragement of water conservation. However, providing the following basic requirements are met; that the supply is safe, reliable, and meets the reasonable needs of the population that it serves, the general community satisfaction remains [31].

The Office of the Controller and Auditor-General is responsible for the monitoring of territorial authorities and the degree to which they carry out

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[29] Ministry of Health (1995): *Guidelines for Drinking Water Standards in New Zealand.* Government Printing Office, Wellington.
[30] Statistics New Zealand, (1994): *New Zealand Official Year Book*, p 505.
[31] Leggat, G. (1995): *The Privatisation Issue*. NZ Local Government Journal, April, pp. 32-33.

effective planning, update their records, maintain and manage their assets, and comply with annual statutory documents. The Department of Internal Affairs, Ministry of Agriculture, and Ministry of Commerce and Treasury provide oversight in their areas of interest, but no agency currently monitors and provides feedback on the performance of local government water operations in a comprehensive way. There is room for improvement in this area, where central records of the effectiveness of conservation pricing, and other such information be made available to territorial authorities that are considering implementing such mechanisms. If territorial authorities can provide reliable, updated information on the benefits of conservation rates to their communities, it may encourage increased understanding of the need for conservation pricing mechanisms.

A number of institutional deficiencies in the management of information (of territorial authorities) of water resources are identified in a recent review [32]. The following three factors were highlighted in the report by the Auditor-General, as they relate directly to water conservation and the role of territorial authorities in water management.

- A comprehensive knowledge of water infrastructural assets is varied across the board.
- The degree of awareness of assets must be coherent in order to calculate asset management strategies and audits.
- Water loss and leak detection is a field that must be considered in the realm of water conservation.

The variation of the knowledge of infrastructural assets between territorial authorities may be attributed to the expansion of many territorial boundaries during the amalgamation of local government during 1989-1990. Many councils inherited the assets of other councils and their variable systems of auditing and record keeping. Lack of accurate information also impedes the auditing process.

[32] Chapman, J.T., (1993): *The Financial Condition of Regional and Territorial Local Authorities*, Office of the Controller and Auditor-General, pg. 6-7.

A comprehensive understanding of a water resource is vital to ensure the best possible service is being provided. Furthermore, an understanding of the physical infrastructure system is vital if leak detection is to be carried out effectively. For example, the exact location of a burst main-pipe under the road is needed before any repair works can be undertaken.

The degree to which water is considered an economic commodity, not just by the council but also the public, is a crucial factor in reflecting the pricing mechanism adopted by the council. This may be justified by the nature of the supply in the region, be it a steadily depleting aquifer, or a vast expanse of rivers and tributaries.

The Auditor-General noted that the operating results of many territorial authorities did not reflect their true position because all costs relating to infrastructural assets were not being taken into account. He noted also that few councils had reliable and objective assessments of water supply assets and that there was a lack of formal systems to monitor the conditions of these assets.

The 1996 amendment to the Local Government Act (1974) requires that all local authorities are to prepare long-term financial strategies by 1 July 1998. The purpose of such an amendment as stated in s.122B is to "promote prudent, effective and efficient financial management by local authorities". These plans are designed to provide a structured framework for local authority decision making, and to provide an effective and appropriate avenue for public participation in local authority financial policies and funding decisions.

A long term financial plan is to be prepared every three years, concurrently with the annual plan (which is to include to an outline of the financial plan each year), and shall relate to a period of ten or more consecutive financial years. Section 122L states that the content of these plans shall cover the following;

- Estimated expenses, allowance for debt servicing, the decline of service potential of assets necessary to meet the identified needs of the local authority over the period of the strategy,
- Reasons why activities giving rise to the estimated expenses are engaged in,
- Proposed sources of funds to cover the expenses,
- Estimated cash-flow projections, asset sales, and changes in working capital,
- Estimated long term borrowing requirements for the period of the strategy.

The preparation of these plans will require territorial authorities to foreshadow long term commitments for managing infrastructure and providing services, such as water supply.

Discussion

In designing a suitable conservation strategy, a campaign to raise public awareness of the need to conserve water, and the structure of the pricing mechanism would contribute to community understanding at an early stage. To be effective, support for conservation water pricing structures has to be integrated and strongly supported by council.

A water authority unit has the responsibility for asset management and maintenance, supplying water, and collecting the revenue. With the preparation of the new financial plans under the Local Government Amendment (1996), greater infrastructure management will be seen soon as more comprehensive audits of council assets are undertaken. Support from management would result from a comprehensive analysis of the present water system; an examination of current and future consumption demands, including forecasted growth, peak demand periods, peak usage of water, an analysis of alternative conservation methods that could be implemented, and a cost/benefit analysis (or another form of evaluation) of the preferred method.

This chapter reviewed mechanisms for water pricing and outlined the institutional context for water management in New Zealand. Lack of water is both an international and national problem. Although New Zealand does not have water shortage problems on the scale of many international countries, water restrictions over the summer months are evident in many districts.

It is crucial that conservation measures are addressed sooner rather than later as to avoid problems such as the Auckland water crisis in 1994. The Auckland region experienced an extremely dry summer and autumn in 1994, and a previous winter of unusually light rain. A pipeline was proposed by the five Auckland mayors, to pump water from the Waikato River to supply Auckland with potable water. The following months resulted in heavy rain, and as a consequence, the pipeline was unnecessary as water levels in the reservoirs rose. However, this isolated case illustrates the nature of water scarcity in New Zealand, and the need to undertake comprehensive conservation programmes to avoid such crises in the future.

Chapter Three outlines the empirical research component of this study. The research framework is detailed together with an introduction of the four territorial authorities who agreed to participate in the study. The findings and analysis of the results follow in Chapter Four and Five.

Chapter Three

Research Methodology and Case Studies

The purpose of this research is to determine if pricing techniques adopted by four territorial authorities encourages conservation of the residential supply of water. In order to achieve this purpose, a number of research objectives were determined, and a number of methods were used to gather the appropriate information. This chapter explains the research methodology, by setting out the format of the research objectives, questions, and methods of collecting the data.

Research Goal:

The overall goal of this study is to:

> ***Determine if water pricing techniques adopted by territorial authorities encourage conservation of the residential use of the water resource.***

Objective One:

To examine the literature to understand the nature of water scarcity and water pricing mechanisms.

> *Research Question One:* In an environmentally aware decade (the 1990's), is resource scarcity considered in the pricing of a resource such as water?

Objective Two:

To examine the New Zealand organisational arrangements for water management allocation.

Research Question Two: What is the current water pricing approach in use by territorial authorities in New Zealand?

Objective Three:

To determine how selected territorial authorities effectively reduce water consumption when there are shortages in the supply (with reference to four case studies).

Research Question Three: Are territorial authority conservation techniques reaching the consumer?

Research Question Four: Would adopting a user-pays approach to residential water consumption reduce peak or average demands in the supply?

The design of the research methodology is illustrated in Figure 3.1. The research goal was identified followed by the development of research objectives. The research focused on using case studies as the principal method of investigation. Two key research instruments, questionnaires and personal interviews, were used to explore the research questions. The questionnaire was designed to extract issues of water shortages, water pricing, and water resource scarcity in each of the four cases. Four territorial authorities were chosen because they draw on different water sources (river, aquifer, reservoir), and each territorial authority has a unique water pricing system established. However, they are all facing new problems with the capacity of their supply, in particular whether to expand the supply to meet increasing demand, or to curb demand with price increases, and thus delay expensive capital works.

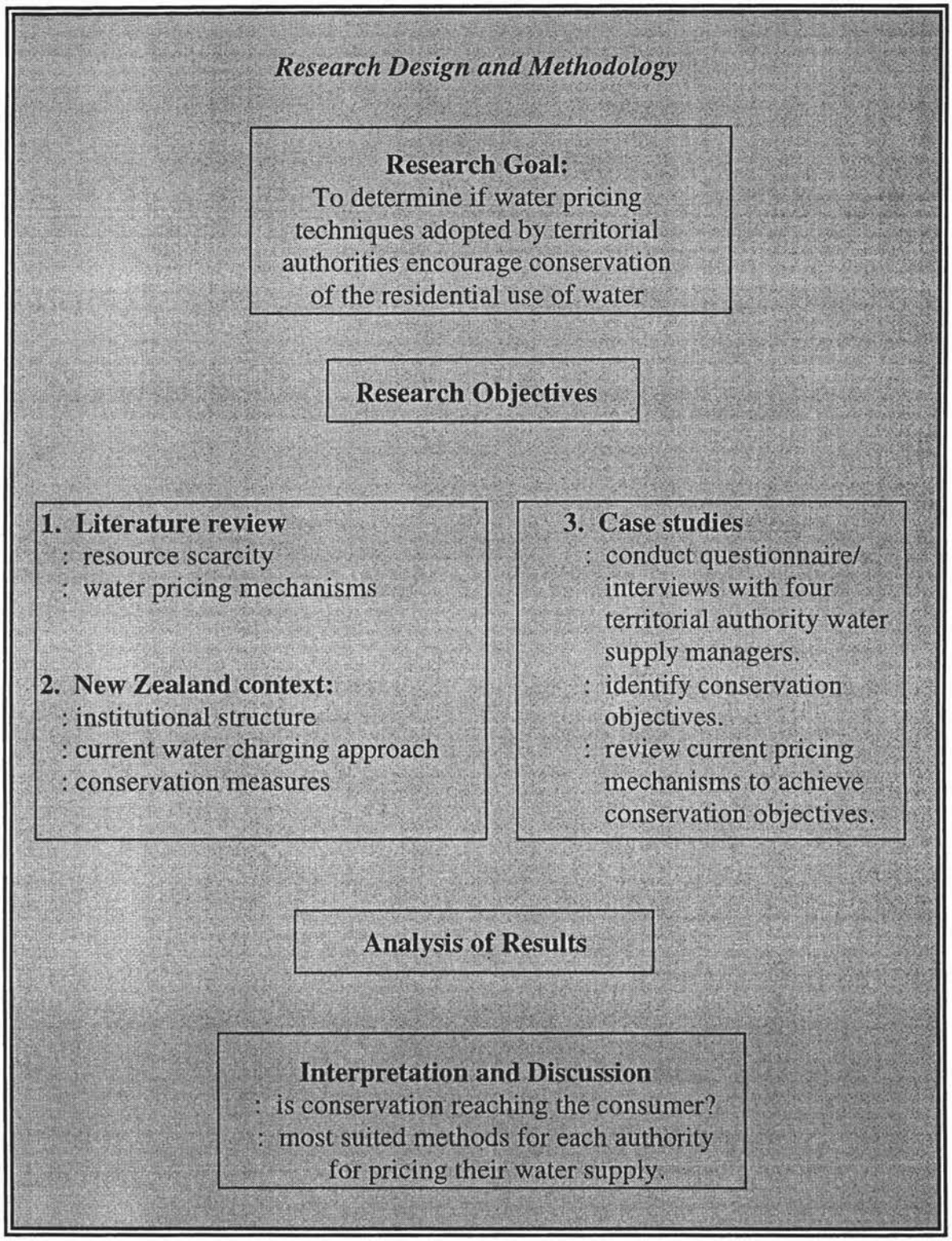

Figure 3.1 Design of Research Methodology

Water supply information was gathered from documents and plans relevant to each of the four cases. These included reviewing past water audits and

examining proposed regional policy statements, and regional and district plans. This stage was necessary to obtain a history of each of the cases in terms of past approaches to water management. A detailed study of both international literature with regard to global resource scarcity and the supply of fresh water was carried out, followed by a review of New Zealand literature of water pricing in particular, conservation pricing, to determine the rationale behind conservation rates.

A questionnaire was constructed to gather water supply information (see Appendix One) and presented to the four water supply managers who participated in the study. The questionnaire was designed to extract the type of water pricing structure presently in place in the studied area, with a forecasted indication of future growth. The future source for the supply of water and suitable pricing mechanisms were examined in the context of a shift towards conservation pricing in each case also.

A suitable time for the interview was arranged, and the questionnaires and a covering letter were sent two weeks in advance to each participant. This gave the recipient time to gather graphs of the community's water consumption and demand patterns, and sufficient information needed to complete the questionnaire. The water consumption graphs provided in the interviews are analysed in Chapter Four, to show times of peak demand, and the techniques adopted to reduce this peak consumption. Furthermore, this analysis will show the effectiveness of educational promotions that run long term as a preventative measure, rather than direct restrictions on water consumption which tend to be a more reactionary response rather than a preventative one.

Interviews were conducted in a semi-structured format with the water manager of each of the four territorial authorities. The one and a half hour interview was carried out in the council office, on a one-to-one basis (in one case two staff were interviewed). Notes were taken as specific details or histories were given about

the authority's water supply. On a number of occasions, supplementary reports are provided to substantiate a number of points, such as the council's previous consideration of price structures for water meters, consultant reports on previous water audits, and business unit management plans. These reports are used to substantiate the history of water issues for each case.

During most of the interviews, there was considerable discussion beyond the written questions, namely with regard to water conservation initiatives adopted by the councils in previous occasions, and previous events in the history of the water supply. These included the referendum in Tauranga, and the debate in Christchurch as to the setting of water rates. At the end of each interview, the respondent was given the opportunity to add any further comments.

In most cases, the questionnaires were completed before the interview was conducted. The interview then served to clarify points of the research and discuss relevant conservation issues. The interviews were not tape-recorded and all participants were willing to contribute additional information if necessary.

The Analysis Method

A matrix has been developed to indicate how important or necessary conservation rates are for each authority. The ability of each territorial authority's pricing structure to achieve water conservation is examined. Water consumption patterns and the characteristics of the area determines which of the four rates (indicated in Chapter Two) are the most effective to achieve conservation and increase public awareness of the need to reduce excessive consumption of the water supply.

From the information gathered in the questionnaire, a comparative analysis of each of the techniques the territorial authority uses to promote water conservation was undertaken. Furthermore, the effectiveness of this technique to reduce consumption is examined. These results are reflected in the urgency of the need

for water conservation techniques to be adopted, and the reduction in peak or average consumption to allow for existing supply facilities to meet current and forecasted demand as demonstrated in the graphs.

Introduction to the Case Studies

According to Stake [33], case studies are ideal in evaluating qualitative research. They will succeed in giving valid portrayals if they give "an accurate and useful representation of the case in a certain setting". In undertaking qualitative research, it is vital to understand the issues at a community level and to become fully aware of the agenda of community action groups, and other community responses that may not be represented. This will often require talking with certain sectors of the communities, however for the purpose of this research, interviews have been conducted only with the managers of the water supply units in the council environment.

The four territorial authorities chosen for the analysis are;

- Christchurch City Council
- Hamilton City Council
- Palmerston North City Council
- Tauranga District Council

Each case is described briefly as follows:

- Christchurch City is the first case. The City Council is in the unique situation of drawing on a number of aquifers and reticulating this water untreated in its natural and most purest form. It is also a useful case study because the Council holds a great deal of data with regard to its water consumption. Therefore, there is an appropriate source of information to draw on. Christchurch City is also interesting because of its location in relation to

Canterbury University, a characteristic that is thought to increase community awareness of water conservation.

- Hamilton City is the second case for the comparative analysis. The City draws its water supply solely from a river source. This is the only case study in which the water is managed by the territorial authority acting as a business unit. Like Christchurch and Palmerston North, it too is a university city.

- Palmerston North is the third case chosen for the analysis, primarily for convenience of location to the researcher, but also to gauge how effective previous water conservation campaigns were reducing residential consumption. Massey University is located within the City. The influence of the tertiary sector on water consumption, and the degree to which water consumption is reduced by means of conservation will be examined.

- Tauranga District has a history of water shortages and in 1994 the District Council proposed to curb water consumption by using universal metering. This proposal met a great deal of public opposition, and resulted in a Citizen Initiated Referendum (CIR) to decide the future management of the district's water resource. Interest in this case lies in how the Council has dealt with such a public reaction, and whether the response has encouraged conservation, or made the situation worse.

In collating similar information from each of the territorial authorities, the following factors have been considered:

- The population serviced by the supply of water,
- The source of the water supply,
- The current charging system for the supply of water,

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[33] Stake, R.E. (1978): Case Study Methodology, in *Foundations of Program Evaluation: Theories of Practice*. Shadish, W., Cook, T., and Leviton, L., (eds.). 1991. Pg. 120.

- The ability of the supply to meet demand,
- History of previous water problems,
- Recent undertakings that may affect the effectiveness of conservation objectives,
- Significance of regional policy statements and prepared water plans.

Christchurch City

The City of Christchurch covers an area of 45 250 ha, comprising some 16 300ha in urban use and 29 000 ha in rural use. The population of the City was estimated at 315,000 as of a 1995 census. Population growth is forecasted at 9 percent for the next ten years, and the population is estimated to grow from 315,000 to 343,000 people [34].

The Water System

The groundwater resource beneath Christchurch is currently the sole source of potable water for the City's inhabitants. It is relied on to continuously provide high quality water for which no treatment is required. Christchurch obtains its water supplies via groundwater bores ranging in depth from 25-180m. The significant groundwater resource beneath the City contains the water in a series of aquifers. This water supply is *artesian* in nature and near the coast, wells are *flowing artesian.* The four groundwater aquifers are recharged in the inland plains, and later flow eastward towards the coast, finally discharging offshore. These four aquifers go down to a depth of approximately 200 metres. While it is considered possible that deeper aquifers exist below this level, (down to about 500m) the more compact gravel found here is unlikely to yield useful quantities of water.

The City's groundwater supply is finite and difficulty is already being experienced in abstracting sufficient water to meet peak summer demands. The

Canterbury Regional Council's best estimate of the long-term sustainable yield from the Christchurch West Melton aquifer system (which supplies all of Christchurch's water) is approximately 130Mm3/year (million cubic meters per year). Currently, the City takes 55Mm3/year, and other users take 65Mm3/year, a total of 120Mm3/year (*Christchurch City Plan*, 1995).

The Charging Structure

All houses in the Christchurch area are fitted with water meters which are read each month. The householder is given a reading of their meter, which will indicate how much they have consumed, along with the City's average household consumption for the month, to indicate to the owner, excessive use or the possibility of leaks. This is anticipated to make the public more aware of their water consumption, and to encourage a reduction in overuse of water (Aldridge, 1996, pers. comm.)[35].

The current charging system in place in the City is a Uniform Annual Charge (UAC). This annual charge is based on a capital value system, whereby water rates are calculated based on the land value of the occupant's property. It is assumed that if residents live in an expensive area of the City, they pay more for their water, whereby residents in lower socio-economic areas of the City pay less for their water because their property holds less financial value. Furthermore (as with Hamilton City) a landowner living on a more expensive property would be able to afford the insurance for fire safety, therefore they pay an increased rate for fire insurance.

The water supply is managed through the Council's Water Supply Unit of the Technical Services Group. Separate rates are charged by the Council for water,

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[34] Vantoor, E., (1996): *Planning Engineer*, Water Services Unit, Christchurch City Council, 27 August, 1996.

[35] Aldridge, B., (1996): *Water Services Manager*, Water Services Unit, Christchurch City Council, Pers. Comm. 27 August, 1996.

sewerage and land drainage based on capital value. Properties connected to the water supply network pay full water rates, otherwise half the rate is charged.

History of Water Issues

Demand on the water resource is growing at 3% per year. At this rate of growth, demand for water will reach the sustainable yield near the turn of the century. The sustainable yield is the point at which the net withdrawal matches the net inflow. When this point is exceeded, more water is being drawn from the aquifer than flows into it.

The observable effects include;

- a fall in both aquifer pressure and well water level,
- a deterioration in water quality,
- an inshore movement of the saline/fresh water interface.

To date, the seriousness of such effects have not been noticed, however during periods of high demand over the summer, there have been traces of sand in the pipes, due to excessive pumping and a fall in the well water level. This point will be elaborated on in Chapter Four.

Regional Policy Statement and Plans

Objectives of the water section of the Canterbury Regional Policy Statement are to "safeguard existing drinking water and to promote efficiency in the use of water" and to "develop and implement a programme for improving degraded water" [36]. The major groundwater quality issue in Canterbury is the actual and potential contamination of sources of drinking water. Proposed methods to implement these policies include education, service and information provision, water user groups and water usage information. The environmental results that are anticipated from such implementation include;

[36] Canterbury Regional Council (1993): *Proposed Regional Policy Statement for the Canterbury Region*. September 1993, pp. 102-122.

- Adequate and safe drinking water,
- Protection of the life-supporting capacity ,
- Efficient use and better water availability,
- Maintenance of the value of groundwater.

Surface waters in Canterbury are largely free from significant contamination. Keeping water clean requires continuing community involvement, monitoring and control. The promotion of the efficient use of water enables future needs to be met, and enables in-stream requirements to be more readily provided for.

The Canterbury Regional Council is preparing an "Omnibus Regional Plan" that will incorporate "significant issues relating to land, water, air and natural hazards, with generic policies and rules to govern the whole region" [37]. At present there are two notified Proposed Water Management plans, *the Opihi Catchment Plan*, and the *Waimakariri River Plan.* The first is under Appeal at the Planning Tribunal and the second is under review. At present, there are no specific rules in the existing Regional Policy Statement regarding groundwater abstraction, and conditions on consents are used as a measure of abstraction.

In this new plan, Glennie explains that "groundwater levels will be established, rules will be set to cover the whole Canterbury groundwater area, and levels of safe yields over the recharge areas will be set". A draft copy of the plan is due for release in June 1997.

Hamilton City

Hamilton City Council's water supply unit provides potable drinking water to a population of approximately 106,000. The City Council is forecasting a 1 per cent increase in population for the next 10 years.

[37] Glennie, J., (1997): *Council Officer,* Canterbury Regional Council. Pers. Comm, 18 February, 1997.

The Water System

This supply is drawn solely from the Waikato river, where it is treated at the Waiora Terrace treatment station and pumped to reservoirs throughout the city. This provides an almost limitless supply of raw water. The city is spared the high costs of head-works development, but every drop of Hamilton water must be fully treated and pumped at least two or more times [38].

At present the system is capable of meeting peak demand. This has been pitched at under 80,000 cu.m per day since 1988. Like Palmerston North, Hamilton City also has an abundant supply of water, and although conservation of the supply is an ever present consideration, the degree of its application varies when compared with Tauranga and Christchurch cities.

The Charging Structure

The current charging system in place is through a standard uniform annual charge, based on the capital value of the landowner. The capital value is determined by the value of the land, and subsequent improvements to it, and like rates, is re-evaluated each financial year.

The uniform annual charge comprises of two costs;

- The production cost of supplying the water, and
- The capacity cost of enabling the system to meet peak demand. The philosophy is that the system is only as good as its capacity to meet peak demand [39]. This cost includes the cost of laying pipes and reservoirs to cope with peak demand, including fire flows.

[38] Property Services Group, (1988): *Report on Charging for Water.* City of Hamilton, November 1988.
[39] Sang, R. (1996): *Water Engineer,* Water Supply Unit, Hamilton City Council, Pers. Comm, 7 October, 1996.

History of Water Issues

Hamilton City has a number of issues that relate to water supply. These include reviews by the Council with regard to charging options, consumer criticisms about metering, and attempts to educate users to reduce excessive and wasteful use of water (Property Services Group, 1988).

In the past, properties with swimming pools were metered, and water was charged at a unit rate. However, in 1971 when a larger reservoir was commissioned, swimming pool owners increased their criticism of the system. The metered cost for swimming pools was considered inequitable by owners, when their non-metered neighbours were using sprinkler systems without an extra charge. The Council decided to stop reading the meters as the cost to remove them ($100) would fall on the landowner, and it was thought that they could be removed later for less cost when works were being carried out in the area.

Water restrictions apply in the City for 2-4 weeks over the summer when consumption increases, and water levels are relatively lower. The suggestion of returning to meters has proven to be a great enough deterrent to encourage householders to use the alternate day sprinkling method, or resort to hand held hosing of gardens, which use less water than a sprinkler running 12 hours a day.

Regional Policy Statement and Plans

Water quality and waste discharges into the Waikato River are of significance to the Waikato Regional Council, particularly as Hamilton City Council draws its water supply from the River. Toxic substances are emerging as an issue of concern in some areas [40]. Nitrate levels several times above that recommended by the Ministry of Health (1995) have been recorded around Hamilton.

[40] A significant proportion of toxic contaminants in urban storm-water is derived from motor vehicles (lead, copper, zinc and hydrocarbons), and increasing levels are being detected in non-point sources such as urban run-off and storm-water. Waikato Regional Policy Statement (1996), p.63.

In the Waikato region it is necessary to make provision for periodic seasonal shortages of water, in water allocation strategies. The Regional Council states "that there is a need to ensure that the available water, which can be taken, is apportioned in a way which ensures that the greatest benefit is derived, particularly in the case of water bodies subject to the greatest demand" [41]. Policy about the efficient use of water aims to ensure that the water which is available to be taken from water bodies is used efficiently. This is to be implemented through a variety of methods;

- Regional plans, develop water allocation strategies.
- Resource consent application process to consider methods that may be adopted to use water efficiently.
- Advocate the adoption of water conservation practices, including the use of water saving devices; water metering, water recycling, and the use of more efficient plant or manufacturing processes.
- Advocate research into methods for achieving water conservation practices and the efficient use of water.

"Conservation of water resources applies to all water users. Encouraging the careful use of water by domestic households, industrial, agricultural and other consumers, can avoid excess or wasteful use. Moreover, "water metering and associated charging for water provide incentives for consumers to reduce wasteful use" (Waikato Regional Council, 1996, 77).

The Waikato Regional Council is developing a regional plan to cover all resources (land, air and water). In terms of water allocation, the Council is operating under the guidance from old water and soil management plans prepared before the RMA [42]. Dickie explained that as a general "rule of thumb in practice, the Council allows 30 percent of the five year low flow of rivers to be available

[41] Environment Waikato (1996): *Waikato Regional Policy Statement* for the Waikato Region by the Waikato Regional Council. March 1996, pg. 76.
[42] Dickie, B., (1997): *Council Officer,* Waikato Regional Council. Pers. Comm, 18 February 1997.

for allocation". A discussion document on the proposed regional plan is due for release in mid March.

Palmerston North City

The population of Palmerston North is approximately 75,600 with 26,576 rateable properties, and 97 non-rateable properties. The Council administers 32,594ha, including the communities of Ashurst, Aokautere, Whakarongo, Linton, and the Palmerston North urban area. Forecasted growth for the upcoming 10 years is pitched at 1.7 percent. Population is estimated to be 90,000 by the year 2016 [43].

The Water System

The City has a combined supply of bore (40%) and reservoir/river supply (60%). The reservoir water supply is fed from the Turitea Stream, which is then treated at the treatment station before being distributed around the City.

The Charging Structure

The current charging system by the Council for residential customers is through UAC's. The household charge is the same across the board for all residential connections, and in the 1995/96 year it rated at less than $142.00. The per capita cost is less than $48.00 (based on 2.9 persons per household).

History of Water Issues

In the City plan, the city vision is expressed as a City with residents whose "education, research and knowledge will be their strengths". This is reflected by the increasing awareness that the community has in the Council activities, the local university, polytechnic and teachers training college. Palmerston North residents consider their City the 'knowledge city', this philosophy may be

[43] Palmerston North City Council (1996): *Water Supply Development Plan*, Design Report - Volume 1. Report prepared by Royds Consulting Ltd, June 1996, p. 71.

reflected by the fact that over 50% of the population is involved in education/research activities in the City.

The City does not have the extensive water shortage problems as experienced by other territorial authorities in this analysis, although hosing restrictions are in place when works are being carried out on bore supplies and when shortages occur during the summer. However, promoting awareness of water conservation in the City is a significant issue, and this will be covered in more detail in Chapter Four.

Regional Policy Statement and Plans

The Manawatu~Wanganui Regional Council states that there is strong public concern about low water quality of many water bodies, some of which are heavily contaminated. "Water quality is a public good and individuals have few incentives to improve and maintain water quality voluntarily" (Manawatu~Wanganui Regional Council, 1993, 88)[44]. There is a policy to promote to efficiency in the use of surface water (however the methods to achieve this are not directly stated). Another policy is "to identify groundwater resources sensitive to pollution, and strive to prevent discharges to land in these areas" (Manawatu~Wanganui Regional Council, 1993, 88). This is to be achieved by monitoring of representative bores.

These policies are not considered to be restrictive by the Regional Council, as in most of the Region, "natural quality of groundwater is high, and impermeable clay layers separate groundwater from the surface, so it is not susceptible to contamination from surface activities". The groundwater (Palmerston North City Council's source of water) has potential to be over extracted. In many cases however, "the resource is large compared with the use, and an enabling policy framework provides an effective and efficient means to maintain sustainable use

[44] Manawatu~Wanganui Regional Council., (1993): *Proposed Regional Policy Statement for Manawatu~Wanganui.* September 1993.

of the resource" (Manawatu~Wanganui Regional Council, 1993, 88). It is envisaged by the Regional Council, that groundwater quality will be maintained and improved, long term groundwater levels maintained, and the water resource used more efficiently with less wastage.

At present there are two water plans prepared. The Manawatu Catchment Water Quality Plan, which is concerned only with water quality in the region, and the Oroua Catchment Water Allocation and River Flows Regional Plan, which in concerned with the flow levels in the Oroua catchment that services Fielding and the many abstractions for horticultural uses. In the Oruoa catchment, "River flow thresholds are established and when abstractions reach these thresholds, all takes (except those for the Manawatu District Council) are suspended at a restricted rate until the river has recharged" [45]. Forsythe explains that the Palmerston North City Council's abstractions for their water supply are controlled by water permits. Surface water abstractions from the Turitea stream are based on flow levels. She also stated that there is no plan that controls groundwater abstraction, only the conditions on consents.

Tauranga District

The population of this east coast district is approximately 75,000 with an annual growth rate of 4.5 percent per annum, which is approximately 3,000 people a year (and 1,000 new connections to the water supply). The areas of strongest growth include Bethlehem, Matapihi subdivision, Papamoa and Bayfair (Speirs, pers. comm., 1996) [46].

[45] Forsythe, K., (1997): *Council Officer,* Manawatu~Wanganui Regional Council. Pers. Comm, 18 February 1997.
[46] Speirs, J., (1996): *Water Services Manager*, Tauranga District Council, 8 August 1996.

The Water System

The district's water supply system is fed from two rivers; the Tautau Stream which filters into the Joyce road treatment station, and the Waiorahi Stream, which is fed into the Oropi road treatment station.

The Tauranga District Council has two water treatment plants (Oropi Road plant and the Joyce Road plant) with a combined design capacity for about 42,500 cu.m per day. With a combined average consumption running at about 25,000 cu.m per day in the winter, the two plants have sufficient *average* capacity to allow for an increased supply, without plant additions for the next 20 years.

The problem is that both plants cannot cope with *peak* demands (typically in the summer). Back in 1990, the ratio of summer peak demand to average winter demand was about 2:1 for the Oropi Road plant, even when hosing restrictions were in place. There has been a steady increase in total average consumption and with Oropi Road capped at 30,000 cu.m per day, the current ratio peak to winter demand is about 1.6:1, and this requires severe restrictions for nearly six months of the year (Tauranga District Council, 1994.7) [47].

Charging Structure

At present the Papamoa and Mount Maunganui communities operate on water meters, and the remaining 70 per cent of the district operate on a fixed annual water charge. The Mount Maunganui and Papamoa residents pay a flat uniform charge for access to the water system, plus a variable metered charge for water used above a given threshold. Tauranga residents, on the other hand, pay a higher UAC for unlimited water consumption. Water meters are not installed in the Tauranga City region (who account for 70 percent of the consumption).

[47] Tauranga District Council, (1994): *Audit of Water Conservation Strategy.* A report prepared by KPMG Peat Marwick for the Tauranga District Council. 25 August, 1994.

History of Water Issues

The Tauranga District has been plagued with water related problems for at least the past six years. The District has had water restrictions operating for a number of years. However, with an increased growth rate in the area (up to 4.5% per annum), demands on the water supply are ever increasing.

The Council has considered adopting water meters as a means to reducing water consumption along with continued conservation measures such as enforced hosing restrictions. Mount Maunganui had water meters installed under the old Mount Maunganui Borough Council before the local government amalgamation in 1989.

Post amalgamation in 1994, the option of installing and using water meters in the whole of the (newly formed) Tauranga district was put to the public, however, a section of the community picked up on the campaign, and reacted strongly against the idea of paying for water in that way. This group became known as the Water Action Group (WAG) and acted prominently through the media, as they manipulated the Council's attempt to gain support for such an option.

Opposition grew as the action group picked up momentum. The Council retained a low profile with the assumption this opposition would pass. The contrary happened, and any response given by the Council was attacked in the media. Eventually the campaign reached a peak in August 1994, and a Citizens Initiated Referendum (CIR) was undertaken, resulting in strong opposition to water metering. The referendum illustrated (by a 70 percent majority - the 70 percent who make up the non-metered population) the public preference for an increase in the pump capacity of the Joyce Road plant to cater for peak demand.

The Council has set up a working party to reach some form of consensus among the community, and a community advisory group was formed. The group comprised of representatives of Iwi, ratepayers, business and environmental

interests, and some WAG members. The recommended increase in the capital works programme went ahead, and is due to be completed by the end of 1997.

Regional Policy Statement and Plans

The Bay of Plenty Regional Council acknowledges that while water is a renewable resource, it is finite and efficiency is required to ensure that the most benefit is obtained from its use [48]. The use of water must be moderated so as to maintain the values associated with its occurrence in natural water bodies. Water policies include;

- the application of the precautionary approach to the management of water,
- the encouragement of the efficient use of water,
- to limit the range and rate of change of water body levels and flows,
- to enable people to provide for their well-being, and to
- protect aquatic life naturally occurring there

(Bay of Plenty Regional Council, 1993, 96).

Methods to achieve include; "setting criteria for the efficient use and development of water resources, setting priorities for allocation. Other methods include establishing minimum flows and water table levels through regional plans and consent conditions" (Bay of Plenty Regional Council, 1993, 97). The Council has prepared a number of reports regarding the monitoring of river quality in the Region.

The Bay of Plenty Regional Council is preparing a Water Management Plan, and they are reviewing confidential reports that have been prepared by consultants. Other than the catchment plans addressing flows and water quality in the Tararua and Kaituna Catchments, "there has not been clear and explicit rules governing the water allocation in the region"[49]. There are transitional policies in place from

[48] Environment Bay of Plenty (1993): *Proposed Regional Policy Statement*, Prepared by the Bay of Plenty Regional Council. September 1993, pp. 89-98.
[49] Darryl, P., (1997): *Bay of Plenty Regional Council.* Pers. Comm, 18 February 1997.

plans prepared before the RMA, however, most of the water allocation guidance is coming from draft reports and the Regional Policy Statement (Darryl, pers. Comm., 1997). "Water allocation issues in the region are constantly evolving", and he hopes that these will be included in the preparation of the plan by the end of the year.

Conclusion

This chapter has introduced the research methodology and four case-studies. It has served to introduce the goals and objectives of this research, and to illustrate the reality of water shortages and water supply problems encountered in some cities in New Zealand. Chapter Four presents findings from the analysis of the questionnaires and the interview data.

Chapter Four

Case Study Findings

This chapter presents the findings of the questionnaires and interviews. Key themes relating to the water supply of the participating councils have been identified, and characteristics of each of the council's water supply are discussed. Conservation characteristics of each case are presented in a matrix (Figure 4.9) where they are analysed. The significance of conservation measures adopted by each case is examined, followed by the matrix to highlight the key factors that influence conservation as they are described in the text. The suitability of the conservation rates for each case is indicated in Chapter Five.

Key Themes Concerning Water Conservation

The findings of the research are divided into five key themes that were revealed from the data collected in the questionnaires and interviews. These themes are;

- *Population and characteristics of each case*
- *Water supply and perceived problems*
- *Water demand*
- *Water pricing*
- *Conservation Programmes*
- *Public involvement and consultation*

Population and characteristics of each case

This section provides brief details about each of the four case-studies, both demographically and geographically. Figure 4.1 displays the population of each of the case studies as of 1996. The mean annual temperatures and rainfall of each of the cases are presented in Figures 4.2 and 4.3. This visual representation

enables ready identification of the amount of much water naturally supplied to the area and the size of the community each council must provide for.

The City of *Christchurch* covers an area of 45, 250 hectares (ha) comprising of some 16, 300 ha in urban land use, and 29, 000 ha in rural use. A growth rate of nine percent means a minimum population increase from 315,000 to 343,000 people in a decade. Christchurch is located on the east coast of the South Island of New Zealand, in the Canterbury region.

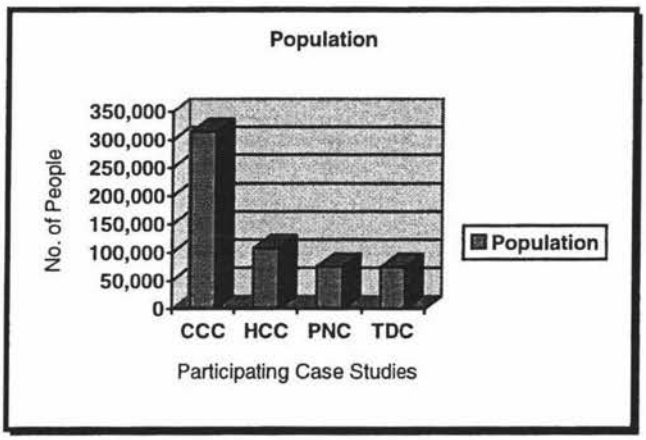

Figure 4.1 Population of each Participating Territorial Authority [50]

Hamilton City covers an area of 9,400 ha. Population growth in Hamilton is estimated at one percent for the following ten years. This indicates a property demand of 600 sections per annum. The City of Hamilton is located in the upper half of the western side of the North Island, in the Waikato region.

Palmerston North is one of the more smaller populated cities in the study. The Palmerston North City Council administers 32, 594 ha, including an number of smaller nearby townships. Based on growth rates of 1.7 percent, the Council expects the population to reach 90,000 by the year 2016. Palmerston North is located in the lower central North Island, in the Manawatu region.

[50] All statistics provided by Statistics New Zealand (1995): New Zealand Official Yearbook. Government Printing Office, Wellington.

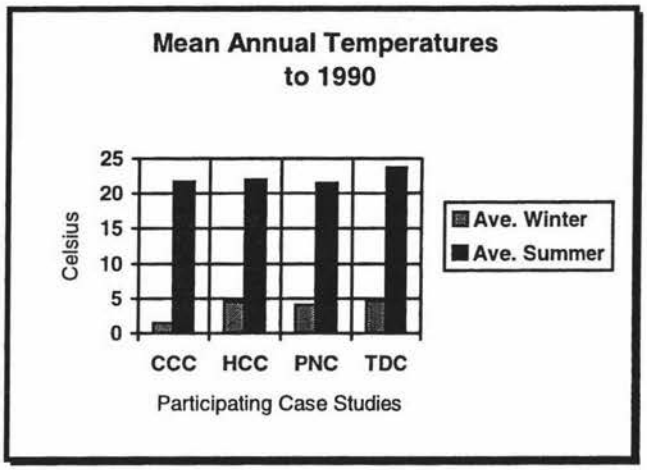

Figure 4.2 Mean Annual Temperature to the Year 1990.

Tauranga District is the final case study. This area is experiencing an extremely high growth rate of 3,000 people per annum. The Tauranga District Council administers approximately 12,800 ha. Its temperate weather, and beach-side location make the area a popular place to retire, or raise young families. The Tauranga district is located on the east coast of the North Island, in the Bay of Plenty region.

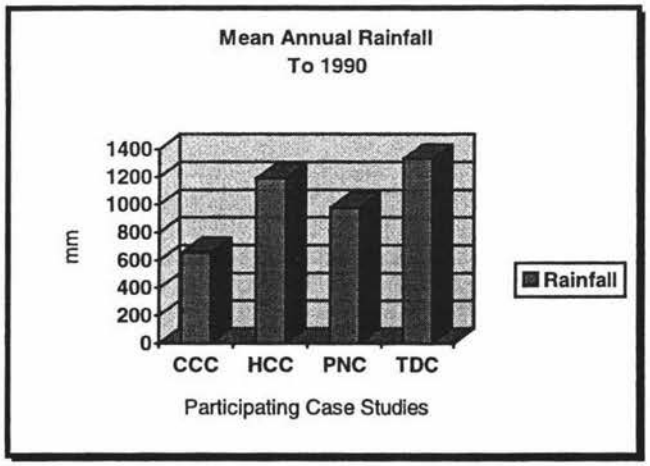

Figure 4.3 Mean Annual Rainfall to the Year 1990

Rainfall in the Tauranga region is the highest at 1370mm annually, yet considering the population of 75,000, this district has the greatest water problems. Comparatively, Christchurch records the lowest rainfall at 640mm annually, yet surprisingly for the largest city in the study, it has relatively fewer water problems than Tauranga. Residential consumers in Tauranga do use a

greater amount of water per person than Christchurch, with the new plant upgrade allowing each person 800*l* per day, compared with 290*l* per person per day in Christchurch.

Water Supply

In this section, the source of the supply is discussed, together with the perceived problems of the continuous supply of water should consumption continue 'business as usual'. All four territorial authorities carried out their water supply functions within their council operations, either as a council service, or that of a business unit, operating within the council system. Business unit functions are similar to any other service provider in the community, whereby the unit must bid amongst private contractors and consultants each year for the right to funding from the council and the provision of the service. A contract is entered into between the water unit and the city council, as is the case with Hamilton and Palmerston North City Councils.

The *Palmerston North City Council* Water Unit operates 50 per cent as a council service which sets the service specifications, and the remaining 50 percent as an in-house business unit, for service delivery. *Hamilton City Council* operates a complete in-house business unit. Both *Christchurch* and *Tauranga Councils* operate a complete in-house council service of water delivery. Not one of the case-studies operated as a Local Authority Trading Enterprise with regard to water management.

Each of the cases have a different type of water supply *source* that they draw on for their municipal supply from. This supply provides the residents of the city or district with potable water.

Christchurch City Council

Christchurch City is a unique example, whereby the Council supplies potable water to its citizens from an untreated natural aquifer system. Ninety seven per cent of the City's supply is from groundwater aquifers located under the City and surrounding areas. This water does not require any treatment whatsoever, and is pumped directly to consumers. Approximately 3 per cent of residential households draw their own supply from bores. The fact that these bore users are drawing from a higher aquifer than the Council, and only small quantities are involved, places no threat on the Council supply. Problems may arise however, with commercial and industrial users sinking their own bores, and larger amounts of water taken. Water meters are in place in almost all households in the City. They are being read, but not charged for as yet. At the time of printing, a suitable pricing structure was yet to be set by the Council.

Christchurch City, being solely an aquifer sourced supply has forecasted a number of possible problems for the near future. These problems include; a lowering of the water table, pollution and contamination of the aquifer, an endangering ecosystems of rivers, and the possibility that high abstraction of groundwater could cause spring-fed streams to dry. Occasionally in summer months problems with sand in the water are encountered as peak supply is drawn from the low water table. The duration that these problems are encountered, and percentage of the supply affected, was not given in the questionnaire.

The Christchurch City Plan, and Annual Plan for 1996/97 were both examined to establish any further significant water issues, however, they were not particularly detailed, as the issues were covered sufficiently in the Regional Policy Statement. A Strategic Plan for the City had not been prepared by the City Council.

With the preparation of a regional plan setting rules for the abstraction and protection of groundwater, the City Council will have to be even more aware of reducing consumption, and complying with these regional policies.

Hamilton City Council

The Waikato River provides all of *Hamilton City* with a supply of fresh water. The water is treated and pumped to various reservoirs located throughout the City. There are no operational residential water meters installed in the City.

At the moment, Hamilton City has no present or forecasted problems with the supply, providing set trigger points are achieved [51]. Mr. Sang [52] (Water Engineer) stated that the demand for continuing higher water quality standards may prove to be a major concern. This includes associated costs of improving the water quality, such as removing Boron levels. At present Boron levels are acceptable as stated by the Waikato Regional Council, however Mr. Sang was concerned that should these standards be raised, serious costs would be incurred on the Hamilton City Council Water Asset Management Unit to remove the Boron. These standards have not yet been raised by the Waikato Regional Council.

The Hamilton City Plan was examined, along with the 1996/97 Annual Plan, to identify any further significant water issues in the City. Only minimal information is presented concerning the expenditure on the replacements of trunk lines and infrastructure were mentioned. The Strategic Plan, released in December 1996, briefly mentioned the water resource, however, this was only in the context of lakes, rivers and other significant water bodies that require sustainable management.

Palmerston North City Council

Palmerston North City Council supplies water to the City from a combination of reservoirs, fed from the Turitea Stream (60 %) and deep groundwater aquifers (40%). Ninety five to ninety eight per cent of the supply is serviced by the

[51] Trigger points have been strategically set with regard to capital works that need to be carried out. These points include factors which consider the life span of main trunk pipes, the treatment plant, reservoirs, and forecasted growth of the city. A timeline and budget has been forecasted to cover these replacements when necessary. If these replacements are carried out, asset maintenance is continued.
[52] Sang, R., (1996): *Water Engineer*, Water Supply/Refuse Unit. Hamilton City Council, Pers. Comm. 7 October, 1996.

Council, with the remaining 2-5 per cent coming from individual bore users and rainwater collection in the rural areas. The rural bore users are not charged by the City Council, other than the cost to sink the well. These users draw water from the same supply as the Council, and are considered a possible threat to the supply in the long term, as they include market gardeners (and others) which will eventually limit the quantity of water the Council can take as granted by the Manawatu~Wanganui Regional Council. There are no residential water meters installed in the City.

Palmerston North City has shadowed problems with the lowering of the water table. The present aquifer has reached its complete capacity. Therefore, the Council is undertaking the development of the *Very Deep* (third level) aquifer. Other problems that have also arisen include a serious reduction in the flow of the Turitea stream and often resulting in a complete stop. No minimum flow requirements have been set by the Regional Council for the stream to date. However, the City Council has determined their own minimum flow scenarios in the water supply development plan [53].

The proposed Palmerston North District Plan, and 1996/97 Annual Plan were examined for issues relating to the water supply. Once again, no significant mention was given to the conservation of the supply, or conservation initiatives that may be adopted in the region. The Annual Plan detailed goals of "maintaining or improving the quality and quantity of the water supply", but no methods were illustrated to achieve this point. The Draft Strategic Plan prepared by the City Council mentioned much the same goals. No explicit mention of the efficient use, or conservation of the resource was given.

There are no specific rules about water allocation, only conditions included in the water permit which allows the Council to take water for supply purposes.

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[53] Royds Consulting (1996): *Palmerston North City Council, Water Supply Development Plan*, Design Report - Volume I, pg. 29.

Monitoring of bores and groundwater is the only method used by the Council to ensure these water sources are not being contaminated or overused. Minimum flow levels, if established for the Turitea Stream from the Regional Council, will help the City Council to calculate the limits of the Stream, and make abstraction estimates more accurately than their estimations of low flows to date.

Tauranga District Council

Tauranga City has two streams that each serve the two treatment stations. The Tautau stream services the Joyce Road Plant, and the Waiorahi stream supplies the Oropi Road Plant. Private bores are sunk in the Tauranga District, and used for residential irrigation purposes, and rainwater is collected by rural consumers for residential purposes. The amount taken from the bores and streams for these private purposes is relatively minor, and is therefore deemed to have an insignificant effect on the town supply (95-98% of residents are on Council supply, the remaining 2-5% are on their own supply). Thirty to thirty five percent of the district is on a metered supply, with the remaining 65-70 per cent unmetered.

At present Tauranga City has no problems with their actual supply, other than ensuring there is a constant in-stream supply of water throughout the summer. This may involve water restrictions and monitoring reservoir levels.

The proposed Tauranga District Plan was still in the preparation stages, and was therefore unavailable to examine. The Annual Plan for 1996/97 did not give any indication of water conservation mechanisms that may be adopted in the future. A Strategic Plan for the District has not been prepared.

There are no clear and explicit rules for water allocation from the Regional Council at the moment. Water allocation is generally based on guidance from policies and objectives set in the Regional Policy Statement. The preparation of a Water Management Plan due to start this year, will hopefully see some rules and

minimum flow levels established in rivers and streams concerned with municipal water supply. Establishing these levels will enable the Tauranga District Council to place real limits on water consumption in the District, and hopefully encourage water conservation more effectively.

Water Demand

This theme illustrates how consumers react to conservation messages from the council, be they conservation oriented or reducing water wastage.

The current water supply provided by the *Christchurch City Council* meets peak and average demands. Residential consumption draws on 73.6 percent of the supply, with industrial and commercial consumers using the remaining 26.4 percent. The Council predicts the monthly water demand, and graphs this with the actual observed amount. This graph further indicates the residual and current trend of water consumption. Figure 4.4 illustrates these trends over the past 16 years. Average daily water consumption per household is approximately 800*l*/day. This equates to 290 *l*/person, where the figures are based on 2.76 persons/household.

In order to curb the demand, education programmes are run throughout the year. These include public awareness campaigns [54], and meter readings to illustrate to the householder the volume of water consumed for the month, with an indication of the City's average household consumption for that month also. As Figures 4.4 and 4.5 indicate, these household conservation techniques effectively reduce consumption, as the trend in water consumption continues to decrease.

[54] Public awareness campaigns include radio coverage of 'Rita the Meter', bringing consumers attention to leak detection programmes, benefits of conserving water, newspaper adverts, and mail pamphlets on tips to conserve water around the home.

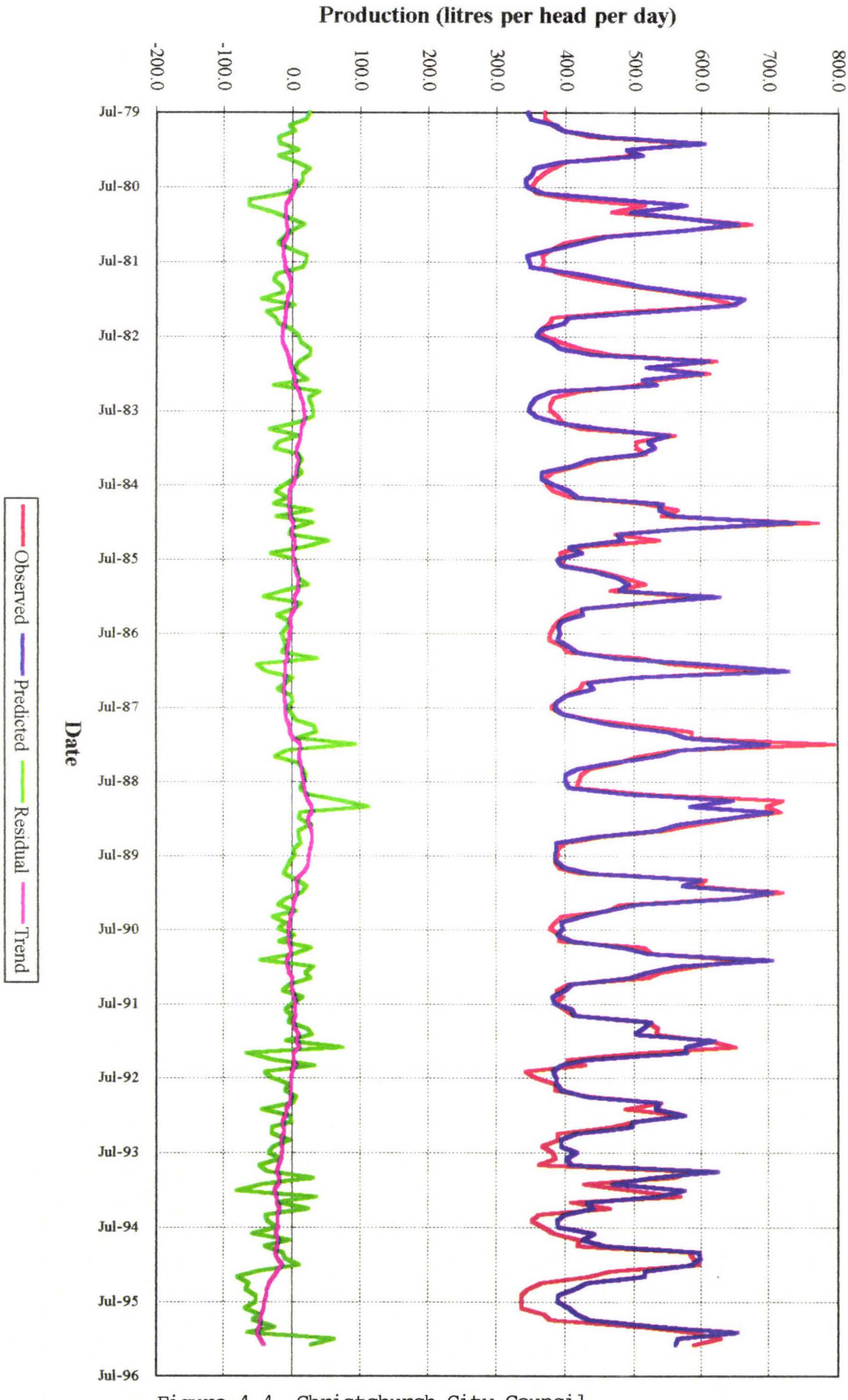

Figure 4.4 Christchurch City Council.

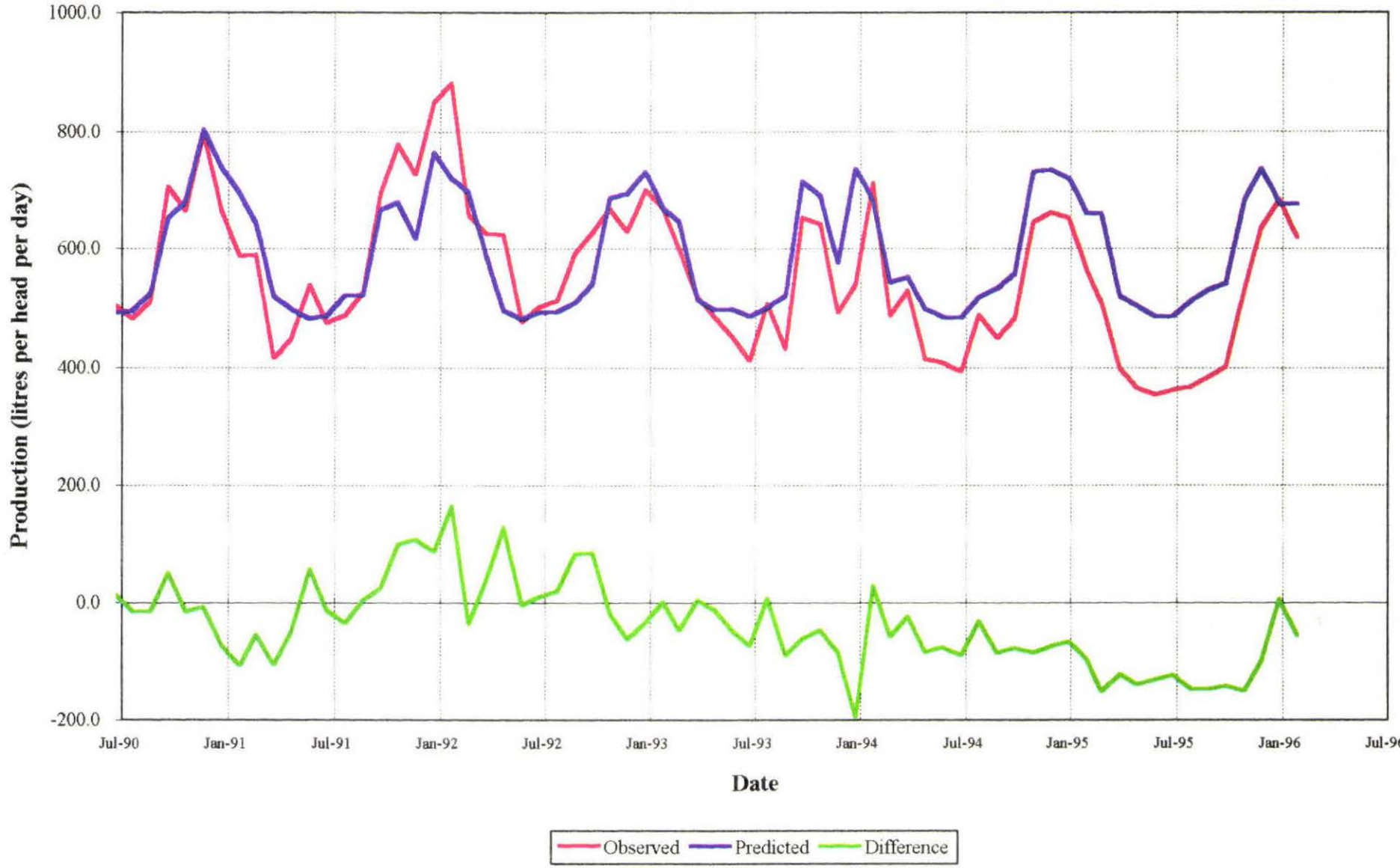

Figure 4.5 Christchurch City Council.

The water supply in *Hamilton* currently meets peak and average demands. Residential consumers take 70 percent of the supply, with industry and commercial users taking the remaining 30 percent. Average daily household consumption of water is 650*l*/day, or 260*l*/person/day (numbers are based on 2.5 persons/household). The Council does have a water shortage problem during two to four weeks of peak summer demand, when the physical capacity-to-supply is stretched.

Conservation techniques are in place in the City to encourage users to reduce their consumption during these times. In the crucial summer months, increased publicity and alternate day sprinkling campaigns are run between December and February. The Council also makes use of education programmes, and the promotion of water conservation at various times throughout the year. A high priority is placed on leak repairs and leak detection programmes. However, more emphasis is placed on reducing unnecessary wastage of water, rather than conserving it.

These techniques are of limited effectiveness in curbing demand because they are based on voluntary participation, rather than regulatory enforcement. The treatment plant has the capacity for pumping 81,000 cu.m water/day. From Figure 4.6 however, it can be seen that peak demand is a lot higher than average demand, indicating many peaks in the later months of the year when water shortages are most problematic.

Figure 4.6 illustrates the history of water demand in the previous years. Prior to 1971 there were regular summer restrictions, including a full ban on sprinkling. 1971 to 1988 saw the commissioning of a new treatment station and nil or minimal water restrictions applied. As can be seen from the graph, consumption was erratic, reaching a record 82 million litres water/day (82,000 cu.m/day) in 1988. Consumption dropped dramatically in 1989 when regular alternate day

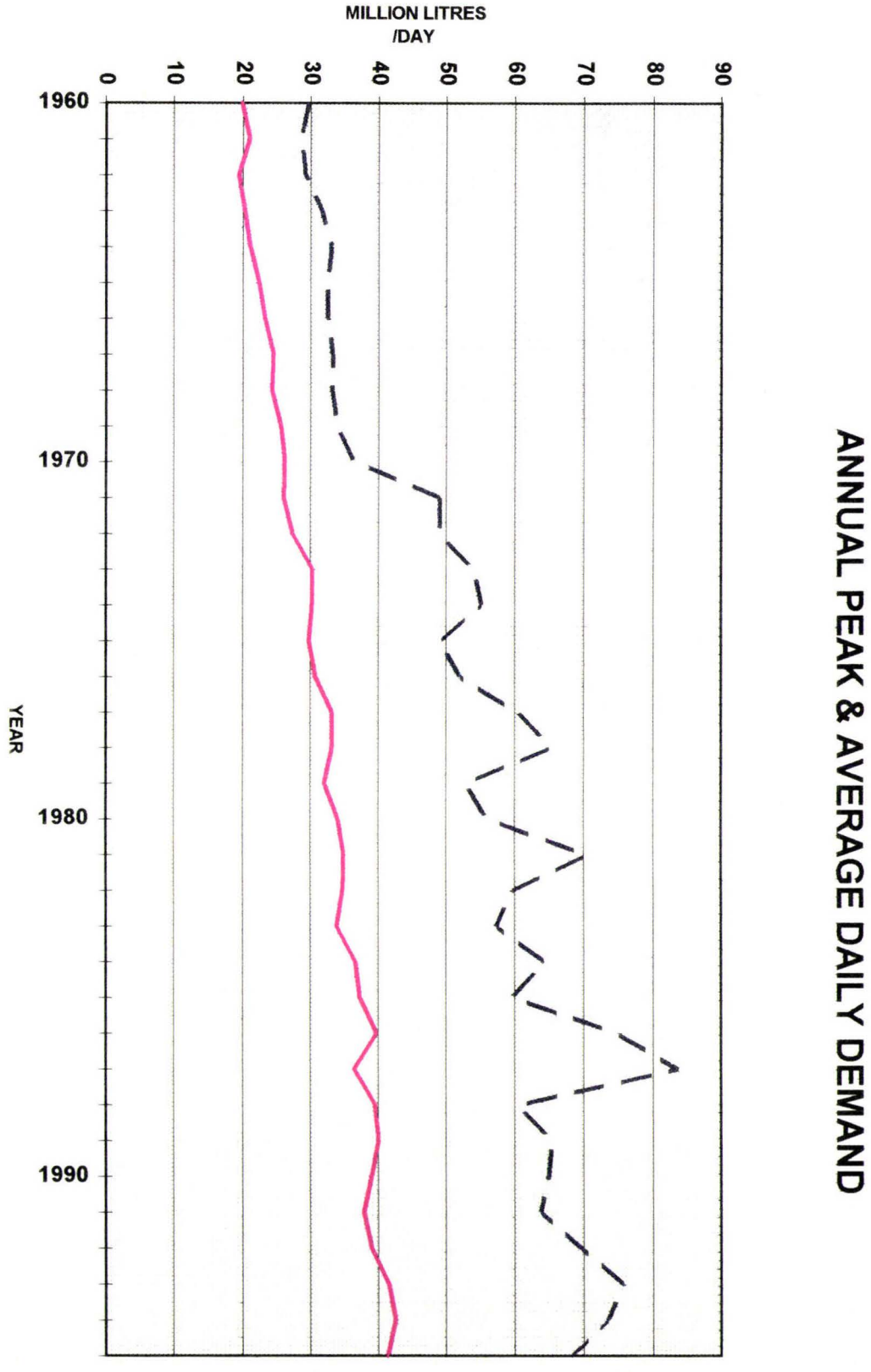

Figure 4.6 Hamilton City Council - Annual Peak and Average Daily Demand.

sprinkling was adopted. However, since then a steady increase in demand has been observed.

Mr. Sang (Hamilton City Council) considers these conservation techniques to be satisfactory for the Hamilton situation. He believes that for the costs involved, alternative options such as universal metering are not justified. Not only that, but Hamilton residents have a 'perceived' view of an abundance of water, as the Waikato River (supplying potable water) runs through the City.

The supply of water in the City of *Palmerston North* does not meet peak demand, although it does meet average capacity. Residential consumers take 51.6 percent of the total supply. Metered customers (industrial and commercial) consume 23.4 percent, and the remaining 25 percent is unaccounted-for-losses in the supply. The average household daily water consumption is 870*l*/day, or 300*l*/person/day (numbers are based on 2.9 persons/household). Water shortage problems are experienced during a dry summer, which may run for up to four months, affecting 90 per cent of the supply.

In an attempt to conserve water, the Council typically adopts the following measures:

- During the crucial months (summer), increased publicity and awareness is raised as the dam draws down.
- In the low season, the Council continues with pamphlet distribution and the occasional media article.
- Hosing restrictions are in place all year round. However, they are not advertised in winter when there is no problem with the supply. Increased advertising of hosing restrictions begins in the early summer. There must be 65 - 70 per cent of supply remaining in the dam before the second line of restrictions (alternate day sprinkling) is enforced.

In terms of evaluating the effectiveness of these techniques, Mr. Austin [55] believes that the Council does encourage conservation, but council officers do not know how effective this encouragement is, and probably never will. Those councils who have installed water meters and have an accurate recording of their water consumption patterns can draw more realistic conclusions on the effectiveness of using conservation type mechanisms to discourage over-use of water.

The present water supply system operating by the *Tauranga District Council* does not meet demand at peak periods of water consumption. Residential consumers draw on 87-89 percent of the supply, with the remaining 11-13 percent taken by industrial and commercial users.

The two treatment stations reach a combined average capacity of 43,000 cu.m/day, however, they cannot individually reach peak *demand*, typically in summer months and dry weather spells. Water shortages are experienced four months of the year, (November to February) affecting 100 per cent of the supply. Current data estimates 2.7 persons per household, however, daily household consumption data was not available, as meters are not consistently read, and would not give an accurate account of water consumption across the whole district as only 30 per cent of the area is metered. Council records do indicate, however, that on average people in metered areas use about 25 per cent less water than people paying the full UAC.

The Joyce Road consumption rate between 1994 and 1996 fluctuated within 8,000 - 13,000 cu.m/day. The plant's maximum capacity is 13,000 cu.m/day, however peak demands in the summer months for the same period exceeded

[55] Austin, B., (1996): *Water Supply Engineer.* Palmerston North City Council. Pers. Comm. 11 September, 1996.

15,000 cu.m/day on at least four occasions (See Figure 4.7). This was only possible due to water restrictions, and the combined running with the Oropi Road plant. The Oropi Road plant has a maximum capacity of 30,000 cu.m/day. Average consumption falls short of this maximum, but once again, peak demand in the summer months may reach as high as 33,000 cu.m/day.

Figure 4.8 illustrates the maximum, mean and minimum daily water conservation for both of the treatment stations. Remembering that Mt. Maunganui residents have meters, there are quite significant differences in the mean and maximum levels of consumption of both plants.

It is obvious, from these shortfalls in the ability to cater to peak demand, that some action taken by the council to reduce this problem was necessary. The Joyce Road upgrade is set to increase the supply from 13,000 cu.m to 37,000 cu.m/day. This will give a 50 per cent increase in the overall supply from the two treatment plants, large enough to cater for both average and peak demands when the capacity of the two plants is usually combined. Water restrictions in the Tauranga district are a common phenomenon in the summer. The level of restrictions are based on reservoir levels. When the treatment stations are running at 100 per cent capacity, reservoir levels are monitored. Level one restrictions (no sprinklers) are enforced when the reservoir levels are below half (the average storage capacity of the eight reservoirs is two days each). Level one restrictions are considered enough to conserve water, with the pending threat of implementing the next stage (Level two; no sprinklers, with odd and even day restrictions, and Level three; complete ban on all hosing). However, a recent move by the Council has seen "Water Police" in force during the 1996/97 summer. The security guards are policing the district, enforcing these water bans, which are advertised in papers and leaflets and on signs throughout the district.

TAURANGA DISTRICT DAILY WATER CONSUMPTION
(cu. m.)

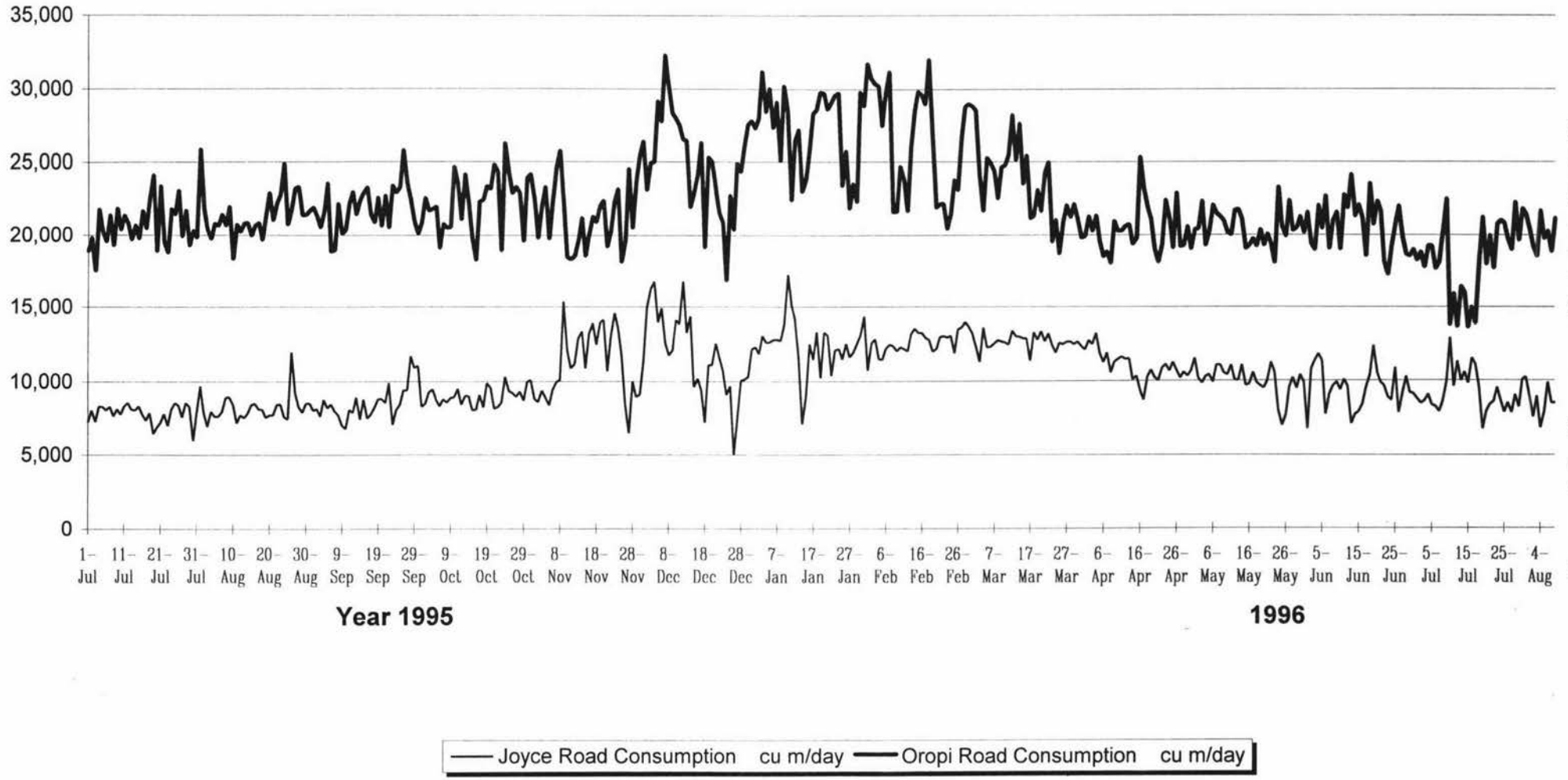

Figure 4.7 Tauranga District Council.

MONTHLY (MAXIMUM-MEAN-MINIMUM) DAILY WATER CONSUMPTION (cu.m.)

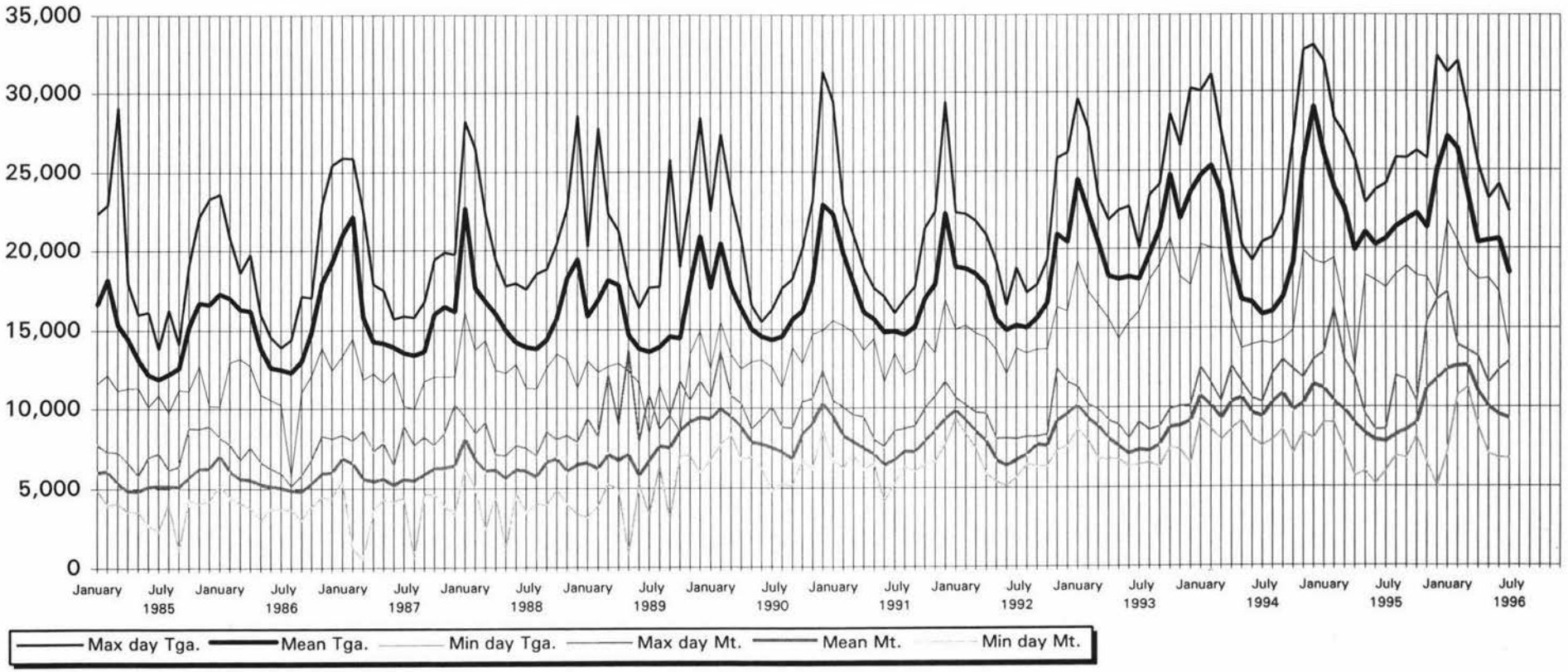

Figure 4.8 Tauranga District Council.

Water Pricing

This theme examines if each council considered, and therefore priced water as an economic commodity. The pricing of water services among the four case studies varies little from the traditional under-pricing approach discussed in Chapter Three. The standard approach adopted by these four territorial authorities is the Uniform Annual Charge (or UAC).

Christchurch City Council

Ninety nine per cent of *Christchurch City* households are fitted with water meters. At present they are operational, but are not being charged for, as the pricing policy is still under consideration. The meters are read, and this information is received by the householder, along with tips on conserving water around the home, as part of a public awareness programme. At present the Council is charging consumption by a UAC based on capital value, for example, $0.50c is charged for every $1000 of property value.

The Council arrived at this option by including the rate in its capital based rating system. Before amalgamation in 1989, two thirds of the City was metered and charged. Fifteen per cent of those were charged for excess use above their capital value allowance. Since amalgamation, meters have been installed in the remainder of the City.

In his questionnaire, Mr. Vantoor states that water is considered an economic good to some extent, but it is also considered to be much more [56]. In terms of the pricing structure reflecting water as an economic good, Mr. Vantoor further notes that "the full cost of supplying water (excluding the cost of capital or GST) is about $13.5 million/annum. All but $2.0 million is recovered from rates, commercial charging and asset cost recovery". The remainder is covered from

[56] Vantoor, E., (1996): *Planning Engineer, Water Services Unit.* Christchurch City Council.

borrowing, and other Council funds. Although water is *considered* an economic commodity, as with Tauranga District and Hamilton City, councils are not recovering 100 per cent of the costs in supplying the resource.

In a true economic sense, borrowing from a loan account or other Council funds is only going to incur greater interest, and more cost for the following year to repay the loans. However, amenities and facilities that will be there for future generations to use and enjoy should be partially paid for by them within an overall parameter of repayment within the life of the asset. If adequate pricing was developed to recover 100 per cent of all costs of supplying water throughout the City or districts, this problem of serious loan repayments would not occur. Mr. Vantoor concludes by stating "therefore in a straight economic sense, water is not treated as an economic good at present, because there is no relationship between the rise (in the amount) of the good (water), and the charge". The Council is moving to rectify this with the setting of the metered rate.

Hamilton City Council

In evaluating the options for pricing water, the *Hamilton City Council* is concerned with the following objectives as stated in the *Report on Charging for Water (1988)*: [57]

- To achieve recovery for the provision of water,
- To achieve consumer equity,
- To minimise capital and operating costs,
- And to discourage wastage or excessive use of water.

Five percent of residential households are fitted with water meters, but are not charged a metered use. As was mentioned in Chapter Three, all houses with swimming pools were metered until about six years ago. The discontinued reading of these meters was due to the review of the water charging regime. The

[57] Property Services Group (1988): *Report on Charging for Water*. City of Hamilton, November 1988.

results of this were presented in the aforementioned water charging report. The present policy states there is no residential metering. Residential water consumers are charged a uniform annual rate based on capital (land) value, plus a UAC which covers operational costs.

The Council arrived at this pricing structure after an in-depth review of the pricing policy report (*ibid.*, 1988). The Council considers water as an economic good, amongst other goals including; health and safety, an essential community service and property protection.

All water costs are covered by revenue through the specific water rate for industrial and commercial users, and the UAC for residential users. The water account is a trading account, and debit/credit are carried forward into the next year. All identified costs of service are included, and the various metered unit costs reflect the individual circumstances. For example, the rated and non-rated customers, bulk water customers, and rural sprinkler customers all have differential rates.

Palmerston North City Council

As has been mentioned, there are no water meters in the City of *Palmerston North* so there is no information available on household consumption. Residential water supplied by the Council is charged as a UAC of $145 per household. In arriving at this rate, the Council followed a formula to match operational costs to the charges as follows;

$$\frac{\text{Operational Costs (\$) - Other Revenue}}{\text{Number of Connections}} = \text{UAC}$$

Mr. Austin considers "water is an essential service that must be maintained at a high level to ensure a healthy economy". Although, the current pricing mechanism does not generally reflect water as an economic commodity. The reasons given by Mr. Austin ware that, the UAC does not cover the net

operational costs, and the water by meter rates (industrial and commercial users) often exceed the net cost to produce the water. The present UAC does not encourage consumers to use less water, and this is especially true for residential consumers. However, the metered commercial and industrial users use less water to keep their metered costs down.

In the questionnaire, Mr. Austin stated that water is relatively inexpensive to produce and industrial and commercial metered rates often exceed actual cost of $0.45 per cu.m, where residential charges fall short. With water being relatively cheap, the effects of encouraging industry to use less water are small.

Tauranga District Council

In the *Tauranga District*, 30-35 per cent of residential customers are fitted with operational water meters. These meters are being read and consumption charged for per unit until the Joyce Road upgrade is completed. Once this is completed reading of meters will stop. The UAC was set at $118 for the 1996/97 year for the unmetered consumers (60-65 per cent). The metered consumers are charged a $50 annual fee, and a 30c charge is made for each cu.m of water consumed above a given threshold. The upgrade of the Joyce Road plant (at a cost of $18.0 million) will not only increase the UAC for all households to $180, but provide up to 880*l*/person/day.

The metered rate works on an increasing block tariff type structure, whereby the first "*x*" cu.m are at a set amount. Consumption above this allowance is then charged at a very low rate. This rate is not substantial enough to be considered a penalty. The UAC was arrived at internally (within the Council), with the water account being closed (surplus/deficit) each year. The annual charge was spread between residential, commercial and industrial, depending on water consumption in each sector. This UAC covers the cost of water abstraction, treatment, delivery, Council overheads, but not the cost of depreciation. Major

maintenance, capital works, treatment and new mains installation are covered by a loan account.

In Mr. Speirs [58] opinion, the Council considers water as an economic good, but he thinks the recent plant upgrade at a cost of $18 million, does not reflect this as it was not the Council's first choice for reducing consumption. Furthermore, the current pricing structure is set as such a low rate, it does not reflect water as an economic commodity. However, Mr. Speirs believes that with the referendum history, the Council cannot revisit the pricing structure at the moment. This comes from a fear that the emotive argument previously put forward by the Water Action Group will result in community opposition to any Council proposal involving meters. The plant upgrade is due to be finished at the end of 1997, with a plan to promote conservation afterwards.

Conservation Programmes

Within the *Christchurch City Council*, a comprehensive list of water conserving methods, educational programmes and water pricing scenarios were the primary techniques considered for reducing water consumption. Each was analysed for their costs and benefits. Application of these conservation techniques have resulted in a marked decline in water consumption through promotional education programmes and media coverage. Throughout the water conservation campaign to raise public awareness, the following techniques were adopted;

- The promotion of water conservation awareness through the media,
- The promotion of mulches on gardens,
- The promotion of water stop weights in toilet cisterns,
- Recommendations for planting of appropriate drought resistant plant species in private gardens,

[58] Speirs, J., (1996): *Water Services Manager*. Tauranga District Council. Pers. Comm, 8 August, 1996.

- The use of efficient irrigation systems,
- The use of urinal controllers,
- Continuing the programme of renewals of water mains and sub mains,
- Continuing the programme of leak detection in the council's reticulation network,
- Providing advice to consumers about leaks on private property.

The observed savings from these water conservation techniques include a savings in the base demand (rather than peaks). An approximate 12 per cent savings over the past five years has been seen in the reduction of water consumption. Mr. Aldridge [59] is confident that this reduction is due partly to the increased awareness, public nature and media coverage of the water charging debate.

Hamilton City Council encourages water conservation in summer, as the water level in the reservoirs draws down, and while the sprinkler bans are in force from early December to late February annually. Educational programmes are continued throughout the year, with a high priority placed on leak repairs. These techniques, as mentioned, do encourage conservation, but in a limited manner. The savings include;

- reduction in the peak demand,
- savings in water process/pumping costs,
- savings in peak power pumping costs,
- better emergency storage available,
- removes the total ban situation,
- delays major capital works expenditure.

The 1988 pricing report [60] discussed a number of water pricing options available to the Council. The purpose of the report was to develop conservation measures,

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[59] Aldridge, B., (1996): *Water Services Engineer.* Water Services Unit. Christchurch City Council. Pers. Comm. 27 August, 1996.
[60] Property Services Group, (1988): *Report on Charging for Water.* City of Hamilton, November 1988.

and adopt a suitable pricing structure for the different users. Public consultation about a suitable structure followed, and concluded with a Council resolution. A number of key factors were influential in the final decision in deciding the path the water conservation programme would follow. These included;

- The source of water for Hamilton,
- Hamilton's treatment and distribution system,
- The cost structure for Hamilton water,
- The community dislike for metering and fondness of gardening,
- Alternate day sprinkling - minimal impact on community,
- The cost of metering, plus associated costs (maintenance, reading).

In Mr. Sang's opinion, expanding the supply to meet the increased demand is an efficient use of the resource. Presently less than 0.5 per cent of the flow of the Waikato River is used, with great potential for extra pumping and treatment capacity. The water is available to expand the supply with minimal cost, compared with other options (such as universal metering). An education programme with attention on the reduction of wastage and wise use of water is considered more of a priority than conservation and is intended to be implemented in the future.

As with Hamilton City, water scarcity is not really an issue for *Palmerston North.* However, to raise general awareness about reducing water wastage, the Council distributes pamphlets and media articles about water conservation. Hosing restrictions do apply, especially as the dam draws down in summer months. The savings from this result in reduced sprinkler usage in the dry season. This reduces peak day demand, but probably not peak hour demand. There is some overall reduction in water wastage year round, but this would be relatively small.

Tauranga District's increasing water shortage problems cannot seem to be significantly curbed by educational conservation mechanisms, regardless of the

efforts by the Council to illustrate to users the need for water metering as an effective tool to achieve this. The aforementioned hosing restrictions are in full force over the summer, and are regularly patrolled. To date, the savings from conservation measures have seen a reduction in the running cost of water treatment and pumping, and delaying the capital works for a new treatment plant.

Mr. Speirs considers that enlarging the pump capacity will cater to the forecasted growth of the City. He further believes that because of the "motive argument put to the Council by WAG", approving the upgrade and expanding the supply seemed like the only option available to the Council. This he believes, does not negate the need for water conservation.

Conservation measures under consideration for Tauranga's immediate future include; The

- Introduction of restrictions on shower roses
- Requirement of dual toilet flushes (dependent on Building Act Amendments, and bylaws)
- Active encouragement to industry to conserve and re-use water in industrial processes

Time-clocks in urinals are now operational in public, commercial and industrial buildings, and the Council is encouraging Mount Maunganui residents to use bore water for irrigation purposes, as they are relatively inexpensive.

Public Involvement and Consultation

In developing its water conservation techniques, *Christchurch City Council* carried out public consultation with regard to water charges to raise public awareness of the issue. General support for low impact conservation measures by both the community and councilors was the key characteristic that influenced the final decision to carry through with the conservation programme. Concern

has been raised about equity pricing issues and no consensus was reached on whether there should be an 'allowance' (allowable limit of water before unit charges are made), and how large it should be.

Sprinkling bans, metering, education and the use of fittings (urinal controls, shower heads) were put to the public in *Hamilton City* throughout the development of the conservation campaign. Sprinkler bans and education techniques, however, emerged as the more favourable options from the public consultation process.

No consultation (public or private) has been undertaken in the process of developing conservation techniques in *Palmerston North.* Hosing bans were considered a necessity to preserve the supply. The decision to put down a new bore was seemingly made without consultation. In the *Water Supply Development Plan* [61], it was stated that Palmerston North has a low consumption per capita (340*l*/day), so any gains from conservation are likely to be correspondingly low.

The report further suggests that the cost of extensive conservation programmes can be high. To maximise consumer based conservation, universal metering would need to be implemented at a cost of $6.0 million in capital and $1.0 million in ongoing annual operational costs. A new bore has been proposed, and subsequently works have begun to develop this, to take over the duty of the two other bores in need of rehabilitation or replacement. Further conservation measures may be adopted in the future. The report suggests conservation techniques would not significantly alter the rate of consumption, and the non-development of the new water sources could result in the council having to overuse the current sources thus taking on a major risk of possible water shortages especially in the summer. For these reasons, expanding the supply is

[61] Royds Consulting (1996): *Palmerston North City Council, Water Supply Development Plan*, Design Report - Volume I, pg. 29.

considered an efficient use of the water resource, because the cost to expand source capacity is less than the cost to implement full conservation measures (universal metering). The issue of water an a finite resource does not appear to enter into the Palmerston North City Council debates about water supply.

The Analysis

The matrix serves to summarise the main themes that have developed through the questionnaire, and to illustrate the type of themes present when considering the suitability of water conservation rates. The following matrix combines themes from the questionnaires, and identifies common characteristics portrayed by conservation oriented communities (Raftelis, 1993). Each characteristic is identified in the literature review, or is noted in the questionnaire as a theme common to each of the case studies.

The criteria given shows an indication of the degree of relevance each category has with the corresponding city. A *strong* indication reflects a heavy influence in the city. A *medium* indication denotes that the factor is relevant in pursuing water conservation. A *conflicting* indication has implications, whereby the factor will affect sections of the community in different ways. For example, in Tauranga, some consumers would be obliging in accepting water meters as a conservation initiative, whereas a strong majority of the community would not. *No indication* denotes that in some instances, this factor is relevant in developing conservation programmes, however, it was not indicated to be of relevance in this case.

All four of the cases strongly rely on groundwater or river sources for their supply of water. These sources (like any source of fresh water) are finite, and must be treated as such. Three of the four have a strong tertiary education

influence in the community, including three universities, four polytechnics and two teachers colleges between them. Raftelis (1993) argues that this influence

Figure 4.9 Conservation Characteristics Matrix

Characteristics of conservation oriented Communities	Christchurch	Tauranga	Palmerston North	Hamilton
Rely on groundwater aquifers, river sources for supply.	S	S	S	S
Community has strong educational influence, i.e., University and Polytechnic.	S	M	S	S
Supply - Demand imbalances, i.e., high growth.	M	S	M	M
Rising cost of supply pumping, treatment, transmission, distribution.	M	S	S	M
Concern about resource preservation through waste minimisation, pollution prevention.	S	M	S	S
Conservation rates are competitive to adjacent or similar communities.	N	N	N	N
Conservation rates would be acceptable by utility customers.	S	C	M	C
Community is readily informed about conservation programmes	S	C	M	M

Criteria Definition

S	Strong indication; this is a characteristic of this community
M	Medium indication; this factor is relevant to this community
C	Conflicting indication; this factor may affect specific sectors of the community in different ways
N	No indication of this characteristic at all

tends to increase a community's awareness of conservation issues. These may include issues of water conservation, recycling waste and an efficient public transport system. This awareness may be attributed to the number of students living in these areas, who tend to be responsive to new initiatives. The Bay of Plenty Polytechnic in Tauranga does not have a significant influence in increasing the community's awareness of water conservation, and resource scarcity.

Supply and demand imbalances feature as both a strong or medium indication. Both Tauranga and Christchurch are experiencing (or forecasting) high growth rates for the next ten years. This growth has serious implications on an already limited supply. There is water available to meet this growth, however, in order to truly reflect the economic benefit of water, the cost of water must rise, and limits to the expansion of the supply must be realised.

The rising cost of pumping, and increasing the capacity is an issue facing all water supply authorities. As existing treatment facilities become incapable of meeting demand, the option of expansion is always considered. In Tauranga and Palmerston North, this is necessary to cover future growth. However, now conservation programmes should be undertaken to overcome the perception that there is even more water available than before the expansion. It should be reported to the community that the expansion is to cover the forecasted growth, not to increase the average daily household consumption. Unfortunately, the Tauranga District Council has not given this message to its rate-payers. Instead, it has indicated that average consumption will rise to 880*l* per person/household. This figure is compared to 350*l* per person/household in Palmerston North, where the population is approximately the same as Tauranga.

The adoption of conservation rates has to be acceptable by the consumer, and this is an obvious contributing factor as to why the proposal of meters were so strongly opposed in Tauranga. The referendum illustrated to the Tauranga Council that rate-payers did not want their money spent on water meters, and the upgrade would be a much better option.

Discussion

The current pricing structure (UAC) for all four of the councils does not encourage residential consumers to use less water, unlike the alternate day sprinkling which is a physical imposition. The existing under-pricing structure

will not effectively achieve water conservation (although in some cases, this is not the immediate goal). Mr. Sang states "conservation for conservation sake is not a starter unless there is a valid reason" for Hamilton City. Valid reasons may include the scarcity of raw water, high cost projects to expand the capacity, or high costs to produce the water. Whereas education, wise use of water, and reducing wastage has ongoing emphasis in the Council's water unit.

The fact that residential consumption of the supply is a significant 70 percent indicates that these users are the most appropriate to target. If 70 percent of the supply can be encouraged to reduce their consumption, a notable difference would be seen in the resultant savings. These savings result not only in less water being used, but less cost to pump the water around the city, and less cost on running treatment stations and maintenance work.

As can be seen from the matrix, each territorial authority demonstrates at least one of the characteristics, if not the majority of them. All have a strong reliance on either groundwater aquifers or river sources for their supply. These are sources of a renewable resource, but somewhat finite in supplying current demand of high quality without extensive treatment. Supply and demand imbalances are all recognised issues with supplying water to meet current demand. Suppressing this demand through education and cost effective pricing mechanisms do aid in reducing demand, regardless how small. In order to promote conservation, awareness must be increased, or attempts are seemingly futile.

Strong indication was illustrated with concern about waste minimisation and resource preservation in Hamilton, Palmerston North and Christchurch. This is an immediate problem that needs to be addressed, is the rising concern of costly treatment upgrades and increasing the supply and distribution network. Tauranga is an excellent example where this is a *real* concern. Now that the upgrade has

gone ahead, it is time for that Council to seriously consider the next conservation options.

All these factors point to the need for an adoption of conservation rates. Understandably, with these four cases, the degree of implementation of conservation programmes would vary. However, it cannot be denied that a comprehensive conservation programme should be undertaken. This is especially true for those councils who have recently invested in expanding their supply (Tauranga and Palmerston North). Now, more than ever, is there a need for the council's to educate users that although the supply has increased, the wise use of water must be adopted if conservation programmes are to be effective. This too, would help to defer the cost of further capital works in 20 years time when the supply is once again stretched.

With regard to the Tauranga, Christchurch and Hamilton situations, all the proposed conservation measures have (and would have to) included public consultation. The common-held fear by staff in the water services unit of the Tauranga District Council is that once the upgrade is completed, and the meters are shut down, water use will increase dramatically. A new structure, if implemented in the next five years may well work towards realistically achieving water conservation. Increasing the price of water to reflect its scarcity is a viable option in the Tauranga district. Mr. Speirs (Tauranga District Council) believes that a differential block tariff, or low-rate marginal cost structure would work to target the big users, and subsidise large families.

The need to adopt conservation rates cannot be demonstrated more clearly. Chapter Five draws conclusion on the results of this research, and suggests a suitable conservation rate for each of the participating cases.

Chapter Five

Conclusions

This chapter collates the results and findings of the four case-studies. In this chapter, consideration is given to whether the conservation techniques adopted by the territorial authorities are effective in reducing water consumption in the long term. Resource scarcity and water management issues outlined in Chapters One and Two are further reflected on. The effectiveness of each council's existing pricing mechanism is reviewed in light of reducing consumption and increasing public awareness of the need to conserve water. The most suitable conservation pricing structure for each of the cases is suggested.

Research Goal and Objectives

The purpose of this research was to determine if the existing pricing techniques adopted by the four territorial authorities encouraged conservation of the residential use of the water resource. A number of objectives were developed to examine the water pricing and conservation techniques adopted by these territorial authorities. International experience has shown that water conservation pricing mechanisms, when adopted in suitable environments can actually reduce consumption. The comparative analysis of these four case studies reveals the degree to which water pricing actually influences water consumption, and subsequently promotes water conservation.

Initially, an examination of both international and New Zealand literature was undertaken to understand the nature of water scarcity and water pricing mechanisms. From the case-studies, it would seem that only one council (Christchurch City) considers *resource scarcity* as an issue in water pricing, but not one of the councils consider the *economic value* of water when developing a suitable pricing structure. The Tauranga District Council has encountered serious

problems in attempting to adopt water conservation methods, such as water meters. Hamilton and Palmerston North City Councils have yet to successfully challenge a prevailing view in their communities that there is an abundance of water in their cities.

The second objective was to examine the organisational arrangements for water management allocation. This objective enabled the examination of the past and present legislative frameworks surrounding water pricing, and the organisation of the governing bodies responsible for the management of water. The management of water is shared between the regional and district councils. The regional council determines the allocation of water in water bodies through consents granted under the RMA. Territorial authorities, or other water supply authorities (such as LATEs) manage and maintain responsibility for the supply of water to their communities.

The final objective sought to examine how the selected territorial authorities reduce water consumption effectively when there are shortages in the supply.

Discussion

The discussion that follows details the findings of each objective and their relevance to the cases.

Objective One

Water issues cannot be viewed in isolation from other resource allocation decisions. The use of water should be examined not only in its role as essential to all life-systems, but in its role as indispensable to most human activity, and thus to socio-economic development. A holistic approach to managing environment and development issues is now regarded as essential. Artificially low water prices and other policies encourage overuse of water which leads to the construction of unnecessary water storage facilities with high capital input.

A consideration of the water principles detailed in Chapter Two (from the ICWE, 1992) is evident in New Zealand. All four of the council staff interviewed in this research identify with the first principle, and consider water as a scarce natural resource. However, in Tauranga, Palmerston North and Hamilton cities, pricing structures do not incorporate consideration of this ides. The concept is also not accepted by the community, because of the perceptions held that there is an abundance of water. The second principle, that "water management should be based on a participatory approach" is varied in its application. Water management is now based on a participatory use. Understanding the effects of over-consumption, and how effective techniques are at educating and encouraging users to reduce consumption, is part of this participatory approach. Christchurch, Hamilton and Tauranga Councils consulted their communities widely when developing water conservation techniques. Palmerston North City Council however, developed their water restrictions without public consultation.

The third principle, recognising that 'water has an economic value, and should be recognised as an economic commodity' has received limited application within the four case studies. As was examined in Chapter Four, all four councils "consider" water an economic commodity, yet not one of them prices it in such a manner as to reduce demand and prevent the current capacity being exceeded. Economic pricing of a water resource includes the cost of depleting the natural resource, the opportunity cost of using the water, the cost of operating, maintaining and replacing the supply system and the opportunity cost of capital. Raising the price of water to better reflect its true cost is one of the most important steps in progressing towards conservation. Proper pricing gives consumers an accurate signal about just how costly water is, and allows them to respond accordingly. If conservation pricing was correctly in place, then the consumption of water would be at such a rate as to assure the production of maximum sustainable yields for present and future generations. Only when the human use of water matches the resource's ability for natural regeneration, is the use sustainable.

Objective Two

Members of the community have an opportunity to participate in the preparation of regional policy statements, regional plans, and district plans. As has been demonstrated in Christchurch, a community participatory approach raises the awareness of the importance of water among policy makers and the community. Only when consumers are aware of their consumption, and have the knowledge and an incentive to reduce it, will the benefits of their actions be realised.

The statutory framework provided for in the Local Government Act, enables territorial and water supply authorities to price water at a level suitable to recover costs. Moreover, it enables the use of water meters to measure and charge for water based on consumption. These provisions are not yet being fully exploited in the case of Tauranga, Hamilton and Palmerston North cities. The new requirement to prepare ten year financial plans which provide detailed accounts of a city's assets, infrastructure and funding demands long term forecasting of major capital expenditure, including the provision for supplying water. The mandate of the Resource Management Act for sustainable management imposes another obligation on councils to be taken account of in their strategic planning and growth management. The combined effects of the mandates under the Local Government and Resource Management Acts should result in coordinated planning of urban growth and infrastructure management, in which the principle of sustainable management is given practical application.

Objective Three

As not one of the councils had *operational* meters installed, water restrictions and hosing bans were the only mechanisms available to the councils for reducing demand. Water restrictions and hosing bans are effective only in the short term, and give no measurable indication of water consumption patterns. Water meters provide an accurate, measurable record of water consumption. Christchurch City was the only Council moving towards the implementation of a conservation-orientated metered rate. To be effective in penalising users for over-consumption,

a progressive increase of the charge on users is needed, the greater the volume of water consumed.

Christchurch City Council seems to be effective at reducing the peak demand sufficiently to prevent the supply becoming exhausted. However, this has been achieved to date through education programmes and increasing public awareness, not through effective pricing. Water savings over the past five years have resulted in a 12 percent reduction in the base demand. Although an adequate metered conservation rate is being proposed, continuation of public awareness campaigns would still be beneficial. Christchurch City Council has made a large investment by installing universal meters. This is a substantial move towards successfully implementing a conservation rate.

Hamilton City Council has decided reducing water wastage is more of a priority than conservation. The Council has proposed the launch of an education programme to increase public awareness of water wastage. Like Palmerston North City Council, Hamilton City Council has a problem with the community view of a perceived abundance of water. For this reason water scarcity is not reflected in the pricing structure. Increasing the capacity of the supply to meet future growth is on the Council agenda, however, limits to the expansion of the supply need to be placed by educating to users that fresh water is a finite resource. A metering option would need to be investigated more thoroughly if a comprehensive conservation programme was ever to be successfully implemented.

Water consumption in *Palmerston North* is not metered and the Council has no immediate intentions of installing meters. Therefore increasing the supply by sinking the bore is the only option available to cater to the demand. Although it seems there is no immediate need to be concerned with water consumption and excessive over use of water in the City, educating users about the wise use of water and the implementation of conservation techniques that can be adopted

around the household would be appropriate given the regular restrictions on water use which are put in place every summer. If the Council adopts a cautious approach about the use of water in the City, a reduction in overall consumption may be significant enough to postpone the need for future expansion of the water supply.

The *Tauranga District Council* cannot curb peak demand regardless of non-regulatory conservation efforts, or public awareness campaigns. With a third of residential consumers receiving a metered rate, and the remaining 70 percent on an annual charge, a complete review of the pricing regime needs to be considered. To be effective at promoting water conservation, water meters need to be installed throughout the entire district. Only then will excessive consumption be measured and charged for accordingly. Residential consumers take 87 percent of the supply. Industrial and commercial users make up the remaining 13 percent, yet these consumers are charged a metered rate for their water consumption.

Adopting a universal metering programme, although capital intensive initially will be worthwhile in the long term as the district is faced with a future increase in the supply, given growth rates in the Tauranga District. A marginal rate, whereby the metered rate is set high enough to cover the costs of expanding the supply the next time may be beneficial in this case, to illustrate to consumers how costly it will be to increase capacity further, encouraging a reduction in consumption until residents are prepared to pay for this additional increase.

Findings

The following findings suggest the suitability of each case to a conservation pricing rate.

The *Christchurch City Council* is well on the way to implementing an effective pricing regime for water. An ***increasing block tariff*** structure would be a suitable rate, as it is highly conservation orientated and discourages use over a certain threshold by incrementally charging the higher consumption becomes. Unlike the Marginal Rate, it does not generate large amounts of surplus money (which is not legally allowable), as users are not paying for the future cost to increase the capacity. The existing structure should allow for easy conversion to an Increasing Block Tariff, and this is currently being discussed by the Council. This rate is a lot more user-friendly, and widely accepted by consumers, as its design structure is easily explained.

An Increasing Block Tariff may have a substantial impact on high volume users such as business and industry, however, differential rates for these users can be set to encourage conservation within realistic limits. In using the block tariff for residential users, the price of water for essential use (threshold for water use within the house) should be less than discretionary use (non-essential uses; watering gardens, washing cars and filling swimming pools), and essential use may be priced below the cost of service to reward users who are responsive to conservation initiatives. This rate may prove to be beneficial, as the Council has a strong conservation campaign and it has been proven to be effective in reducing the demand in water consumption.

Hamilton City residents are not metered. Thus, continuing with the ***Uniform Annual Charge***, and raising the cost to recover all water costs would be a viable option for the Council. More time needs to be spent on reducing water wastage as water restrictions indicate a shortage of supply. The uniform rate, although not as effective as some of the other conservation rates, would suit the Hamilton situation at the moment. The infrastructure (water meters) is not available to successfully implement any of the other rates suggested. Increasing the charge, to reflect the cost of water production would be a useful step to a more

progressive conservation rate in the future (should meters ever be fully installed). Limits to the expansion of a finite supply need to be realised.

Palmerston North City Council appears to meet their operational costs through the UAC and the metered rate charged for industry and commercial users. However, water shortages are occurring. A more adequate conservation and wise use of water programme may help to reduce wastage. Even though there may be a perceived abundance of water, the onus is on the Council to produce evidence of the contrary if there is to be a reduction in consumption. Indicating to users by increasing the ***UAC*** that substantial cost are involved when enlarging the pumping capacity may be just the trigger needed to effectively start a conservation campaign. Although the UAC is considered a type of conservation rate, it is very limited in its application. However, given that Palmerston North City does not have water meters, no other conservation rate is suitable in this instance.

In the case of the *Tauranga District Council*, expansion of the supply seemed inevitable. However, now that the community's views are being considered, it would be wise to develop a comprehensive conservation programme. Obviously with the additional supply, there will be a perceived abundance of water, however with an increasing UAC for all customers, the reality of the ongoing water problem may need to be heeded. A move to voluntary metering is a new idea that may be adopted by the Council. Once the alterations to the new treatment plant are completed, the Council has proposed to discontinue reading the meters. By increasing the UAC from $118 to $180 as proposed by the Council, metered residents will realise that they are better off financially, being charged a metered rate, (which should hopefully be set at a level which penalises users for excessive use). It is envisaged by the Council that eventually all residents in non-metered households in the District will observe the benefits of the metered users, and subsequently request the installation of meters.

The characteristics of the *Tauranga District* suggest its suitability for the application of the ***seasonal rate***. With the pump increase, the supply can now meet peak consumption. A seasonal rate is based on high costs during the summer (on-season) and a lower rate in the winter (off-season). Since the off-season typically has a lot of rain, the need for watering gardens and supplying enough water for the summer influx of visitors is deferred. In summer when demand increases, the rate increases after a given allowance per household, therefore discouraging high water consumption. This seasonal rate has a less predictable impact on users than the other rates, and it is highly dependent on the frequency of the billing cycle to be effective (monthly, if users are to see their savings, and respond accordingly). It has been proven to be highly popular in areas where average and maximum demands are significant, and because it is strongly conservation orientated through the efficient use of water facilities during the on and off season.

Conclusions

Educating users, whether it be through regulation, or financial incentives, or by increasing the cost of water so as to create less demand, is a way of successfully achieving conservation awareness. Christchurch City Council has proven this by demonstrating to users how much water they consume monthly. The use of meters, while the Council settles on an appropriate pricing scheme, has proved invaluable as it has raised the awareness of consumers and resulted in a decline in consumption.

In all cases, residential consumers are the largest users of the Council water supply. Targeting these users is the most reasonable option available to water supply authorities when attempting to curb water consumption. In most cases, the residential consumption of water is at least 70 percent, with the remaining 30 percent taken by industrial and commercial users. Although water recycling programmes may be targeted to these large volume users, sensible use and

conservation campaigns would be beneficial if directed effectively at residential consumers. Any type of effective conservation campaign requires the use of water meters to measure consumption efficiently.

Communities who are readily informed are more aware of water issues in their district, and aptly adjust their consumption accordingly. Communities who are mislead by public campaigns or unsure of the facts (as Tauranga City residents) may not see past the cost factor to implement conservation measures like water meters. Councils need to respond with factual information to enable the community to fully participate in resolving the issues concerning them.

Concern over water shortages, and the future pricing of the water supply are only two of many issues facing councils. Reducing household waste, dealing with the expansion of urban infrastructure into adjoining cities, enhancing community well-being and encouraging the sustainability of both natural and physical resources are all equally demanding tasks. However, the councils all have one common goal; promoting the sustainable use of resources, to ensure there are enough natural resources for future generations to meet their own needs. It is at this local level where real change can be affected.

If water is provided at a less than adequate price, using traditional under-pricing approaches, more of it will be demanded. The obvious danger is that this greater level of demand is unrelated to the capacity of the surrounding natural receiving environments to meet this demand. This has been highlighted in at least two of the four cases in this study (*Christchurch* with its depleting aquifers, and *Palmerston North* with its over-use of the existing bores). *Hamilton City Council* has a larger source of water to draw on to meet its future demand than the other councils. The *Tauranga District Council* has problems with the existing facilities meeting the demand, however, by increasing the pump capacity, this demand can be met and the increase in supply will cover projected growth in the region. This increased supply provides an ideal opportunity for the Tauranga District Council

to begin conservation programmes and continue with moderate sprinkler bans, as is the case in the other three authorities.

The use of conservation techniques such as hosing restrictions (by all four councils), which are in force for two or three months of the year, demonstrates only to the consumer that the water shortage problem is seasonal. More often than not though, consumers revert back to their wasteful habits when the rains come. Installing a metered rate year round encourages users to be aware of their water use practices twelve months of the year, and develops long-term wise water use patterns. Conservation pricing and metering of the supply provide two approaches to reducing excessive water consumption. If a conservation rate structure and a comprehensive education programme is implemented in the correct conditions, they should indicate to the user the nature and urgency of impending water scarcity.

Adopting a users-pays approach to residential water use by installing water meters and abandoning the universal annual charge, would ultimately reduce water consumption (both peak and average demands) and would reflect the position of water as an economic commodity more appropriately.

This research has examined the water conservation techniques of four territorial authorities in New Zealand. However, it is significant that the thesis findings reveal that water shortage problems plague all four participating councils. These findings could also be relevant for most territorial authorities in New Zealand. Similarly, all four councils are experiencing difficulties in establishing a suitable pricing structure to reflect water scarcity, and meet basic operational costs.
The delivery of water to the residential consumer is dependent on a complex system of governance and statutory requirements. Approaches to water pricing examined in this thesis will come under increasing scrutiny as the setting of priorities for expenditure becomes more transparent in financial planning undertaken by territorial authorities. The future management of water in New

Zealand as a limited resource, will be a test of whether it is possible for councils to reconcile national and international obligations for sustainable management at the same time as they are required to deliver a cost-effective service to their local community. Fulfilling the requirements of several mandates, that at times may be in conflict, will be a major challenge for councils in a devolved and cooperative system of environmental management where much depends on local setting of priorities for achieving environmental quality and managing public expenditure efficiently.

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APPENDICIES

Aldridge, B., Water Services Manager. Christchurch City Council.

Sang, R., Water Engineer. Hamilton City Council.

Austin, B., Water Supply Engineer. Palmerston North City Council.

Prasad, M., Water Distribution Engineer. Palmerston North City Council.

Speirs, J., Water Services Manager. Tauranga District Council.

QUESTIONNAIRE

WATER CONSERVATION

This questionnaire is designed to establish the nature of the residential water supply system that you supply to your district as a municipal service.

It has a special focus on the *conservation techniques* employed and the *degree of effectiveness* of these techniques in achieving conservation of municipal residential water.

As you are no doubt aware;

- Water is increasingly viewed as a scarce resource,
- It is difficult for territorial authorities to justify the pricing of water services,
- Consumers are long used to the view that water is a 'free' resource.

It is my aim to determine the degree to which this viewpoint is considered by territorial authorities, and their subsequent community. With this questionnaire, and your help I will attempt to identify the most appropriate water conservation pricing technique, and the characteristics of the community it is most suited to.

Phase One.

Objective 1: *To determine the existing operating water supply system.*

Objective 2: *To establish the pricing mechanism(s) in place for the supply of water, and the reasons for this (does it reflect the use of water as an economic good, and operate within these boundaries?).*

The initial section of this questionnaire will attempt to develop an understanding about the present circumstances of your water supply system. This will include questions about how the system operates, the existing pricing mechanisms in place for water consumption and the consideration of water as an economic good[1].

[1] Proper pricing of a water resource includes the cost of depleting the natural resource, the opportunity cost of using the water, the cost of operating, maintaining and replacing the supply system and the opportunity cost of capital (Raftelis, 1993, pg. 219).

Phase Two.

Objective 1: *To determine what types of water conservation mechanisms/ techniques are operating within the council and the community.*

Objective 2: *To establish the characteristics of the chosen technique and why it was suitable for the community. (What elements were considered.)*

The second section is concerned with the consumption of water by the community and the subsequent effects of over use, by identifying the effectiveness of the conservation pricing mechanisms in place for water consumption. Implicit in this section is the need to identify the characteristics of the chosen water price structure, and why this technique was adopted. It is through analysing these characteristics, we can determine if the chosen pricing framework is the most appropriate.

Phase Three.

Objective 1: *To identify the projected growth for the region, and thus the anticipated impact of the demand on the current supply.*

Objective 2: *To identify the degree to which the current water source and the current pricing mechanism take into account the future use/demand on the resource. This will hopefully indicate the degree to which the current mechanism achieves a goal of attaining water conservation.*

This section deals with the district's future growth forecasts, and the demand that will be placed on the water supply. It will hopefully establish if the current pricing mechanism will effectively recover costs of the service. Furthermore, does it encourage the conservation of the supply by reducing consumption of water at the residential level. If it is shown that the current pricing technique is inadequate, then we may apply the characteristics of alternative pricing structures that may be appropriate in the region.

Section One

1. How is the water supply utility operated within the council?

Council Service ☐
Business Unit ☐
LATE ☐
Other (please explain) ☐
_____

2. What is the type of source of water drawn on for municipal supply?

Reservoir ☐
River/Lake ☐
Groundwater/Aquifer ☐
Combination of above ☐
Other (please explain) ☐
_____

3. Do any residential households draw on their own supply?

Bore ☐
Rainwater ☐
Other (please explain) ☐
_____

a). What are the percentages of the council supply v.'s own supply?
Council ____ % Own _____ %

b). How are these individual supplies charged for? _____
_____

c). If supplied by bore or 'other', do they draw from the same source as the council?
Yes ☐ No ☐

d). If answered yes, is this perceived as a potential problem, and why?_____
_____
_____

4. Are residential houses fitted with water meters?
   Yes ☐ %___ No ☐ % ___

5. Are they all in operation (charging for water by consumption)?
   Yes ☐ No ☐ Why not?_____
   _____

6. How is the potable domestic water[2] supplied by the council charged for?
   i. Uniform water rates ☐
   ii. Metered
      a) Increasing block tariff ☐
      b) Marginal Cost Pricing ☐
      c) Seasonal pricing ☐
      d) Other _____ ☐
   iii. Other (please explain) _____ ☐
   _____

7. How did the council arrive at this pricing mechanism? _____
   _____
   _____
   _____

8. Does the Council consider water as an economic good[3]? _____
   _____
   _____
   _____

In your opinion, (or that of the council's) does the current pricing mechanism reflect water as an economic good? Reasons? (For example, does it cover the true cost of supplying the water; what are these costs?) _____
_____
_____
_____
_____
_____
_____
_____

[2] Definition of potable water, MoH.
[3] Proper pricing of a water resource includes the cost of depleting the natural resource, the opportunity cost of using the water, the cost of operating, maintaining and replacing the supply system and the opportunity cost of capital (Raftelis, 1993, pg. 219).

Section Two

1. Does the current supply meet peak capacity or average capacity? (graphs)
   Yes ☐ No ☐
2. What is the average daily consumption of water per household? (graphs)

   _____

3. Does the council have a water shortage problem at any time of the year?

   Duration: _____ months
   % of community (supply) affected ___

4. Are there any present or forecasted problems with the supply?
   For example:

	P	F
• Lowering of water table	☐	☐
• Salination of the aquifer	☐	☐
• Pollution / contamination of the aquifer	☐	☐
• Endangering ecosystems of river systems	☐	☐
• Exceeding minimum flow levels in river systems	☐	☐

   • Other _____
   Comments: _____
   _____
   _____

5. What types of conservation techniques are in place for the council to encourage residential users to conserve water?

   In the crucial season:_____
   In the off season: _____
   No change between season:_____

6. Do these techniques encourage water conservation?:_____

7. How and what are the savings? _____
   _____
   _____

8. What was the process undertaken in the development of these conservation techniques. For example; Public consultation, council decision._____

9. What characteristics of these techniques were appealing in the final decision?

Section Three

1. What is the growth rate of the city?
   % _____ Numbers _____

2. Does this forecasted growth place additional strain on the existing water supply?_____

3. Is there an additional source of water available to cover this demand?

Yes ☐ No ☐

a). If yes, what is the source, and what is the extra cost?_____

_____

b) If not, how do you intend on supplying this existing demand? _____

_____

_____

_____

4. Do you think expanding the supply, or increasing the treatment capacity is an efficient use of the water resource? (How)_____

_____

_____

_____

5. What other techniques have you considered to reduce water consumption?

_____

_____

_____

_____

_____

_____

6. Did this include public consultation, and what was the response? _____

_____

_____

_____

_____

_____

_____

7. Do you think the existing pricing mechanism is adequately encouraging consumers to use less water? In other words, does it encourage conservation?

_____

_____

_____

_____

8. Do you realistically think the existing pricing mechanisms will achieve water conservation?_____

9. Do you believe increasing the price of water to reflect its scarcity is a viable option in the district? Will this eventually happen?_____

Do you have any further comments about the conservation of you water supply?___

Would you be interested to participate further should any new information come to hand in the interim that you could pass on to me? (e.g. interested in the findings of the interview):_____

Thank you very much for your time, I appreciate you taking time out from your schedule to answer my questions, they have been most helpful in enabling me to undertake my research. The results of this interview will be used as a comparative analysis in my Thesis, however all names and other sensitive data will be kept confidential.
Melissa Slatter