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Cost Reflective Pricing Study

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Executive Summary

Cost based pricing in the water industry has had increased attention in recent years due to corporatisation, economic reform and, to a lesser degree, competition. This study aims to develop a cost reflective pricing methodology for an integrated urban water supply system (based on an actual system). It examines the practical application of this methodology and analyses the impact on actual customers.

Several scenarios are examined to reflect the alternate methodologies that might be applied if regulators, major customers or the utility were to seek cost based pricing.

Utility pricing decisions are based on a number of sometimes conflicting objectives, including economic efficiency, social obligations, customer perception and ease of administration. These objectives are viewed with different levels of importance by utilities depending on the environment within which they operate. This study, however, is primarily concerned with the economic objective and reflecting the cost of service provision in the price to the consumer.

The pricing system has been modelled based on an actual Australian urban water supply system. The results have been modified, however, to represent other Australian utilities more generally and to protect the commercial confidentiality of the utility supplying the information. The scheme includes three metropolitan regions and two remote towns (one 60km and the other 100km from the metropolitan area).

Cost drivers

For the modelled scheme, the study found that pipelines accounted for the majority of asset costs (around 70%), with sources, pump stations, tanks and treatment accounting for a further 20%. The remainder was composed of miscellaneous expenditure such as computers, buildings, land and meters. Asset costs, as a whole, represented approximately 70% of the total costs to the organisation (based on an indicative industry cost of capital of 7%).

Operating costs were comprised of labour, energy, chemicals, materials and other services, although no one category was dominant.

In summary, the major drivers of cost in the modelled system were:

- Bulkwater distribution mains – location and peak daily to monthly usage,
- Local mains – location, density, peak instantaneous usage,
- Dams – annual consumption,
- Bores – peak weekly to monthly usage,
- Source trunk mains – consumption, peak weekly to monthly usage,
- Treatment – peak weekly to monthly usage,
- Labour – local asset condition, length of mains,
- Energy and chemicals – consumption, and
- Support – direct expenditure, number of customers

Scenarios

Two methods of developing a cost reflective pricing framework include the *economic price signal approach* and *the proportional distribution approach*.

Economic price signals: Sending efficient economic price signals requires linking changes in customer behaviour to actual changes in cost. This effectively means that most consumption, peak, developer, locational and other differential charges are based on future expenditure and requires recognition of past investments as sunk. Sunk costs and costs that do not change with changes in customer behaviour (such as some overheads) are reflected in a fixed charge that is applied in a manner that least distorts consumer behaviour. This has the effect of providing a true signal regarding the change in costs the utility will experience as a result of changes in customer behaviour. (The exception to this is where cost reflective prices have been set in the past and now act to control demand.)

Proportional distribution: This methodology distributes costs to customers regardless of when or why the asset was constructed. Under this framework, existing assets are allocated to users based on their proportional usage of the asset (based on the appropriate cost driver, such as annual consumption, peak usage, etc). This methodology has the advantages of being intuitively understood by customers, comparatively easy to calculate (compared to the efficient pricing signal approach) and may be seen as an "equitable" distribution of sunk costs. For these reasons it may be favoured by regulators of an access regime.

To represent the range of results these approaches can provide, four scenarios have been developed. These include both the economic price signal approach (Scenarios One to Three) and the proportional distribution approach (Scenario Four).

Scenario One: Economic pricing for a new development on the outskirts of an existing scheme. The development uses a combination of existing assets and new assets.

Scenario Two: Economic pricing for a developed area within an existing scheme. The development primarily relies on existing assets.

Scenario Three: Economic pricing for a new scheme. The development relies exclusively on newly constructed assets. This approach also closely reflects the proportional distribution of assets within an existing scheme.

Scenario Four: Existing assets are apportioned to consumers on the basis of usage, and customers pay a capacity charge for a defined peak requirement.

Results

A summary of the results is presented in the tables below.

Efficient Pricing Approach

Location	Off Peak	On Peak	Fixed Annual Charge per Customer*	Developer
	(Mar to Dec)	(Jan to Feb)		Charge
	Per kL	Per kL		Per kL/day
Scenario One				
Metro Areas	0.34 - 0.36	1.28 - 1.75	128	170-274
Towns	0.42 - 0.43	2.63 - 3.87	128	877-1,936
Scenario Two				
Metro Areas	0.34 - 0.36	0.79 - 0.82	273	NA
Towns	0.42 - 0.43	1.98 - 3.43	273	NA
Scenario Three				
Metro Areas	0.34 - 0.36	2.04 - 2.72	2	612-1,177
Towns	0.42 - 0.43	3.51 - 5.46	2	1,442-3,150

Proportional distribution of costs

Location	Consumption Per kL	Fixed Annual Charge Per Customer*	Annual Capacity Charge Per kL/day
Metro Areas	0.29 - 0.30	55	106 - 150
Towns	0.37 - 0.38	55	164 - 329

* The fixed annual charge may be varied between customers based on the size and administrative requirements of servicing the customer. Major customers may have a significantly higher fixed charge based on higher business development, customer account management and legal requirements.

Incidence Analysis

Cost reflective pricing based on the modelled scheme would produce a significant shift in charges from the central metropolitan area to the non-metropolitan towns and areas supplied by the scheme. A “typical” metropolitan residential customer would see a drop in total charges of around 30%, while non-metropolitan areas would see an average increase of 30-50% under most of the proposed scenarios.

In addition, residential customers would see an increase in their annual bill due to peak charging, while commercial customers with relatively low peaks would see an additional fall of around 20%.

The peak charge would increase the average annual bill to most customers, although the upfront developer charge and fixed annual charge would be significantly lower.

Conclusion

Implementing cost based prices in the modelled scheme would require a major change in charges and a significant re-balancing between fixed, volumetric and developer charges.

In general, the costs of servicing individual customers will vary according to:

- location,
- peaking factors, and
- total volume consumed.

Economic prices require variable charges to reflect the change in cost to the utility as a result of changes in demand. That is, prices should reflect the future costs required rather than costs already incurred (sunk costs). A clear economic signal about the cost of servicing the customer is not reflected by a proportional distribution of existing assets, although this approach is simpler and may avoid significant price shocks for some customers.

While opportunities will exist for some customers to reduce their charges under a cost reflective pricing system, the increase to some customers may be of concern to Government. However, without cost reflective prices, competition could result in “cherry picking” in overpriced areas with no corresponding reduction in costs to the utility.

Peak pricing does lead to significant price differentials between customers. However, a surprising result was that, due the economies of scale in laying large mains and the minimum sizing for firefighting requirements, the savings from peak pricing were significantly less than anticipated[1].

While the results of this exercise were specific to the scheme examined, the model and cost driver methodology are transferable to other areas but require the use of local cost and demand data.

[1] While peak prices appear high in some instances, they reflect a relatively small volume of consumption and therefore a correspondingly low cost.

1. Introduction

Cost based pricing in the water industry has had increased attention in recent years due to corporatisation, economic reform and, to a lesser degree, competition. This study aims to develop a cost reflective pricing methodology for an integrated urban water supply system (based on an actual system). It examines the practical application of this methodology and analyses the impact on actual customers.

Several scenarios are examined to reflect the alternate methodologies that might be applied if regulators, major customers or the utility were to seek cost based pricing.

2. Pricing Objectives

Utility pricing decisions are based on a number of sometimes conflicting objectives, including:

- economic efficiency,
- fulfilling social obligations,
- maintaining adequate levels of revenue,
- managing customer perceptions of equity and value for money,
- ease of administration,
- price stability over time, and
- avoiding “cherry picking”.

These objectives are viewed with different levels of importance by utilities depending on the environment within which they operate. This study, however, is primarily concerned with the economic objective and reflecting the cost of service provision in the price to the consumer.

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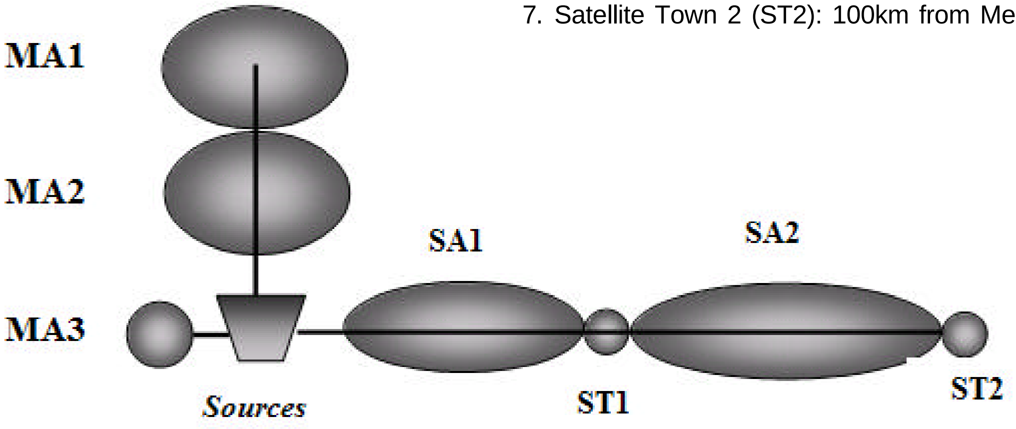
3. Modelled Urban Water Supply System

The pricing system has been modelled based on an actual Australian urban water supply system. The results have been modified, however, to represent other Australian utilities more generally and to protect the commercial confidentiality of the utility supplying the information.

The scheme is represented diagrammatically below:



The scheme is divided into 7 locations:

1. Metropolitan Area 1 (MA1)
2. Metropolitan Area 2 (MA2)
3. Metropolitan Area 3 (MA3)
4. Satellite Area 1 (SA1): Includes small towns and rural areas
5. Satellite Town 1 (ST1): 60 km from Metropolitan Area
6. Satellite Area 2 (SA2): Includes small towns and rural areas
7. Satellite Town 2 (ST2): 100km from Metropolitan Area

4. Cost drivers

After examining detailed asset and operating cost information, the project team established that the utilities costs were broken into the following categories:

Capital

Pipelines	70%
Sources, pump stations, tanks, treatment	20%
Miscellaneous: Including computers,	
buildings, land, meters etc	10%

Operating

Labour	25%
Energy	25%
Chemicals and materials	15%
Other (incl external services)	35%

Capital costs represented approximately 70% of the organisation's total costs (based on an indicative industry cost of capital of 7%), while operating and support costs form the remaining 30%.

The cost drivers of the most influential costs were then examined individually, as detailed below. It should be noted that cost drivers will be specific to each scheme and should be reviewed for those circumstances.

Capital Costs

A full listing of cost drivers is detailed in Appendix One, however the main drivers are described in more detail below.

Bulkwater Distribution Mains

The cost of large trunk mains is predominantly determined by the distance between sources and consumers. For the modelled scheme, existing sources are substantially at capacity and increasing consumption will require the development of sources increasingly further from the metropolitan area.

In addition, the cost is also determined by the capacity of the storage into which the trunk main feeds. As this is typically between one day and one month's storage, the mains will be sized for corresponding peak usage. Due to the economies of scale in laying pipe, the cost does not increase proportionally with peak requirements.

Local Mains

Within urban areas, the cost of local street pipes is predominantly determined by density, lot frontage and peak instantaneous requirements. Housing density and lot frontage affects the length of main required for each lot while peak instantaneous requirements will determine the size of pipe required. However, due to the economies of scale in laying pipe, the cost does not increase proportionally with peak requirements.

The cost of larger distribution pipes will be affected by the distance from the feed source (eg trunk mains) rather than specific lot frontages.

Source Assets

The modelled scheme contains a combination of dams and borefields.

The predominant driver of dams is annual consumption, while the number of bores required is driven by peak usage – often between peak week and peak month depending on the storage available. However, the annual extraction available from both borefields and dams is limited by the sustainable annual yield. Therefore, higher levels of annual consumption require the development of new sources further afield, which in turn affects the length of trunk mains required to transport that water. (Based on a long run forecast of costs for the system modelled, new trunk mains have been estimated to cost approximately 50% more than existing mains.)

The cost of trunk mains will also be affected by peak and seasonal use, depending on available storage.

Treatment

The downstream storage will determine the exposure of the system to peak usage, which in turn will affect the scale of the plant required. In general this will be between peak week and peak month requirements.

Customer and regulatory requirements (such as National Health and Medical Research Centre guidelines), and the quality of available sources will ultimately determine the cost of treatment. Common forms of treatment include disinfection, fluoridation and iron removal. However, as these requirements are applied system wide and cannot be modified for individual customers, the pricing system distributes the costs involved based on the relevant cost drivers (for example, peak usage for capital components and annual consumption for chemicals).

Operation and Maintenance Costs

Labour

Labour cost is incurred for water monitoring and maintenance. The major cost drivers are asset condition, length of main per service, and remoteness. In the modelled scheme, labour costs are essentially fixed, although may be allocated to specific locations.

Energy

Energy is an operating cost predominantly associated with pumping. In general, it is proportional to consumption, although there may be variations in costs associated with the tariff structure of the electricity utility.

Chemicals

The cost of chemicals is also related to the volume of water consumed. In addition, the type of source and the quality of water determine the extent of the chemicals required.

Support Costs

Support costs can be separated into the major sub-categories of operational and non-operational support. Operational support will generally be driven by the level of activity and therefore (simplistically) by the level of expenditure incurred by each scheme. Non-operational support (such as customer service) may be related to drivers such as the number of customers in each scheme.

SUMMARY

In summary, the major cost drivers include:

Bulkwater distribution mains – location and peak daily to monthly usage

Local mains – location, density, peak instantaneous usage

Dams – annual consumption

Bores – peak weekly to monthly usage

Source trunk mains – consumption, peak weekly to monthly usage

Treatment – peak weekly to monthly usage

Labour – local asset condition, length of mains

Energy and chemicals – consumption

Support – direct expenditure, number of customers

5. Scenarios

Two methods of developing a cost reflective pricing framework include the proportional distribution approach *and the* economic price signal approach.

Proportional distribution: This methodology distributes costs to customers regardless of when or why the asset was constructed. Under this framework, existing assets are allocated to users based on their proportional usage of the asset (based on the appropriate cost driver, such as annual consumption, peak usage, etc). This methodology has the advantages of being intuitively understood by customers, comparatively easy to calculate (compared to the efficient pricing signal approach) and may be seen as an "equitable" distribution of sunk costs. For these reasons it may be favoured by regulators of an access regime.

Economic price signals: Sending efficient economic price signals requires linking changes in customer behaviour to actual changes in cost. This effectively means that most consumption, peak, developer, locational and other differential charges are based on future expenditure and requires recognition of past investments as sunk. Sunk costs and costs that do not change with changes in customer behaviour (such as some overheads) are reflected in a fixed charge that is applied in a manner that least distorts consumer behaviour. This has the effect of providing a true signal regarding the change in costs the utility will experience as result of changes in customer behaviour. (The exception to this is where cost reflective prices have been set in the past and now act to control demand.)

To represent the range of results these approaches can provide, four scenarios have been developed. These include both the economic price signal approach (Scenarios One to Three) and the proportional distribution approach (Scenario Four).

Scenario One: This scenario assumes the economic price signal approach will be applied to a new development occurring on the outskirts of an established scheme.

Scenario Two: Similar to Scenario One, except the pricing relates to existing consumers within an established scheme. In this case, many assets (particularly pipework) have already been installed to meet long term demand, and changes in customer behaviour will have a lesser impact on costs than the other scenarios (hence the variable charges are correspondingly lower and fixed charge higher).

Scenario Three: This scenario represents an entirely new scheme. As no assets have yet been constructed in this scenario, all costs are considered marginal. This scenario will therefore present the highest variable charges and lowest fixed charge. As all asset costs are marginal and therefore fully distributed based on usage, this approach also closely reflects the proportional distribution approach for an existing scheme.

Scenario Four: The final scenario allocates costs based on usage. For assets related to peak usage, an annual capacity charge is applied and for assets and operating costs related to consumption a volumetric charge is applied. The predominant difference between this and the previous scenario is the access style arrangement of paying a fixed fee for a defined peak requirement.

6. Pricing Framework

Appendix Two presents a diagrammatic representation of the proposed pricing system for Scenarios One to Three (the economic price approach). The total revenue recovered by the system is composed of variable charges (annual consumption, peak consumption and developer charges) and fixed annual charges. The variable charges relate to long run marginal costs that may be influenced by changes in customer behaviour. The fixed charge comprises the balance to achieve revenue neutrality between the existing and proposed system.

The **variable charges** are divided between:

Annual consumption charges – annual consumption drives the cost of dams, source trunk mains and direct operating costs such as energy and chemicals. To reflect the long run marginal cost, the present value of future expenditure has been divided by the present value of volumes to produce a cost per kilolitre.

Peak charges – these relate to the long run marginal cost of “adding” capacity to supply peak requirements. Strictly speaking, various asset groups are affected by different peaks (from peak instantaneous to peak month), but to avoid a myriad of charges only the most influential peak – peak summer use (January and February) – has been used as the basis for charging consumers. To calculate these charges the long run marginal cost of increasing the capacity of bores, pipelines, pump stations, treatment plants and storages is divided by the present value of the corresponding additional January/February consumption.

In many cases the economies of scale in laying large mains and the minimum size for firefighting requirements can result in a relatively low cost of meeting peak demand. However, larger savings could be anticipated in jurisdictions where outdoor demand is more responsive to price changes. That is, where demand is more elastic.

For more detail on calculating peak charges see Appendix Three.

Developer charges – most costs, other than pipelines, are upgraded in stages and the long run marginal cost can therefore generally be influenced by consumers. Pipelines, on the other hand, are generally sized for ultimate capacity and therefore are relatively unaffected by annual variations in consumer behaviour. As an important pricing signal to the developer about the unavoidable cost of developing in a particular location, the developer charge has therefore been determined based on the present value cost of pipeline assets (for all demand other than the January-February peak) divided by the present value of peak day demand.

For more detail on calculating developer charges see Appendix Four.

Reticulation – small pipelines within a developers’ land boundary are most easily designed and constructed by the developer. Funding the reticulation works also provides the developer with the most immediate pricing signal. For this exercise, almost all of the cost of reticulation is borne by the developer, apart from a very small percentage (less than 1%) related to peak costs (see Appendix Three), which is incorporated in the peak summer charge.

The **fixed annual charge** is the final balancing charge, which accounts for maintenance, support and sunk costs and is adjusted to achieve overall revenue neutrality.

For **Scenario Four** (the proportional distribution approach) the charges are derived from a proportional distribution of expenditure based on usage. As such the charges include a consumption charge, a fixed annual charge and the cost of reticulation.

Annual consumption charges - based on the annualised cost of existing dams, source trunk mains and operating expenditure divided by total annual consumption.

Fixed annual charge - based on administrative and other fixed annual costs.

6. Pricing Framework

Continued

Capacity charge - based on peak capacity requirements and calculated as the cost of peak driven assets (such as distribution mains, pump stations and short term storage) divided by the total capacity of the system in each area (to reflect a typical access arrangement this charge encompasses the costs of both the developer charge and the peak charge of the previous scenarios). This charge may either be levied as an annual or upfront charge.

Reticulation - based on cost of reticulation divided by the capacity (in most access arrangements, this will be redundant as the customer will provide their own reticulation).

In summary, the items included within each charge are:

Annual Consumption Charge	Peak Summer Charge (Scenario 1 to 3)	Developer Charge (Scenario 1 to 3)	Capacity Charge (Scenario 4)	Reticulation	Fixed Annual Charge
Dams and source trunk mains	Distribution and local mains - peak component	Distribution mains - "base" component	Distribution mains	Local mains - "base" component	Maintenance
Energy	Bores		Bores		Support costs
Chemicals	Pump Stations, Storage, Treatment Plants		Pump Stations, Storage, Treatment Plants		"Balancing" charge

7. Cost Distribution

After assigning assets and operating costs to either annual consumption, peak summer, developer or reticulation charges, the costs are then allocated to specific locations by further categorising assets into “source”, “distribution” or “local”.

Source assets are dams and borefields required to serve all locations within the integrated scheme. Costs associated with source assets are therefore borne equally by all customers, based on their annual consumption and peak requirements.

Distribution assets are those required to transport water between locations. While pipelines are the assets that traverse the distance between one location and another, other assets such as pump stations and tanks are also required to supply multiple locations.

Assets such as pump stations that are required to serve more than one location, will be apportioned to only those customers served by the asset (based on the aggregate of annual consumption or peak requirements - see those drivers for more detail).

Depending on the utility’s asset information system, identifiable pipelines segments may be as small as a few metres or as large as several kilometres. The most accurate approach to allocating pipelines will be the apportionment of individual segments of pipe to all “downstream” customers. However, for long mains with a large number of customers this can be time consuming and resource hungry. A simplified method of allocation assumes that a customer located two kilometres along a segment of main is allocated twice the cost per peak kilolitre of a customer located only one kilometre along the main (this is a simplification, as strictly speaking the size of the main does not diminish in direct proportion to demand). Therefore, multiplying the distance by the peak requirement of each customer will give a total number of “kilolitre-kilometres”, which may then be used to apportion the cost of the segment of pipe to individual customers.

For example, three customers located at one kilometre intervals along a segment of pipe, requiring even flows of 4 kilolitres per day, 2 kilolitres per day and 3 kilolitres per day respectively would be allocated the cost of the pipeline based on:

Customer 1 = 1 km * 4 kL = 4 kLkm

Customer 2 = 2 km * 2 kL = 4 kLkm

Customer 3 = 3 km * 3 kL = 9 kLkm

Total = 17 kLkm

Therefore the cost of the pipeline, $Z, would be distributed as:

Customer 1 = $Z * 4 / 17
Customer 2 = $Z * 4 / 17

Customer 3 = $Z * 9 / 17

This methodology can also be simplified to accommodate groups of customers (eg all customers within a town or farmland area).

Local assets include all assets dedicated to serving only one location. These may include local pipes, pump stations, tanks, reservoirs or even local dams. These assets will be apportioned (according to the relevant cost driver) over only those customers in the relevant location.

8. Results

Applying the methodology in this paper to the (modified) scheme results in the prices detailed in the tables below.

Scenario One: Existing scheme, new development, economic price approach

Location	Off peak (Mar to Dec) Per kL	On peak (Jan to Feb) Per kL	Fixed annual Charge Per customer1	Developer Charge Per kL/day	Average Reticulation Per kL/day
Metro Area 1	0.34	1.4	128	274	1,308
Metro Area 2	0.34	1.28	128	170	1,393
Metro Area 3	0.36	1.75	128	273	2,885
Satellite Area 1	0.56	4.22	128	931	7,414
Satellite Town 1	0.42	2.63	128	877	3,127
Satellite Area 2	0.59	3.46	128	1,531	1,407
Satellite Town 2	0.43	3.87	128	1,936	1,169

Scenario Two: Existing scheme, existing consumer, economic price approach

Location	Off peak (Mar to Dec) Per kL	On peak (Jan to Feb) Per kL	Fixed annual Charge Per customer1	Developer Charge Per kL/day	Average Reticulation Per kL/day
Metro Area 1	0.34	0.79	273	NA	NA
Metro Area 2	0.34	0.79	273	NA	NA
Metro Area 3	0.36	0.82	273	NA	NA
Satellite Area 1	0.56	1.64	273	NA	NA
Satellite Town 1	0.42	1.98	273	NA	NA
Satellite Area 2	0.59	2.89	273	NA	NA
Satellite Town 2	0.43	3.43	273	NA	NA

Scenario Three: New scheme, economic price approach / proportional distribution

Location	Off peak (Mar to Dec) Per kL	On peak (Jan to Feb) Per kL	Fixed annual Charge Per customer1,2	Developer Charge Per kL/day	Average Reticulation Per kL/day
Metro Area 1	0.34	2.72	2	1,177	1,432
Metro Area 2	0.34	2.04	2	612	1,525
Metro Area 3	0.36	2.59	2	845	3,157
Satellite Area 1	0.56	7.53	2	3,294	8,114
Satellite Town 1	0.42	3.51	2	1,442	3,423
Satellite Area 2	0.59	4.85	2	2,632	1,540
Satellite Town 2	0.43	5.46	2	3,150	1,279

Scenario Four: Proportional distribution of costs, capacity charge

Location	Consumption per kL	Fixed annual Charge Per Customer1	Annual capacity charge Per kL/day	Average Reticulation per kL/day
Metro Area 1	0.29	55	148	1,447
Metro Area 2	0.29	55	106	1,541
Metro Area 3	0.3	55	150	3,191
Satellite Area 1	0.51	55	420	8,201
Satellite Town 1	0.37	55	164	3,459
Satellite Area 2	0.54	55	290	1,556
Satellite Town 2	0.38	55	329	1,293

Notes

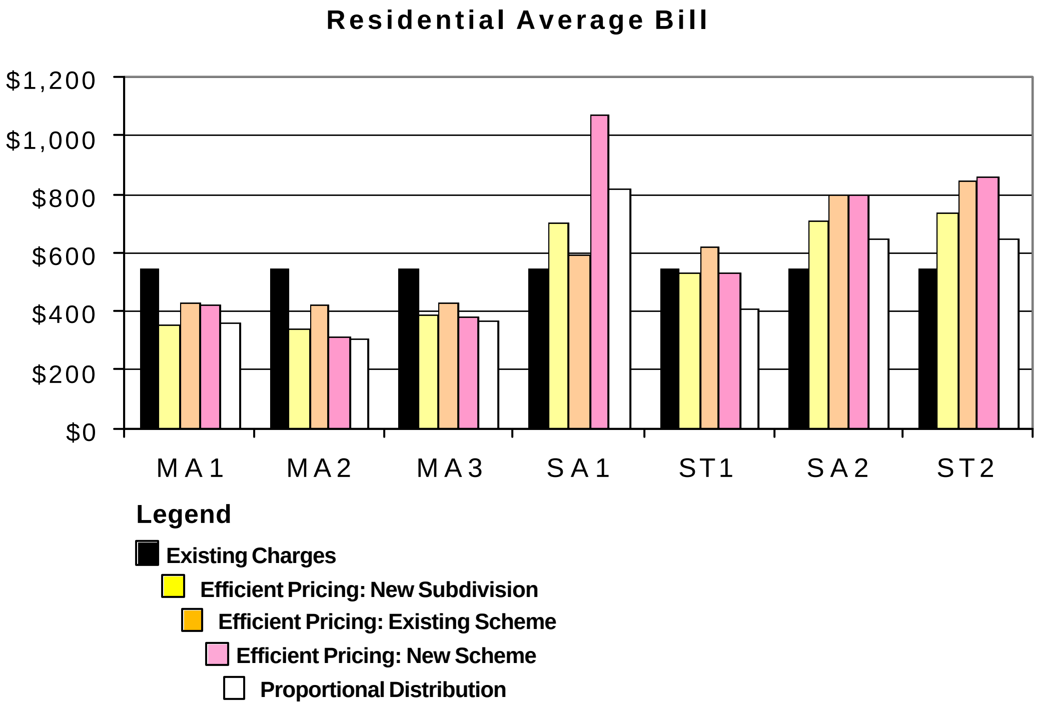
1. The fixed annual charge may be varied between customers based on size and the administrative requirements of servicing the customer. Major customers may have a significantly higher fixed charge based on higher business development, customer account management and legal requirements.
2. In practice a fixed charge of $2 may be rounded to zero and applied elsewhere.

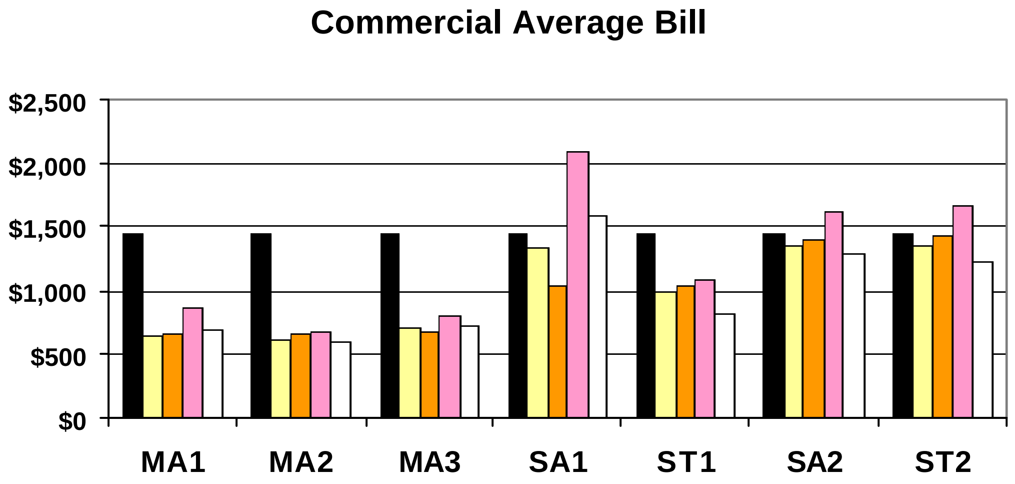
9. Incidence Analysis

Due to the existing policy of uniform statewide tariffs the non-metropolitan residential customers would, on average, pay 30% - 50% more under most of the proposed methods. A "typical" metropolitan residential customer would see a drop of around 30%.

Metropolitan commercial customers, who have peaks relatively lower than their residential counterparts, see an even more significant drop of around 50% in their total charges. Depending on their location and the scenario chosen, non-metropolitan commercial customers receive varying changes to their bill.

The following charts demonstrate the relative impact on the net charges to those "typical" customers examined in Appendix Five.





9. Incidence Analysis

Continued

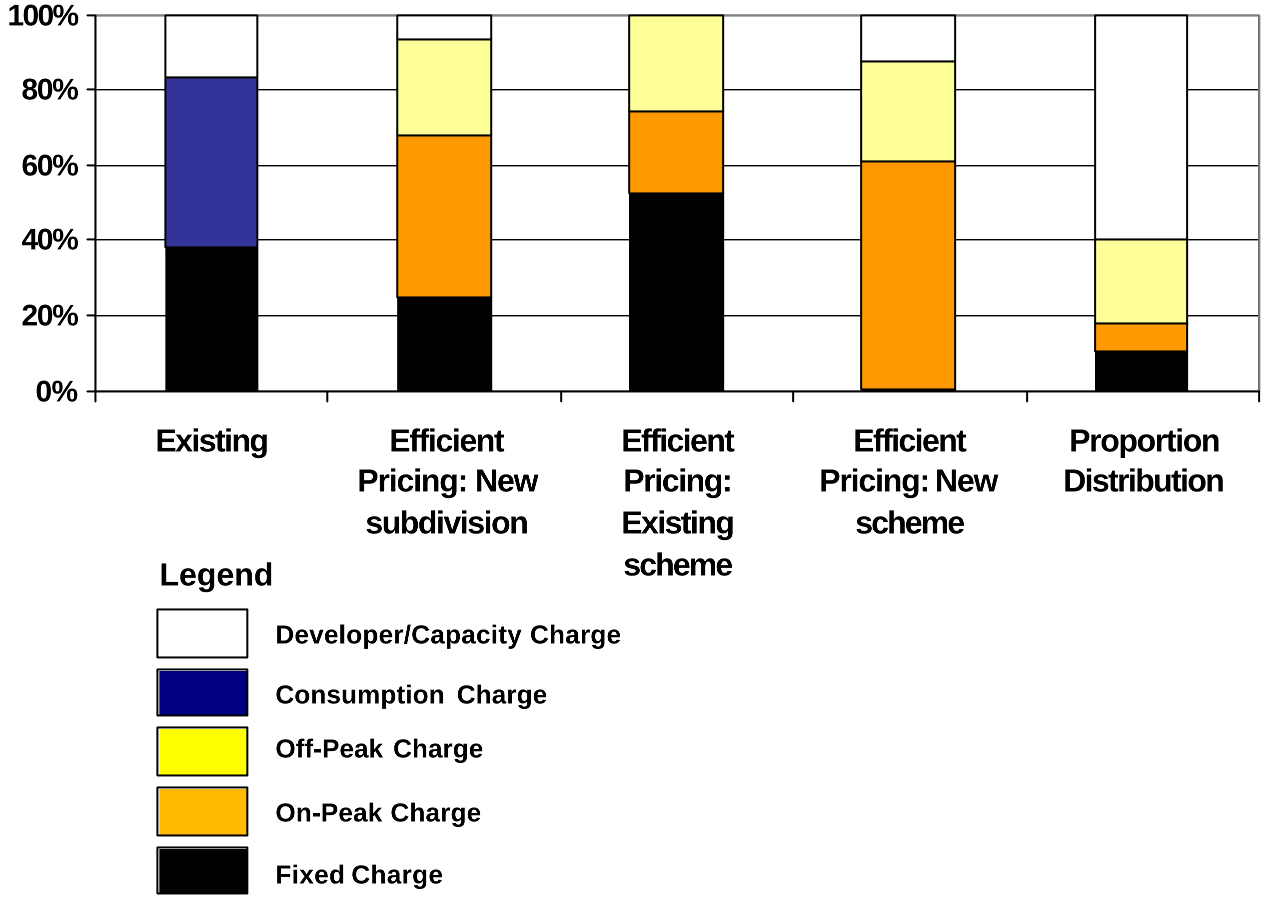
In general, the efficient pricing approaches have a significantly higher charge for consumption with the inclusion of a peak pricing component. Developer charges are reduced due to the more limited range of assets they represent. The fixed charge forms the remainder to achieve revenue neutrality.

The proportional distribution approach applies a much greater charge for capacity due to the inclusion of all existing pipes in the charge calculation.

A summary breakup of the various charges is presented below.

An analysis of movements in individual customer accounts is detailed in Appendix Six.

Proportional Distribution of Average Bill



10. Conclusion

Implementing cost based prices in the modelled scheme would require a major change in charges and a significant re-balancing between fixed, volumetric and developer charges.

In general, the costs of servicing individual customers will vary according to:

- location,
- peaking factors,
- total volume consumed.

Economic prices require variable charges to reflect the change in cost to the utility as a result of changes in demand. That is, prices should reflect the future costs required rather than costs already incurred (sunk costs). A clear economic signal about the cost of servicing the customer is not reflected by a proportional distribution of existing assets, although this approach is simpler and may avoid significant price shocks for some customers.

While opportunities will exist for some customers to reduce their charges under a cost reflective pricing system, the increase to some customers may be of concern to Government. However, without cost reflective prices, competition could result in “cherry picking” in overpriced areas with no corresponding reduction in costs to the utility.

Peak pricing does lead to significant price differentials between customers. However, a surprising result was that, due the economies of scale in laying large mains and the minimum sizing for firefighting requirements, the savings from peak pricing were significantly less than anticipated[1] .

While the results of this exercise were specific to the scheme examined, the model and cost driver methodology are transferable to other areas but require the use of local cost and demand data.

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[1] While peak prices appear high in some instances, they reflect a relatively small volume of consumption and therefore a correspondingly low cost (see Appendix 3 for more details).

Appendix 1

Capital Costs

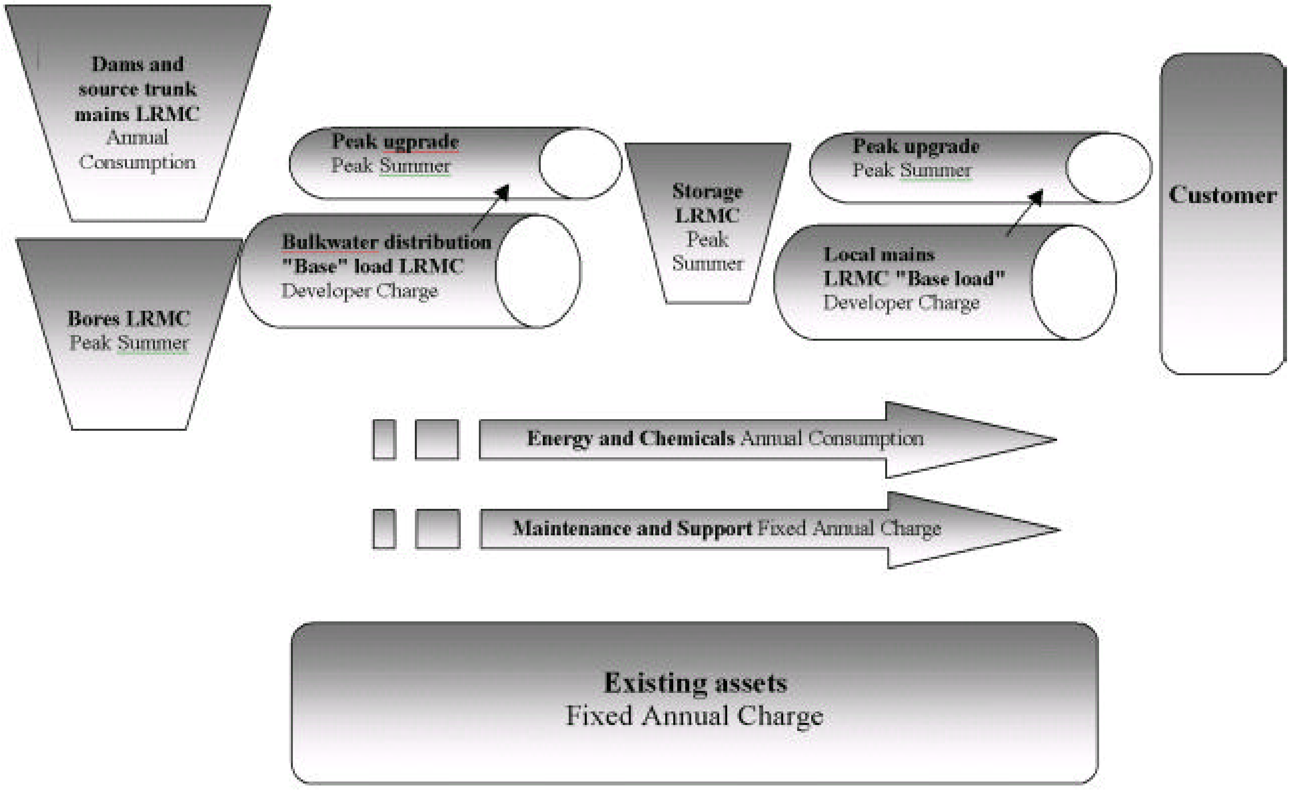
Cost Driver	Influenced by
Urban Pipes<300mm and 300-600mm	
Peak instantaneous use	Customer peak
Density/Lot frontage/Distance from feed source	Development/ Location
Water quality	Community
Fire fighting	Community
Rural Distribution Pipes<300mm, 300-600mm	
Peak instantaneous to weekly use	Customer peak
Distance from feed main	Location
Water quality	Community
Urban and Rural Pipes>600mm	
Peak daily to monthly use	Customer peak
Distance between sources and consumers	Location
Water quality	Community
Integrated Source	
Peak weekly to monthly use – bores	Customer peak
Annual consumption – dams	Customer consumption
Annual consumption – trunk mains	Customer consumption
Peak weekly to monthly use – trunk mains	Customer peak
Dam safety	Community
Environmental	Community/Govt
Water quality	Community
Treatment Plants	
Peak weekly to monthly use	Customer peak
Disinfection; Fluoridation; Iron; Turbidity; Colour Hardness	Community/ Location
Pump Stations	
Peak instantaneous to monthly use	Customer peak
Elevation	Development/ Location
Tanks and Reservoirs	
Peak daily to monthly use (including security)	Customer peak
Elevation	Development/ Location
Aesthetic requirements	Community

Operating and Maintenance Costs

Cost Driver	Influenced by
Labour	
Length of main	Location
Asset condition	Location
Remoteness	Location
Sampling and monitoring requirements	Location
Energy	
Consumption	Customer consumption
Pumping efficiency (main conduit only)	Customer (demand profile)
Peak instantaneous	Customer peak
Chemicals	
Consumption	Customer consumption
Source water quality	Location
Temperature	Location
Support Costs	
Direct operating + capital costs	All
Number of customers (Customer service)	Number of customers
Full Time Equivalent Employees (HR)	Internal
Head Office floor space	Internal

Appendix 2

Proposed Pricing Framework (Scenarios One to Three)



Appendix 3

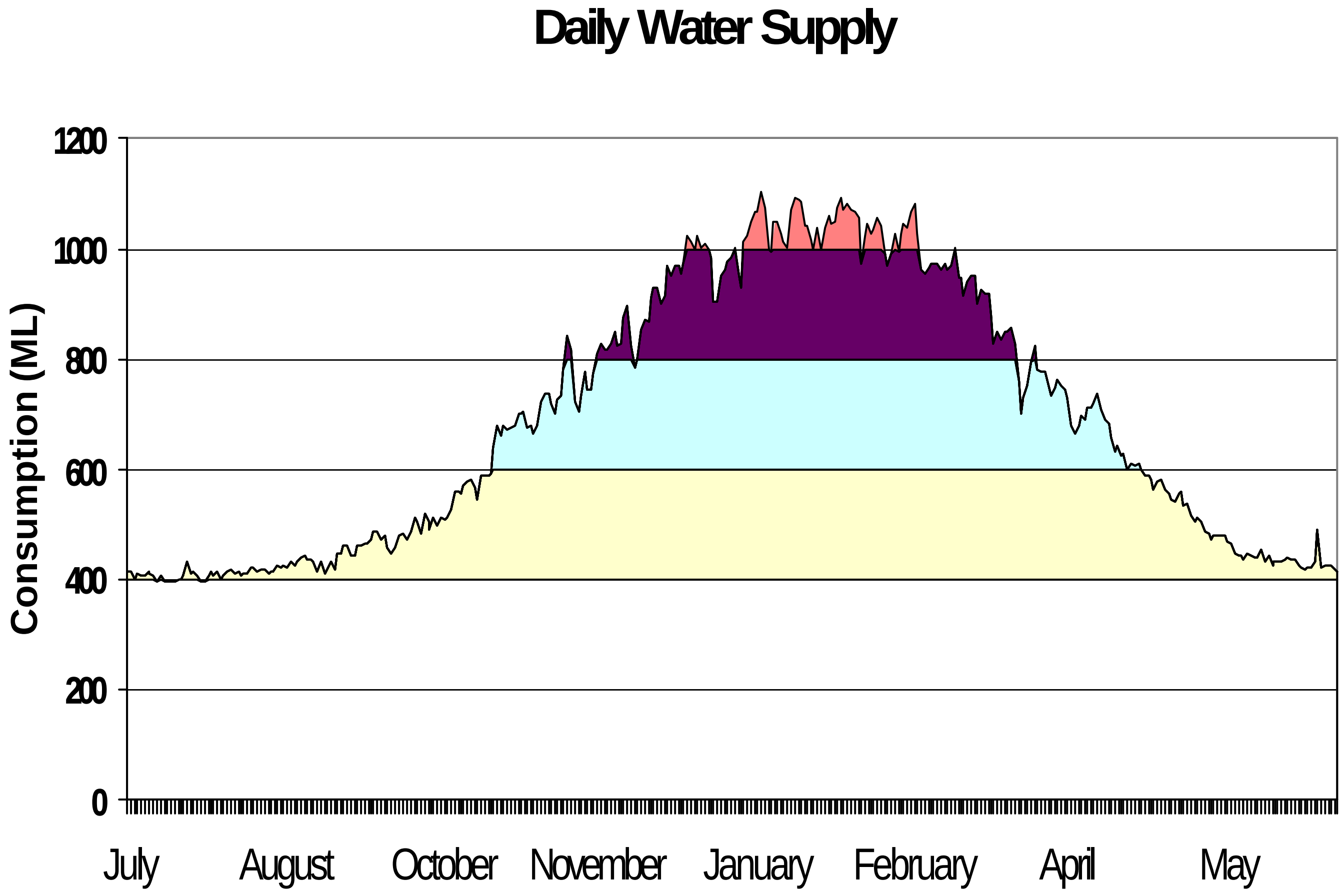
Peak Charging

For the economic pricing approach we have derived two peak prices – one based on peak daily usage, paid initially by the developer, and the other based on peak summer usage (January and February only).

Peak summer usage

The graph below indicates the usage pattern displayed by the modelled scheme over the past 13 years:

It is evident from the chart that the peak usage (over 1000 ML per day) occurs primarily over January and February.



A charge for the shoulder periods (perhaps December and March) could also be justified if demand dropped sharply enough during January and February to create new peaks at either side of this period. However it is considered unlikely that the peak charge developed in this exercise would be sufficient to drop demand in summer below 1000 ML per day.

The summer peak affects the designed capacity of borefields, tanks, reservoirs, pump stations and trunk mains. In general, these assets are sized for peak week or peak monthly use, depending on available storage. The chart demonstrates that the absolute peak of 1100 ML in one day is evident over several periods over January and February. Accordingly, the demand in any one week or four week period over the two months is rela-

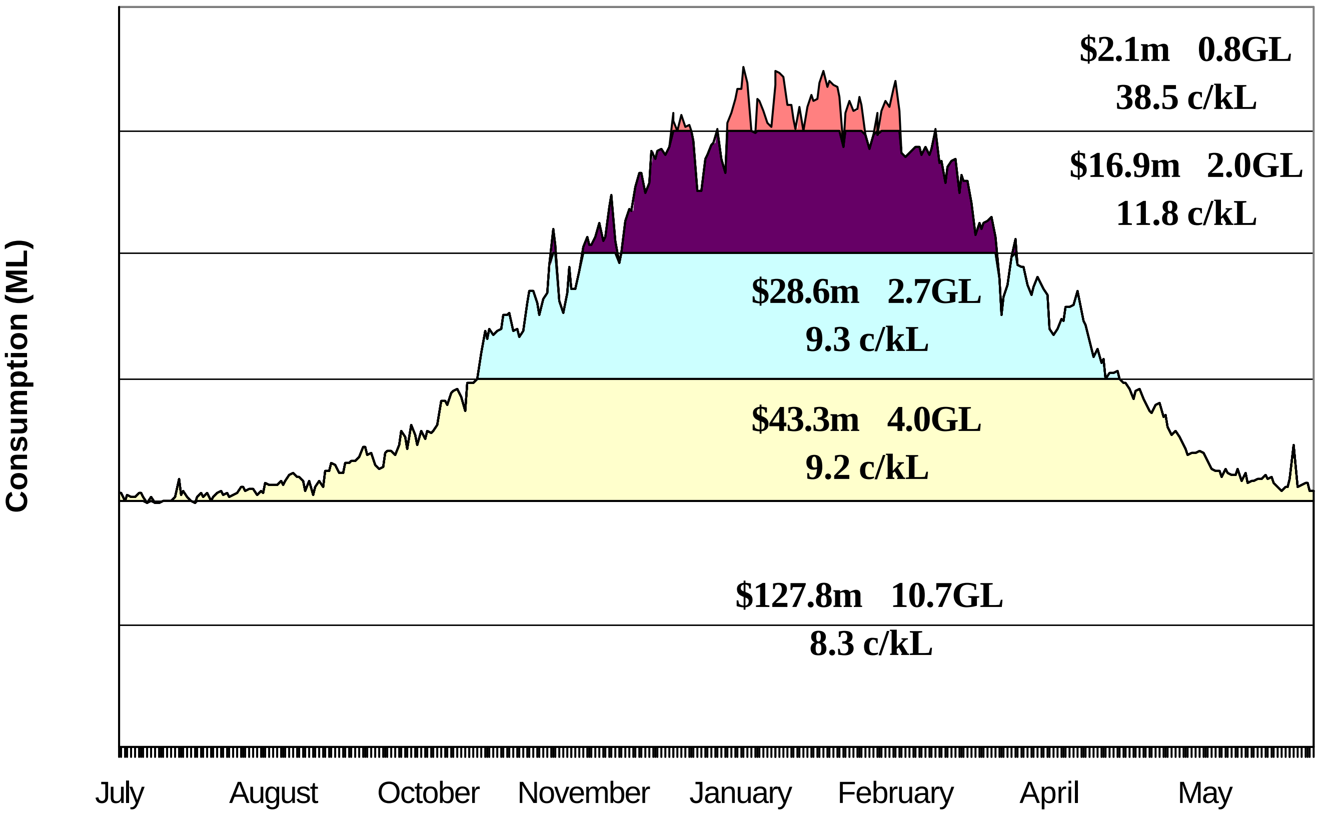
Appendix 3
Continued

tively smooth. This study has therefore allocated the cost of peak usage across the demand from the beginning of January to the end of February.

During summer the peak within the day determines the designed capacity of distribution and reticulation mains. Many 63mm, 100mm and 150mm mains are, however, unlikely to be sized smaller with lower demand due to minimum firefighting requirements. To avoid a myriad of charges to consumers, and due to the comparatively small size of costs influenced by changes in peak instantaneous usage, all costs have been related to consumption across the two months of summer for consumers. As the charge to developers will relate almost entirely to distribution and reticulation mains, however, developer charges will be related to peak instantaneous and daily requirements.

To send an accurate signal regarding the cost of peak usage, the separate layers of usage were costed individually. At each stage the incremental cost of the mains were divided by the incremental consumption. An example based on pipeline costs is demonstrated on the chart below:

Daily Water Supply



The cost of each band becomes progressively lower as the cost of additional pipe capacity diminishes. However, as demand is focussed over progressively shorter periods, the volume also reduces. In this example, the cost of adding pipe capacity for use within the highest band is 38.5 c/kL. As major distribution mains feed into large storage (up to monthly storage), reducing water demand over the peak summer period will reduce the cost of installed capacity by approximately 38.5 cents per kilolitre (assuming demand is relatively evenly reduced over both January and February).

In this example, the incremental cost for January and February use represents approximately 4% of the overall cost, and is designed to cater for only the top 0.95% of total consumption.

Appendix 3
Continued

Finally, in Scenarios One to Three (the economic pricing approach) the calculation is only applied to Long Run Marginal (LRM) costs. As past investments represent sunk costs, they are recovered through the fixed annual charge. Therefore:

- In Scenario 1 (*existing scheme, new development*), only the additional cost of adding a new development have been considered,
- In Scenario 2 (*existing scheme, existing development*), local assets have been assumed sufficient to service expected demand peaks, allowing variation in source and a few major distribution assets only, and
- In Scenario 3 (*new scheme*), all assets are deemed to be marginal. The variable costs for the new scheme are by far the highest of the three scenarios, and significantly higher than current tariffs during peak periods. The peak usage, and therefore the long run marginal cost of supplying that peak, have been reduced accordingly. This is an iterative cycle, as the price affects peak usage, which in turn affects the calculation of price. In reality peak usage for the satellite areas in Scenarios 1 and 2 may also be impacted, but for simplicity the changes have only been modelled in Scenario 3.

While the peak prices calculated in this study were several times higher than the "off-peak" charges, they reflect only the extreme top end of costs and consumption (ie those associated with usage between 1,000 and 1,100 ML/day). Due to the economies of scale in laying large pipes and the minimum requirements for firefighting, the costs associated with this usage are relatively small. However, as the consumption in this range is equally small, the prices can appear high.

In practice, the high peak prices would drive consumption down dramatically at first. However – as evidenced in the diagram above – even a small drop in peak consumption (and therefore costs) would quickly lead to a severe drop in peak prices. The lower prices would then form a lesser incentive to save water and a price/demand equilibrium might eventually settle at around 1,000ML/day (approximately 10% reduction in peak). On this basis, it is estimated that peak pricing would reduce total costs *for a new scheme* by just over 2%. In an established scheme (where major pipelines have already been laid) the scope for saving is almost negligible. (This is a cursory analysis only and will ultimately depend on site specific variables such as demand and expenditure.)

Appendix 4

Developer Charges

If perfect competition existed, customers received perfect information about all prices and alternative goods, and prices were truly cost reflective at a local level, a charge to developers might be equally as effective in sending a price signal as a charge to the final consumer. In theory the consumer would know the level of charges they would face in the future and would make a rational decision regarding the price they were willing to pay for a block of land. Under perfect competition this would see developers sell land with only competitive levels of profit, thereby lowering prices if developer charges were not required.

Without perfect information, a consumer might not "see" the charges until after the block is purchased and the land is developed. Without perfect competition, charges for land might not be varied if the developer contribution is removed. In these cases the pricing signal to the final consumer is weakened significantly. Charging the developer sends a clear, immediate signal to an informed buyer. However, this signal will be most appropriate for those assets which are difficult to stage or upgrade (such as pipelines). Assets (such as new sources for the metropolitan area) and operating costs that can be gradually introduced can alternatively be met through pricing signals to the consumer, as they have the ability to influence these cost through changes in behaviour.

An exception to this may be costs associated with usage patterns, which are better understood and controlled by the water utility (see peak charging in Appendix Three). Estimation and influencing of peaks might therefore be included within the scope of the utility's pricing to the final customer.

Therefore, this study presumes that the most economically efficient and practical model involves upfront contributions for assets that can not be staged or are unlikely to be upgraded, with the peak component separated and charged directly to customers.

It is important to note that this system may be eroded by competition if land developers, rather than the final customer or government, choose the water provider. When faced with alternate providers, the developer is likely to favour the organisation that passes most, if not all, of the cost of water supply on to the final consumer.

Appendix 5

The tables below show the total annual revenue from (1) a typical residential customer, (2) a typical commercial customer, and (3) a major consumer, based on the prices described in this paper.

1. Residential

Annual consumption	340 kL
Peak usage (Jan-Feb)	80 kL
Off-peak usage (Mar-Dec)	260 kL
Peak day	1.4 kL

Scenario 1: Existing scheme, new development

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	90	89	92	147	109	154	112
On-peak consumption	112	102	140	338	210	277	309
Fixed charge	128	128	128	128	128	128	128
Total annual charge	329	319	360	612	446	559	549
Developer charge	384	238	382	1,304	1,227	2,143	2,711
Reticulation	1,831	1,950	4,038	10,379	4,378	1,970	1,636

Scenario 2: Existing scheme, existing development

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	90	89	92	147	109	154	112
On-peak consumption	63	63	66	131	159	231	274
Fixed charge	273	273	273	273	273	273	273
Total annual charge	426	425	431	551	541	659	659
Developer charge	NA	NA	NA	NA	NA	NA	NA
Reticulation	NA	NA	NA	NA	NA	NA	NA

Scenario 3: New scheme

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	90	89	92	147	109	154	112
On-peak consumption	218	163	207	603	281	388	437
Fixed charge	2	2	2	2	2	2	2
Total annual charge	309	254	301	751	391	544	551
Developer charge	1,647	857	1,184	4,612	2,019	3,685	4,410
Reticulation	2,004	2,134	4,420	11,360	4,792	2,156	1,791

Scenario 4: Proportional distribution of assets (capacity)

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Consumption	99	99	103	174	124	184	128
Fixed charge	55	55	55	55	55	55	55
Annual capacity charge	207	149	210	589	229	406	461
Total annual charge	362	303	368	818	408	645	645
Reticulation	2,026	2,157	4,467	11,482	4,843	2,179	1,810

2. Commercial

Annual consumption ....800 kL

Peak usage (Jan-Feb) ....140 kL

Off-peak usage (Mar-Dec) ....660 kL

Peak day .... 2.5 kL

Scenario 1: Existing scheme, new development

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	275	274	284	452	334	475	344
On-peak consumption	196	179	245	591	368	484	542
Fixed charge	128	128	128	128	128	128	128
Total annual charge	599	580	657	1,171	830	1,087	1,013
Developer charge	685	425	682	2,328	2,192	3,827	4,841
Reticulation	3,270	3,482	7,212	18,535	7,818	3,517	2,922

Scenario 2: Existing scheme, existing development

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	275	274	284	452	334	475	344
On-peak consumption	110	110	115	229	278	404	480
Fixed charge	273	273	273	273	273	273	273
Total annual charge	659	657	672	955	886	1,153	1,097
Developer charge	NA	NA	NA	NA	NA	NA	NA
Reticulation	NA	NA	NA	NA	NA	NA	NA

Scenario 3: New scheme

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	275	274	284	452	334	475	344
On-peak consumption	381	286	363	1,055	491	679	765
Fixed charge	2	2	2	2	2	2	2
Total annual charge	658	561	649	1,508	827	1,156	1,110
Developer charge	2,942	1,531	2,114	8,236	3,605	6,581	7,874
Reticulation	3,579	3,811	7,893	20,286	8,556	3,849	3,198

Scenario 4: Proportional distribution of assets

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Consumption	275	273	285	482	344	510	355
Fixed charge	55	55	55	55	55	55	55
Annual capacity charge	370	266	375	1,051	409	725	823
Total annual charge	700	594	715	1,588	808	1,289	1,234
Reticulation	3,617	3,852	7,977	20,503	8,648	3,891	3,232

Appendix 5
Continued

3. Major Consumer

Annual consumption .... 100,000 kL

Peak usage (Jan-Feb) .... 17,000 kL

Off-peak usage (Mar-Dec) .... 83,000 kL

Peak day .... 280 kL

Administrative costs As a major consumer, additional costs ($4,900) have been included to account for business development, customer account management and legal requirements.

Scenario 1: Existing scheme, new development

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	28,576	28,403	29,501	46,862	34,700	49,307	35,684
On-peak consumption	23,765	21,690	29,807	71,820	44,677	58,773	65,764
Fixed charge	5,028	5,028	5,028	5,028	5,028	5,028	5,028
Total annual charge	57,368	55,120	64,336	123,710	84,404	113,107	106,476
Developer charge	76,765	47,639	76,331	260,731	245,486	428,595	542,154

Scenario 2: Existing scheme, existing development

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	28,576	28,403	29,501	46,862	34,700	49,307	35,684
On-peak consumption	13,416	13,407	13,923	27,867	33,736	49,105	58,288
Fixed charge	5,173	5,173	5,173	5,173	5,173	5,173	5,173
Total annual charge	47,165	46,983	48,597	79,903	73,610	103,585	99,145
Developer charge	NA	NA	NA	NA	NA	NA	NA

Scenario 3: New scheme

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Off-peak consumption	28,576	28,403	29,501	46,862	34,700	49,307	35,684
On-peak consumption	46,243	34,671	44,026	128,094	59,608	82,401	92,868
Fixed charge	4,902	4,902	4,902	4,902	4,902	4,902	4,902
Total annual charge	79,721	67,976	78,429	179,858	99,210	136,610	133,454
Developer charge	329,453	171,417	236,712	922,397	403,766	737,078	881,902

Scenario 4: Proportional distribution of assets

Location	MA1	MA2	MA3	SA1	ST1	SA2	ST2
Consumption	29,228	29,020	30,343	51,260	36,607	54,205	37,793
Fixed charge	4,955	4,955	4,955	4,955	4,955	4,955	4,955
Annual capacity charge	41,446	29,783	42,018	117,703	45,796	81,155	92,202
Total annual charge	75,630	63,758	77,316	173,918	87,358	140,315	134,950

Appendix 6

Movement in customer charges

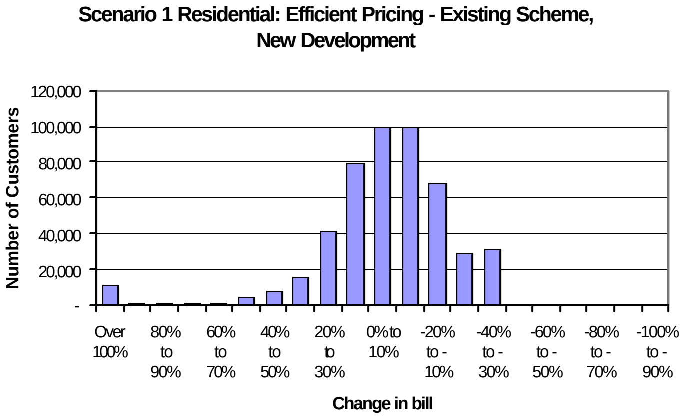
A new development in an existing scheme (Scenario 1) would see approximately 80% of customer bills contained to movements of +40% to -30% with non-residential customers being the primary winners.

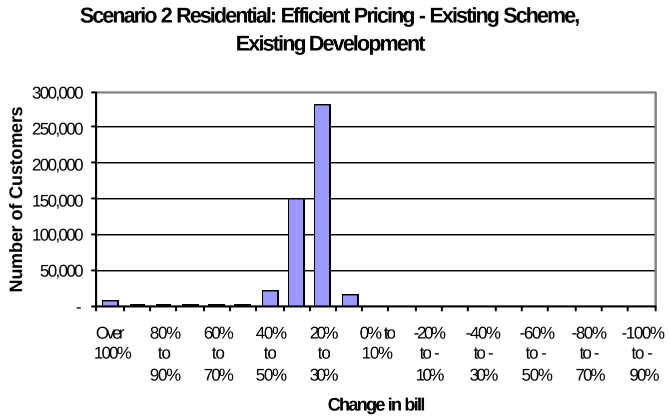
Due to the significant fixed charge for sunk assets (ie costs that are no longer related to usage), the efficient pricing approach for customers in an existing developed area (Scenario 2) would see over 70% of bills (predominantly residential customers who pay a relatively low fixed charge) increase between 20% and 40%. Non-residential customers on the minimum fixed charge (more than double the residential fixed charge) would largely see a drop of 20% to 30%. Customers who face extremely high charges under the current system will have the most significant decrease in their bill.

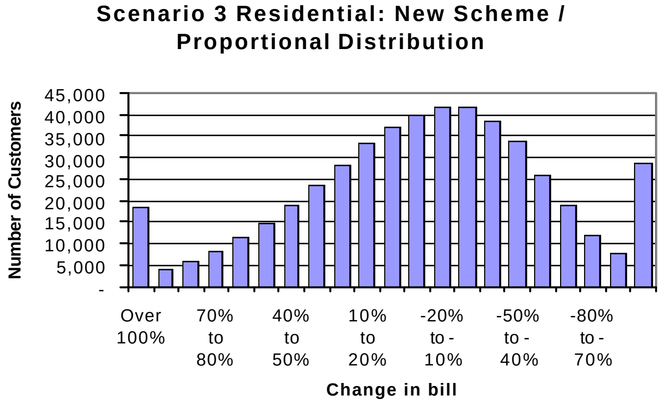
The new scheme model (Scenario 3) and the proportional distribution model (Scenario 4) generate similar increases and reductions as the underlying allocation of costs is similar (the capacity charge is essentially a surrogate for the developer and peak charges). Under these models the spread of total bill movements is broadened, such that approximately 80% of customer bills will move by +/ -60%.

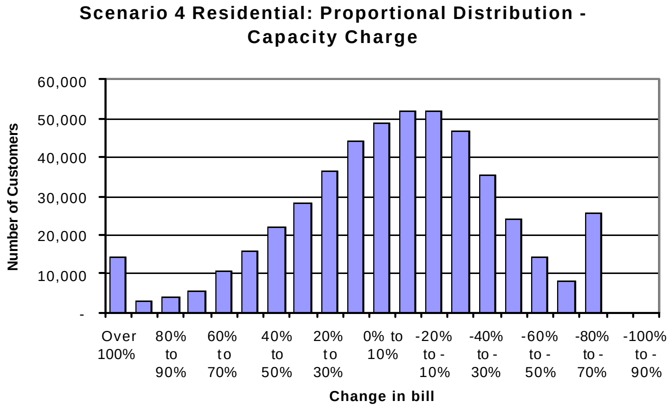
A detailed breakup is shown in the charts below.

Residential





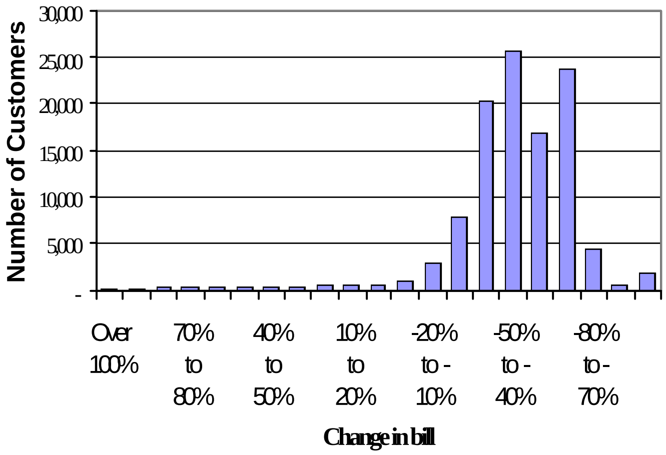




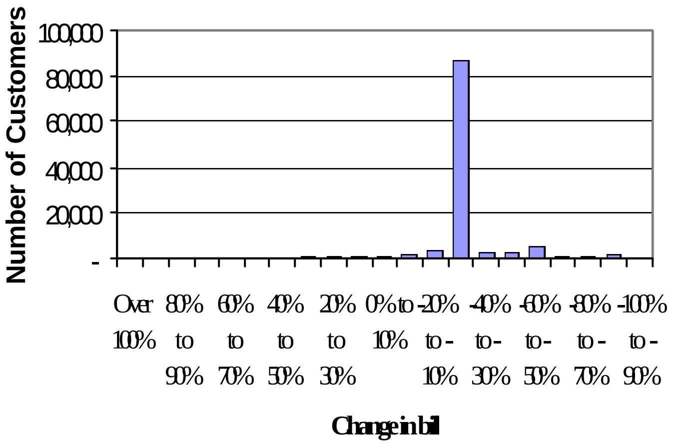
Appendix 6
Continued

Non-Residential

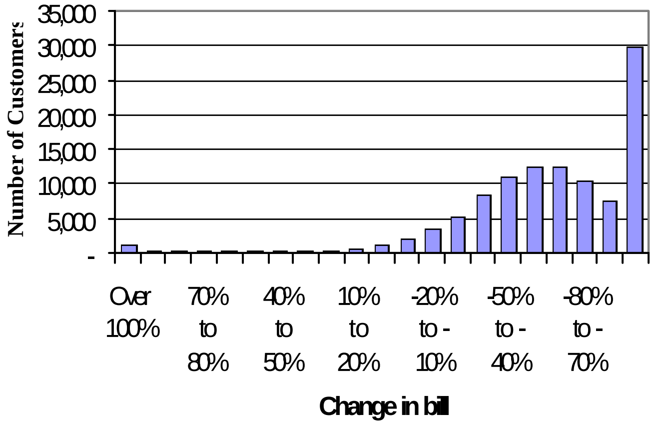
Scenario 1 Non-Residential: Efficient Pricing - Existing Scheme, New Development



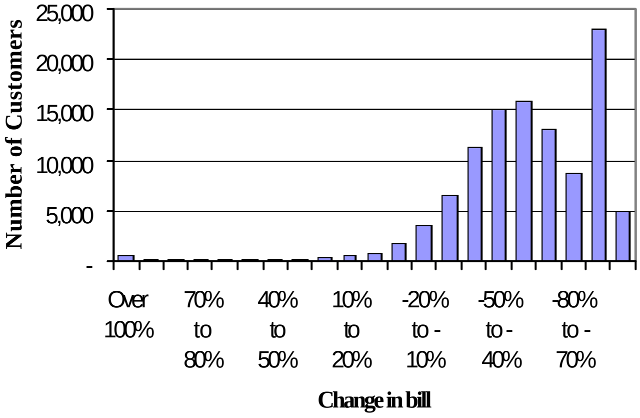
Scenario 2 Non-Residential: Efficient Pricing - Existing Scheme, Existing Development



Scenario 3 Non-Residential: New Scheme / Proportional Distribution



Scenario 4 Non-Residential: Proportional Distribution - Capacity Charge



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