A REVIEW OF WATER METERING PRACTICE IN NEW ZEALAND AND OVERSEAS

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ABSTRACT

A number of New Zealand councils have introduced universal water metering over the last 30 years; others have partial metering and some no metering at all. Different councils are currently considering the implementation of universal metering as part of their Long Term Plan. This paper reviews some of the current approaches to water metering in New Zealand and overseas. This is based on a literature review and discussions with individual councils.

There are a number of different reasons for implementing universal metering. These include reducing water use (generally discretionary use) by improving customers' approach to water efficiency, providing a fair and equitable charging regime, identifying water losses and the development of an improved understanding of the overall network water balance. Prediction of the reduction in peak and average demand from volumetrically charging for water is inherently difficult. The demand for water varies significantly because of a range of external factors including weather related issues such as temperature and soil moisture deficit, together with wider economic drivers.

Tariff structures are an important factor when developing a universal metering programme and an area which can cause significant public concern. Different types of tariff structures are available, ranging from a simple volumetric charge, to a combined tariff which has a fixed and variable component. This paper reviews the different types of tariff structures that have been implemented in New Zealand and reflects on how this potentially affects water use.

KEYWORDS

Water metering, water demand, water efficiency, water tariff

1 INTRODUCTION

Metering to enable water to be charged by volume is becoming more widespread in New Zealand. The approach to metering across the country varies dramatically, with some councils having charged by volume for a number of years, and others where communities appear to be deeply opposed to volumetric charging.

This paper reviews the different approaches employed by councils across New Zealand, examines some international examples and based on this review makes some recommendations about the potential benefits of metering. It also reviews some of the different tariff structures that can be used and how these potentially change the effect of metering.

Metering is one technique that can be used to promote water efficiency, together with education and other approaches. These techniques can incentivise people to implement water efficiency measures and change their behaviour. The water efficiency measures that people implement will vary, but could include being more careful with their use of water, buying water efficient goods (such as low flush toilets) or using rainwater or treated greywater as a substitute for potable water where appropriate.

1.1 THE DRIVERS FOR WATER METERING

Many councils are faced with an increasing demand for water, future population growth and high costs for the implementation of new supplies. This combination of issues leads to a choice; to either invest in new infrastructure; reduce demand; or both.

Universal metering reduces (generally discretionary) water use by:

- Improving customers' awareness of their water use and their approach to water efficiency as there is a financial, and potentially emotional, driver to be conscious of wasting water;

- Identifying water losses, particularly from customer supply pipes; and

- The development of an improved understanding of the overall network water balance which can enable councils to reduce water losses.

In particular, water metering can help to reduce peak demand during summer months when water resources are most stretched. Where water metering is implemented in these situations, demand is reduced and the requirement for new supplies can be pushed back in time. This can lead to both capital and operational savings as the implementation of new schemes is deferred. This is particularly relevant where the development of new water supplies is considered costly or applying for and obtaining a resource consent is controversial.

Other reasons for implementing water metering include:

- The introduction of a fair and equitable charging regime; and

- The improvement of long term water resources planning through a better understanding of consumption data.

1.2 THE NATIONAL POLICY STATEMENT FOR FRESHWATER MANAGEMENT (2011)

The National Policy Statement for Freshwater Management came into effect in July 2011. It sets high level government policy with regard to freshwater management and is focused on water quality, water quantity, integrated management and tangata whenua roles and interests.

Objective B3 is to '*Improve and maximise the efficient allocation and efficient use of water'*. Whilst this is partly focused on allocation, metering and subsequent demand management practices is one way in which the efficient use of water can be demonstrated.

This National Policy Statement is being implemented by regional councils through amendments to their regional policy statements and plans. Most regional plans around New Zealand now require water users to demonstrate the efficient use of water as part of their water take consent conditions. For example, one approach that has been taken to demonstrate efficient use is that of the Waikato Regional Council, whereby any application for a water take consent must include a Water Management Plan which demonstrates the efficient use of water.

1.3 IMPROVING INFRASTRUCTURE EFFICIENCY – REPORT TO THE DEPARTMENT OF INTERNAL AFFAIRS (2013)

In March 2013 the Local Government Infrastructure Efficiency Expert Advisory Group reported to central government (Department of Internal Affairs) following their review of how local government could operate more cost effectively. While this addressed a range of topics, water supply and particularly water metering was a focus of the report. Whilst this report is not formal government policy, it gives some indication of the direction government may take in the future.

The study considered how local government is currently funded and how changing demographics may alter this in the future. It particular identifies a change whereby urban areas remain younger, wealthy and able to meet the cost of achieving high environmental health standards and public facilities. Conversely, rural areas are expected to decline, with a higher ratio of elderly people on fixed incomes. For these areas, the declining population may lead to increased pressures simply maintaining existing infrastructure. Changing demographics is therefore an important factor for all New Zealand councils and should be considered as part of infrastructure provision.

The report identifies the different funding mechanisms that are currently available to councils. These include property rates, fees and user charges, subsidies from central government, road tolls, development levies and investment / asset sales. Water metering falls into the ‘fees and user charges’ category, although before metering is in place water supply is generally funded through property rates.

The report identifies some of the benefits of direct charging for a service. The costs of consumption are met by consumers who can use it more efficiently. It also provides a revenue stream to pay for new investment. The report notes that there are no legislative barriers to direct charging, including the introduction of volumetric charging for water, although road pricing on existing roads is prohibited.

With regard to water metering, the report reviews evidence about the benefits of water metering. Particularly, it notes that:

- As a demand management tool, volumetric charging can lead to the better use of existing resources;

- There are similar benefits of volumetric charging for wastewater, although measurement of the discharged wastewater is more complex and there may be challenges in implementing charging mechanisms ;

- The cost/benefit of the introduction of water metering and volumetric charging indicates that there is a high rate of return where large capital expenditure is required to meet future demand, i.e. the introduction of water metering can offset the need for investment in water infrastructure; and

- Other savings accrue from reduced operational costs and increased leak detection, particularly from customer supply pipes.

The report identifies a number of public perceptions related to water metering. These include that it is a money making exercise for councils, it is inequitable and it is the first step towards privatisation. Whilst these concerns are unfounded, it is essential to consult with communities as a metering programme is implemented.

The report recommends that where it is cost effective, volumetric charging for water and wastewater should be implemented. This should be accompanied by robust educational campaigns to enable people to reduce water use.

1.4 CURRENT WATER METERING IN NEW ZEALAND

Some councils have already implemented universal water metering. These include Whangarei District, Auckland Council (Watercare),Tauranga City, Central Otago District, Carterton District, Nelson City; and Tasman District.

A number of other councils have implemented partial metering and volumetric charging and some have indicated that they intend to implement universal metering in their Long Term Plan. Councils that are currently considering or have made the decision to implement universal metering include Kapiti Coast, Marlborough District, Waikato District, Waipa District, and Western Bay of Plenty District.

This shows that the potential benefits of metering are being widely considered across New Zealand. As noted in the Local Government Infrastructure Efficiency Expert Advisory Group report, this should be considered where the introduction of universal metering has the potential to offset investment in additional water supply infrastructure.

2 METERING CASE STUDIES

2.1 NEW ZEALAND EXPERIENCE

Most councils in New Zealand employ some form of water metering and subsequent volumetric charging for water use. This section reviews the experience of some councils that have implemented universal water metering.

2.1.1 AUCKLAND

Auckland Council was formed in 2010 and combined seven councils into one. Watercare Services Ltd manages Auckland's water supply network. Universal water metering was introduced across most of Auckland in the 1980s and 1990s and wastewater charging based on water supply use has been introduced in recent years.

Figure 1 below shows how total water consumption has changed in Auckland over the last 40 years and how factors such as weather and the economic climate can affect water consumption as well as charging for water by volume. This shows that the overall demand for water has increased due to population growth, but the overall demand for water per capita has reduced and is now considered as the lowest in New Zealand. It is likely that other factors than metering alone affect this low level of demand.

Given the time since water metering was first introduced, it is difficult to separate the benefit of metering from other socio-economic effects. However, it is considered that water metering in Auckland does moderate demand. The effect of wastewater charging by volume is not yet understood. It will be interesting to understand how this affects the demand for water in the future, particularly with the high population growth expected in Auckland.

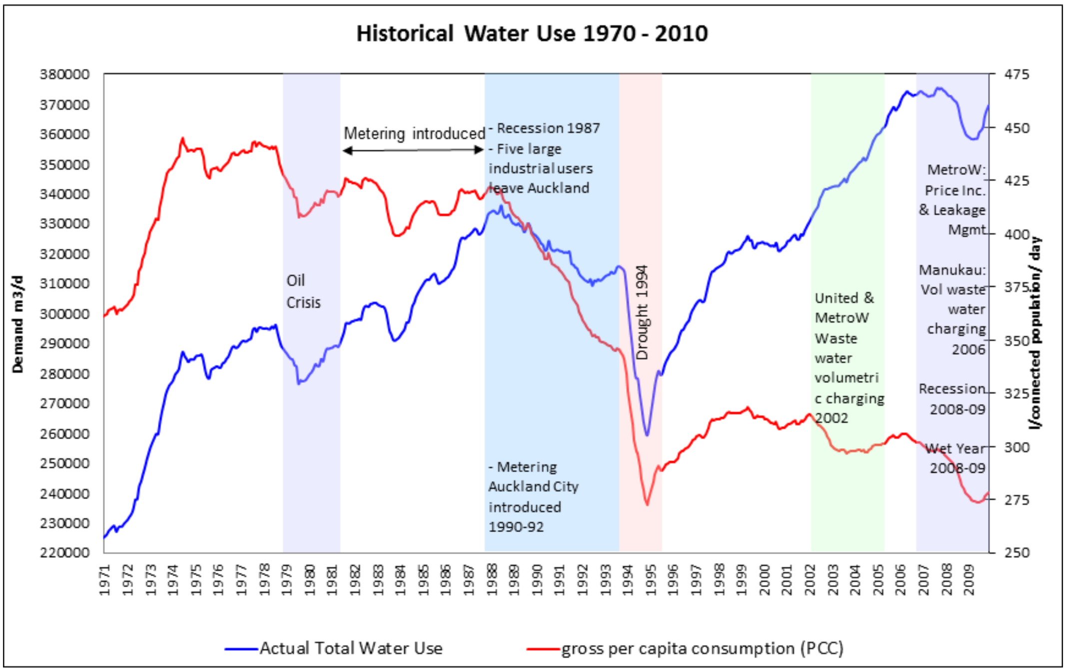

Figure 1 - Historical water use in Auckland from 1970 to 2010.

(Source: The Auckland Region's Water Supply: Past, Present and Future, 2010)

2.1.2 NELSON CITY COUNCIL

Nelson City Council (NCC) provides treated water to approximately 40,000 people. About 80% of the volume of water supplied is to residential customers with the remaining 20% supplied to commercial and industrial customers.

NCC installed meters from 1996 to 1999 and started charging from July 1999. NCC estimated that the introduction of universal metering has reduced peak water demand by 37% and their water usage is now quoted as being amongst the lowest in the country at 160L/person/day (residential metered demand). NCC does not typically impose seasonal water restrictions but has a drought management strategy which sets out certain drought scenarios when restrictions might be implemented. Early 2013 was the driest summer in many years for several parts of New Zealand. Although this resulted in very low stream and river levels in Nelson no water restrictions were required.

Universal metering was introduced to Nelson to address capacity issues within their network. Nelson is a popular tourist destination in summer and NCC found that although commercial usage was steady throughout the year, summer demands were twice those of winter demands. They concluded that this was due to unrestricted outdoor use of water and the increased population during summer. Without implementation of water demand management, NCC was faced with having to increase the capacity of the water supply by 100%, but only using the full capacity 10% of the time.

NCC estimates that the implementation of universal metering delayed the need for an additional water source for more than 50 years.

2.1.3 TAURANGA CITY COUNCIL

Tauranga City Council (TCC) provides treated water to approximately 110,000 people. The proportion of residential to commercial and industrial customers is similar to NCC, at 80:20 by volume.

Metering was introduced by TCC in response to the increased pressure on water treatment capacity and the supply network by growth in the region. Meters were installed on all water service connections from 1999 to 2001. TCC found that early political and community buy-in was crucial to the successful implementation of universal metering. As part of this, TCC introduced the Waterline programme which provides water awareness education to the community and a direct on-site water efficiency service to its residential customers. To raise awareness of their water consumption, customers were sent dummy invoices prior to being charged for their water use, which showed their water consumption, the water tariff and an indication of what they would be charged once formal billing was introduced. Actual billing began quarterly from July 2002.

The average residential water use was about 190 L/person/day in 2012/13. Figure 2 shows the average and peak daily demands before and after billing was introduced. The peak daily demand reduced by approximately 30% and the annual daily demand reduced by about 25%. Note that these are total demand figures (they include residential, commercial and industrial demand) and they have not been normalised to remove the effects of weather on peak demand. The graph also shows the water efficiency targets that TCC have set since 2002 and which have reduced over time. These targets have been successfully achieved and are regularly reviewed. This reduction in peak demand has delayed the need for the commissioning of TCC's third water source, from the Waiari Stream, from 2004 to 2021. This has resulted in large cost savings to TCC.

TCC does not typically employ seasonal water restrictions. As mentioned above, New Zealand recently experienced its driest summer in many years in early 2013 and TCC did not need to impose water restrictions during this period.

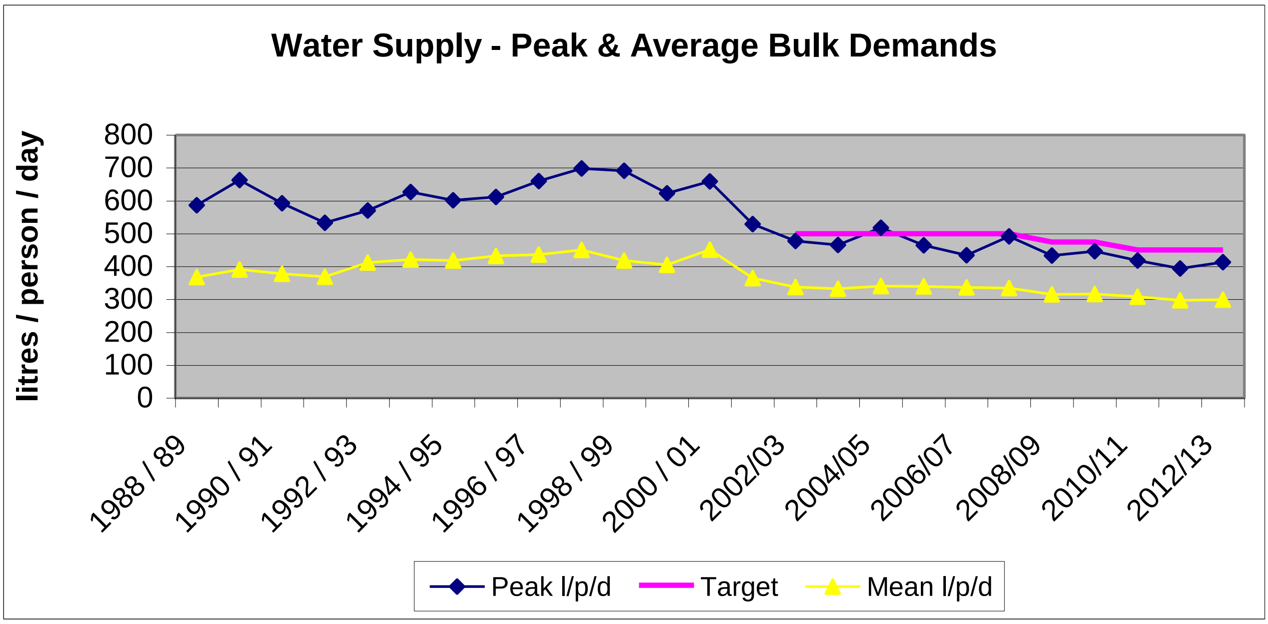

Figure 2- Reduction in Demand (L/person/d) resulting from implementation of Universal Water Metering (Source: Tauranga City Council)

2.1.4 WHANGAREI DISTRICT COUNCIL

Whangarei District Council (WDC) provides treated water to approximately 60,000 people. The proportion of residential to commercial and industrial customers is approximately 70:30 by volume. WDC has 179 of 25,000 connections which are classed as agricultural, horticultural or farming. There are a number of rural residential properties which are classified as domestic as their use patterns fall into this category.

Meters were introduced in the rural parts of Whangarei in the 1960s and in urban areas in the 1980s. WDC has volumetrically charged for water since meters were installed and cannot provide comment on the effects on consumption as it was so long ago.

Whangarei city has an annual demand of 17,000 m^3/day and a peak demand of about 22,000 m^3/day. The average residential water use is usually around 168 to 175 L/person/day.

Whangarei was also affected by the extremely dry summer in early 2013. Seasonal water restrictions were not required which may have been due to large rainfall events in December which filled the raw water storage dams. WDC has only employed water restrictions once in the last 17 years. This was a total sprinkler and hose ban for four weeks in April 2010 after a very dry and hot summer. Average residential use in 2012/13 was 173.5L/person/day.

2.2 INTERNATIONAL CASE STUDIES

This section reviews some case studies where water metering has been implemented overseas. The first is a smart metering case study from Australia. Here, most large urban areas are metered and extending this to smaller centres and rural areas is currently being considered. The second case study relates to the UK, where metering is currently in place for approximately one third of the population.

2.2.1 WIDE BAY WATER CORPORATION, AUSTRALIA

Wide Bay Water Corporation (WBWC) supplies water to over 60,000 people (with over 20,000 residential connections) in the Hervey Bay region of Australia. WBWC installed Automatic Meter Reading (AMR) water meters in all residential properties in 2006-2007. A third party review of the AMR installation was prepared by SMEC (2010).

The objectives of the project were to:

- Reduce customers' water use by a potential 20% to 25% by implementing Australia's first AMR system;
- Research a model for pricing reform, such as 'time of use' whereby water use at night is cheaper than water used during the day;
- Defer capital construction costs of trunk main infrastructure by reducing peak daily use; and
- Reduce residential water leakage.

Hervey Bay is a growth area, increasing at approximately 4% per annum and is one of the fastest growing areas of Australia. It was considered that AMR would offer a far superior level of detail over and above conventional meters and therefore enable a greater understanding of how water is used and then how it could be saved.

The system comprises:

- Elster water meters;
- Datamatic data loggers (Firefly); and
- Datamatic transceiver (Roadrunner).

The water meter is a standard meter that can be connected with a data logger. It is a rotary piston which rotates the counter as a set volume of water is displaced through the meter. The counter then displays cumulative volume.

The Datamatic firefly records water consumption every hour and can store up to 330 days of hourly data. The data is then collected through a transceiver, which in the WBWC case is effectively a field computer. This can either be hand held or fitted to a vehicle to enable drive-by reading. The main reason for choosing a drive by system rather than a wide area network was the reliability of the system as network systems were considered at risk of outage.

The Roadrunner sends a ‘handshake’ signal to the Firefly to request data download. The logger then transmits the data. The Firefly automatically transmits a ‘trickle’ alert if it has recorded consumption every hour, therefore indicating that there may be a leak present. Download times are approximately 10 seconds for a month’s data, or 90 to 120 days could take between 30 and 60 seconds.

The WBWC system was the first large scale implementation of AMR in the world. Some unforeseen events occurred which led to key lessons learnt, as follows.

- A pilot project was proposed for approximately 10% of the population. This was found to be difficult during the tender process due to the commitment required to develop a system for a small group. It was therefore decided to contract the entire 20,000 AMR system as one contract.

- A number of difficulties arose such as defective reed switches, issues with individual meter identity numbering and the need to synchronise the loggers to provide real time recorded data. One comment was that the tender documents could be prepared to pilot a first phase of installation to enable some of these issues to be resolved. Careful preparation of the tender documents is required.

- Contracting proved difficult where different suppliers were required to liaise with each other. The contract was let in two parts and liaison was required to resolve issues with regard to the computer system and database queries.

- Validation of the water meters was required to check that manual reads were the same as the AMR system. This identified a problem where 10% of the installed meters were not logging data correctly. These were replaced at the cost of the supplier / manufacturer.

- It was noted that the software was ‘off the shelf’ and many of the standard reports required modification to make sense.

Some of the key benefits of AMR relate to billing and providing customer advice. This particularly relates to identification of leakage and how WBWC can provide detailed information about water usage. Customers are impressed by this level of service and phone calls to query bills has reduced by approximately 75%.

The operations team now has a much better understanding of real water use in the network. The system can provide an aggregated hourly consumption figure for all customers within a Demand Management Area. Comparison with the bulk meter can then identify real losses, as opposed to apparent losses. The hourly data also provides much more information about losses and types of leaks expected based on the billing data. WBWC has set up a routine report after a billing cycle which issues letters to customers which suggests the potential leaks based on the data records. From the initial data presented it appears that toilets are responsible for a high proportion of indoor household leaks. Similarly, a more active approach to pressure management can be taken. By modulating the pressure within the losses from the system are reduced.

Overall, the benefits of the implementation of metering are difficult to quantify. A reduction in demand of approximately 20% was recorded, although this was due to a number of factors including increased water efficiency messages during a period of drought, which was then followed by a period of above average rainfall which would have served to reduce outdoor water use.

2.2.2 SOUTHERN WATER, UK

Approximately 35% of residential properties in the UK are now metered. Customers can opt for a water meter if they choose and water companies can implement a policy of requiring a water meter on change of occupancy. More recently, legislation was introduced to enable Water Companies in 'areas of water stress' to universally meter their customers.

National metering trials were carried out in the UK between 1989 and 1993. The largest trial was the Isle of Wight, where all 48,000 domestic properties were metered. Subsequent demand was monitored and compared with neighbouring Hampshire (Dovey and Rogers, 1993).

Over a four year period following metering, a 22% reduction in average demand occurred. This was attributed to three key types of saving, as follows:

- A reduction in discretionary use;
- A reduction in demand as a result of factors other than metering; and
- A reduction due to improved leakage control.

In comparison with neighbouring Hampshire, the rate of reduction in domestic demand was substantially greater. Metering led to a step change reduction in demand, following which demand remained reasonably static.

Metering also appeared to have an effect on peak demand. Hot summers occurred in both 1989-90 and 1995-96. The observed peak demands in the Isle of Wight were approximately 14% lower in 1995-96, after metering had taken place. In comparison Hampshire's peak demand was similar during both summer events.

Leakage reduction was important, with reduction occurring in both the Hampshire region and the Isle of Wight over the time period. More leakage reduction occurred in the Isle of Wight. Southern Water attributed a substantial part of this to the metering process, which identified leaking stopcocks, communication pipes and supply pipes during meter installation.

Recently, Southern Water was identified as an 'area of water stress' and took a decision to universally meter the remainder of its customer base of approximately 2 million people. This is the first large scale programme of metering to be undertaken in the UK. The scheme is being promoted as saving customers' water, energy and therefore money. In conjunction with the metering programme, Southern Water is providing customers with more information about how to save water and bills will feature a section which compares water use against an average, therefore guiding customers about how efficient they are.

The universal metering programme will be complete in 2015 and it is expected that more information about the benefits of water metering will then be made available.

2.3 SUMMARY OF CASE STUDIES

The case studies described above apply mainly to urban water supplies which serve populations of at least 40,000 people. All water supplies experienced a reduction in average and peak demand with the introduction of universal water metering. The Southern Water case study demonstrated a reduction in demand compared to a control area nearby.

The reasons for reduced demand are complex and include reduced water use together with improved leakage management. Some examples highlight the need for very careful planning when implementing universal metering, and widespread public consultation during the process. This includes, for example, the provision of dummy invoices which enable customers to understand their water use and take action to reduce it prior to being charged by volume.

The case studies show that the benefits of charging for water volumetrically can significantly delay the high capital costs associated with consenting new water sources and building new infrastructure; and also remove or reduce the need to employ seasonal water restrictions. This was a key recommendation from the Infrastructure

Efficiency Advisory Group (2013); where water metering can reduce demand to a level that offsets the need for resource development this should be implemented to save money.

There is only one case study of smart metering, from Australia. This identified a number of operational benefits and improved leakage management. The programme was considered to contribute to a 20% reduction in average water demand.

3 TARIFF STRUCTURES

There are several costs which must be considered when introducing water metering and selecting a tariff structure. The most obvious are the capital and operational costs of physically supplying water to consumers. Other costs which can be easily overlooked are the costs of locating and separating water connections (e.g. cross lease properties), the additional administration costs of water meter reading and billing, water use education and the ongoing renewal of a relatively short life asset, i.e. typically 10 to 20 years for meters.

This section outlines the different tariff structures available to councils and summarises examples of tariff structures that are in place in a number of different councils across New Zealand.

3.1 LEGISLATIVE CONTEXT

The majority of councils set their water tariffs under the Local Government (Rating Act) 2002 ('the Act') which allows councils to set charges as rates and recover any unpaid rates. The powers of recovery are not available to councils for charges set outside this Act.

Section 16 of the Act allows councils to set targeted rates for activities or groups of activities as identified in their funding impact statement. The targeted rate may be applied to all land or different rates applied to different categories of rateable land. An example of this is a fixed uniform annual charge for water supply or wastewater.

Section 19 of the Act specifically addresses the rating of water supply. This section allows councils to charge for water supply as a fixed charge per unit of water consumed or supplied; or according to a scale of charges, e.g. stepped charges based on consumption.

Sections 57 and 58 of the Act allows councils to impose a penalty of up to 10% on unpaid rates. This intention to impose a penalty must be carried out under resolution prior to the date when rates are set and must state how the penalty is calculated and the date as to when it will be applied.

Charging for the treatment and disposal of wastewater by volume is also possible, and was first introduced in parts of Auckland in the early 2000s. More recently, the wastewater tariff was applied universally across the city. Wastewater charging is therefore an option for councils to use, although some form of customer agreement or charter may also be required. As the wastewater charge will be directly linked to water consumption, any demand savings that customers make results in a double benefit through reduced water and wastewater charges. The effect of wastewater charging in Auckland is yet to be understood.

Note that this section is based on the authors' views and legal opinion should be sought by Councils seeking to implement new water and wastewater tariffs.

3.2 EXAMPLES OF NZ TARIFF STRUCTURES

A summary of typical types of tariff structure is shown in Table 3.1. Auckland's Watercare residential customers with water meters are also charged a wastewater fixed charge of $190 and a volumetric charge $2.28/m^3 on 78.5% of water supplied. The wastewater charge assumes that 78.5% of water supplied to a property is then discharged via the wastewater system.

Nelson City Council charges a stepped tariff structure where the unit charge decreases with consumption. Nelson City Council also imposes a 10% penalty on all water rates which remain unpaid on the last day for payment. As can be seen from Table 3.1, the volumetric charge reduces as consumption increases. This is contrary to a demand management focused tariff whereby the costs would increase with higher consumption to reward efficient use. The steps are also very high, with the first step at 10,000 m^3 per annum, which is more than

50 times what a normal household would expect to use in a year. The tariff is therefore focused on commercial or industrial consumers with high demands.

Tauranga City Council originally anticipated only a 15% reduction in water consumption with the introduction of volumetric charging. As a very high proportion of its water revenue is based on volume, initially Tauranga City Council found that with a 25% reduction in average demand that it was not recovering the full cost of producing water (including the increased operational costs of maintaining and reading water meters).

Table 3.1: Current tariff structures in New Zealand

Council	**Fixed charge per annum (incl. GST)**	**Variable charge per annum (incl. GST)**
Auckland (Watercare)	None	*$1.343/m^3
Nelson	$191.42	$1.968/m^3 for supply up to 10,000 m^3 $1.504/m^3 for supply 10,001 to 100,000 m^3 $1.188/m^3 for supply over 100,000 m^3
**Tasman	$32.04	$1.76/m^3
Tauranga	*$27.00	$1.73/m^3
Whangarei	$29.00	$2.08/m^3

* Residential tariff only   ** Urban supply area

3.3 IMPLICATIONS OF TARIFF STRUCTURES ON WATER USE

Nelson has a substantial fixed charge and then a volumetric rate. Tasman, Tauranga and Whangarei all have significantly lower fixed annual charges and Auckland has no fixed charge at all. The volumetric charges vary across councils but all are below or around $2/m^3.

It is important to balance the proportion of fixed to variable costs as this sends a clear message to customers about how they value water. The combination of a high fixed charge and low volumetric rate minimises the incentive to save water, although it does maximise the certainty of revenue to councils. Alternatively, a low (or no) fixed charge and high volumetric rate provides a higher incentive to customers to reduce water use. This may have repercussions as TCC found when it introduced metering and water use reduced more than expected. As a result they were unable to recover the whole cost of supplying water to their customers.

Councils should also consider the demographics of their communities and their ability to pay when selecting a tariff structure. Kapiti Coast District Council is currently implementing universal metering with the first billing round anticipated in 2014.

In 2011, Kapiti Coast District Council appointed a Charging Regime Advisory Group to recommend a water charging formula for water by meter tariff rates. In its 2012 report "Report to Kapiti Coast District Council on a Recommended Water Charging Formula," the Group provided recommendations on a suitable tariff structure, how to introduce charging, providing water conservation education to different community sectors; and monitoring the effects on low income households. The report recommended a 50% fixed charge and 50% volumetric charge as the most fair and equitable for communities on the Kapiti Coast. However, this may not fully incentivise customers to save water.

3.4 BILLING PERIODS

Another important factor to consider when introducing charging for water by meter is how often customers will be billed for this service. The more frequent the billing period, the more likely users are to be aware of their water use and can pay smaller amounts for water as it is used rather than receive a larger bill for a six to twelve month period. Frequent billing enable leaks to be identified soon after they occur. On the contrary, there is a risk that when receiving small, frequent bills, customers perceive water supplies as more affordable and do not respond to water efficiency messages.

It can be more costly for a water supplier to read a meter and bill more frequently. Gas and power utilities often work together to have their meters read at the same time, which could possibly be extended to water meters. These industries also tend to use other billing options, for example where the meter is read every second month but billed monthly. The introduction of paperless billing where bills are emailed can be more cost effective than posting bills.

The implementation of smart meters would enable more frequent billing. This would depend on how data is downloaded, but the efficiencies provided should permit more frequent billing and therefore better information being provided to consumers.

4 DISCUSSION

This paper has reviewed a number of different metering case studies from across New Zealand, Australia and the UK. Metering is expected to become more widespread within New Zealand, as the potential water savings can make the overall water supply system more efficient. All of the case studies reviewed found it difficult to clearly identify the exact savings attributable to metering. However, all councils and water companies did identify a reduction in water use. This was expected to be as a result of a number of factors but demonstrates the level of savings that can be achieved.

Importantly, metering tends to mostly reduce peak (summer) demand by reducing discretionary water use. Peak demands can be costly for councils to supply, as it requires the development of new sources to meet demand for short periods of time. Meeting peak demand may require the development of new sources or the upgrading of existing infrastructure. Where the application of metering is able to reduce peak demand, this can be cost effective as it offsets the requirement for new sources and makes best use of existing infrastructure.

Metering should not be an end in itself. It is a costly exercise and requires significant time and resources from councils to be implemented successfully. Where this has proved most useful in the past is where councils are faced with high costs to implement new water resource schemes to meet increasing demand. Reducing demand by metering can reduce demand and offset the need for water resource development, as experienced by both Tauranga and Nelson City Councils.

There are costs associated with metering and these need to be carefully considered, particularly for smaller councils in New Zealand. There may be options to reduce some of these costs for example by implementing a shared metering programme with other nearby councils. This would have a number of benefits which could make the programme more efficient. These include bundling installation contracts to obtain efficiencies of scale from contractors and suppliers, together with longer term operational savings for meter reading and billing. Also, promotional messages about water efficiency and metering could be spread across a wider geographical area, potentially creating a more communal response to reduce water use.

In the future new technology could change how metering is implemented dramatically. We have reported one case study of universal smart metering in Australia; this is expected to become more common as this technology advances and implementation costs reduce. Smart metering connected to the internet will enable information to be sent directly to consumers. This technology would also improve the identification of leaks and enable them to be identified and fixed very quickly. Smart metering is used very effectively for large, generally commercial, consumers in Australia and New Zealand. The business case is being further explored by a number of Councils for application in the domestic metering market as the technology advances.

These technologies will only be effective at reducing water use if there is a real benefit to customers. As can be seen, the range of tariffs applied across New Zealand is broad, with a combination of fixed and volumetric components. To be effective at reducing demand, more complex tariffs should be considered which reward efficient use. As in Auckland, volumetric charging of wastewater may be one way to further incentivise reduced water use.

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