5. PRICING POLICY APPROACHES

5.1 Introduction

The purpose of this chapter is to present key background information on current industry practices of water pricing and to relate the feasible rate alternatives which have potential for use in Queensland urban communities. Since pricing can be used primarily as a deterrent to excess or heavy water use in times of water shortages, pricing policy considerations need to include an evaluation of water use restrictions during periods of acute shortage.

5.2 Desired Elements of Water Pricing Structures

In the interest of providing perspective to the process of evaluating rates and rate structures, it is useful to keep in mind the major objectives that are strived for in the rate setting process:

- *Revenue Sufficiency* – The rate structure should generate the total revenue necessary to pay for current operating, maintenance, and capital costs and provide cash reserves necessary to meet normal and surge variations in water sales and operating expenditures.
- *Fairness or Equity* – The rate structure should assign the costs of providing water in proportion to the benefits received by the ratepayers.
- *Ease of Administration* – The rate structure should reflect a balance between precision in cost allocations for equity and the practicality of administering the tariffs.
- *Promotion of Conservation* – The rate structure should promote the efficient use of water by all customer groups to preserve this limited natural resource and avoid the escalating costs of augmenting supply.

5.3 Alternative Pricing Structures

Before reviewing the specific rate structures in place in the five pilot communities, a description of types of structures in use in other cities is presented with some of the logic for their use.

The historical purpose for water rates was to devise a means to generate the revenues needed to operate and maintain the water system and provide additional capacity for growth. Various schemes, including property values, were used in an effort to relate water use to property sized and to affordability. As metering progressed, usage charges were incorporated in the water bills so that customers pay according to the amount of water they use, but a fixed charge invariably was retained in recognition of a pool of

costs that should be shared equally because these costs were not directly related to the quantity of water consumed. With universal metering, various alternative rate structures, each with a special purpose, have become feasible.

5.3.1 Fixed Charges / Usage Component Approaches

Most water companies maintain both a fixed period charge and a charge based on water usage. To assist in making judgments regarding the most appropriate rate structure for any given community, it is useful to discuss the components of the different structures.

- *Fixed Charge* - The fixed period charge is often rationalised as the charge designed to recover specific fixed costs associated with water production and distribution. Since fixed costs often constitute 80 percent or more of the total cost of water production and distribution, the fixed period charge is often rationalised under one of the following bases:
  - *Customer Costs* – The costs that are associated directly with customers and not with the production and distribution of water. These costs include meter reading, billing and collection, customer service including leak detection, and administration costs directly related to customer service.
  - *Fixed Costs* – A portion of fixed costs (usually including customer costs) that should be recovered in a fixed period charge. The logic is that these costs are fixed and do not vary with production and therefore should be evenly applied to all customers (usually proportioned to the capacity of the meter).
  - *Revenue Stability* – Water authorities are subject to normal seasonal patterns in sales and the resulting revenue receipts. In addition, weather and various conservation / restriction programs can result in sizeable short-term reductions in revenues. To moderate the impacts of these conditions, financial managers generally prefer to have a large fixed charge in the rate structure to provide greater stability to the monthly revenue stream, however the fixed charge might be constructed or rationalised. This aspect is especially important to utilities that have frequent meter readings and billings.
- *Usage Component* – The usage component is derived to recover the balance of total costs not recovered by the fixed period charge. The usage rate can be a single rate applied to all water usage for all customer groups, or an inclining or declining block rate applied to increasing levels of water use. The rates can be applied differently in summer peak periods than in winter months in a variety of schemes.

5.3.2 Specific Pricing Structure Alternatives

There are numerous tariff structures that can be identified to meet specific conditions in any given community. Structures may fall into six classes as described below. The rates and charges for each of these tariff structures can be set to produce the same revenue.

1. *Fixed period charge (usually by meter size) plus a single unit usage charge.* Proponents of this structure argue that it is the fairest structure because all users pay the same unit rate for water irrespective of their use. Some even argue that it is a conservation promoting rate structure because the (marginal) cost of each unit of water to all users is clearly identified for them to make an economic decision to use or not use the next unit.

2. *Fixed period charge plus two or more increasing rate blocks.* The first rate block is often set at or modestly below the normal inside water use for a typical domestic account. The second rate block is usually set strategically below the normal requirements for internal plus essential external water use of a typical domestic customer. The higher blocks (3^{rd}, 4^{th} blocks) are usually set at the levels of water use related to certain percentages of the total accounts that would be affected. For example, the top 20 percent or the top 10 percent of all accounts in a customer group may be targeted with a view to discouraging the seemingly discretionary usage at these levels. Proponents of this tariff structure argue it promotes economic efficiency by charging rates that more nearly reflect the costs of peaking from those who caused the peak capacity to be put in place. They further argue that it discourages wasteful water practices and promotes conservation via the direct message of price.

3. *Seasonal rates.* This rating structure can use either of the preceding structures with different rates for the summer (peak season) and winter use. In some cases a multi block structure is used in summer, with a single block in the non-summer months. In other cases, multi-block rates are used during the entire year but with higher block rates in summer.

4. *Declining block structure.* This pricing alternative involves a rates decrease with increasing water use. This structure was initially developed in recognition of the lower peaking of large commercial and industrial customers with lower peaking costs. The application of this structure has often been associated with economic development, that is, the lower rates are applied to large accounts to entice their locating in the service area. The movement in recent years towards uniform and inclining block tariffs has all but eliminated the declining block tariff structure in its original form. Where a single tariff structure was standard for all customer groups with the declining block structure, a different structure is now common for each customer group. The same base rate is usually applied but the blocks then differ based on the unique loadings of the customer groups and the economics of development.

5. *Marginal cost rates.* Economists support this approach since the concept fits into the classical mould for economic efficiency. Actually, the term marginal cost should be replaced with the term incremental cost because the costs are not derived from the next unit of production but the next increment of capacity expansion. The application of incremental pricing is usually applied to the second or third tier in a multi-block tariff structure. The block rates represent the unit costs of the next increments of supply.

6. *Full usage component approaches.* Proponents of this approach argue that all water revenues should be the result of customers' decisions to use or not

to use the water for their specific purposes. The single unit rate is the most used approach in this format, but inclining block tariffs can also be used. This approach is considered a conservation promoting structure, especially with the inclining block structure. The major argument against this structure is that the monthly revenue stability associated with a fixed charge method is lost.

5.4 Evaluation of Historic Pricing

In this section, a summary of the direction of change in pricing structures is provided with an assessment of the current tariff structure as to revenue sensitivity and fairness.

5.4.1 Existing Pricing Structures in Pilot Areas

Details of the water tariff history for each of the five communities in the study area are provided in **Appendix D**.

The tariffs for each of the communities have been broken down into three basic elements:

1. *Standing Charge* – This is a fixed periodic charge that recovers a portion of operating fixed costs and is not tied to any minimum level of water usage. The charge is typically billed annually or at the same time as the usage charge is levied.
2. *Minimum Charge* – This is a fixed periodic charge that recovers a portion of operating fixed costs and is tied to a water usage allowance. A specified amount of water, typically from 100 kL/a to 600 kL/a, may be included in the Minimum Charge. The charge is billed periodically at the beginning of the period as with the Standing Charge.
3. *Water Usage Rate ($/kL)* – There can be several water rates applied to various stages of water use. If a Minimum Charge is in place, the first water rate is applied to water usage in excess of the allowance. If the Standing Charge is in place, the water rate is applied from the first unit of use. If a multi-block tariff structure is in place, there will be a separate water rate that applies to each block. The water usage charge is billed directly after the meter readings, which could be quarterly, semi-annually, or annually.

5.5 Evaluation of Historic Pricing

5.5.1 Mackay City

From 1984 through 1994, Mackay employed a Minimum Charge of $108.80 per annum with an allowance of 300 kL/a, which is 20% less than the current average annual domestic water usage. Usage in excess of the allowance was billed at a rate that increased from $0.21/kL in 1984 to $0.35 in 1994, an average increase of 5.8% per annum.

In 1995, the Mackay version of user pays was introduced. The fixed charge was more than doubled from $108.80 to $223 and the 300 kL/a block was retained. A second rate block was added for consumption over 1,500 kL/a. Both the fixed charge and the excess rates were increased by 1.6% per annum during the period 1994-95 to 1999-00.

Based on the breakdown of water billing in Mackay for 1998 (as supplied by council), the average residential customer used 363 kL. The excess water charges (for consumption of > 300kL/a) were effectively directed at approximately 9,800 residential (48% of residential accounts) and 700 non-residential customers (48 % of non-residential accounts). The combined water use of the excess water customers represents about 70% of total water consumed. In addition, the customers paying the second tier water rate (> 1,500 kL/a) were comprised of 258 commercial accounts (18% of total consumption).

This rate structure is not a user pays structure in the strict sense, as over 50% of all customers pay only a fixed charge and therefore consume less than the first tier allowance. The amount of water use in Mackay above the 300 kL/a level, however, is large at 48% of customers and 70% of total water consumed for the community.

The real test is how the overall rate structure changes affected the bills of individual water users. **Table 5.1** shows the water bills for selected years and selected water usage levels. There is only a slightly higher percentage increase in the bills for larger customers. The water bills clearly reflect the elongated rate block from 300 to 1,500 kL/a at a single unit rate.

Table 5.1: Mackay Annual Water Bills for Selected Years and Usage Levels

Year	Annual Usage Level (kL/a)				
	300	*500*	*800*	*1,200*	*1,500*
1984-85	$109	$151	$216	$301	$365
1993-94	$109	$179	$284	$424	$529
1994-95	$223	$303	$423	$583	$703
1998-99	$230	$316	$445	$617	$746
1999-00	$235	$323	$455	$631	$763
% Change / Annum for Selected Periods					
1985 to 94	0.0	2.0	3.5	4.5	5.0
1994 to 95	105.0	69.5	49.0	37.6	32.9
1995 to 99	0.8	1.1	1.3	1.5	1.5
1999 to 00	2.2	2.2	2.2	2.3	2.3
1985 to 00	7.7	7.5	7.4	7.3	7.3

Mackay experienced a modest (7.1%) decrease in water use coincident with the increase in the fixed charge and the introduction of a second rate block in 1994-95.

5.5.2 Emerald

The Emerald tariff history included a large (750 kL/a) allowance in 1992-93, which was decreased to 650 kL/a from 1995-97, to 450 kL/a in 1998, and to 250 kL/a in 1999. During this period, the base fixed charge was also lowered presumably as the water

revenue increased with the lower allowances. In 1999-00, the allowance was eliminated and the annual fixed charge was lowered to $120. As shown in **Table 5.2**, this change resulted in substantial billing increases for the lower volume customers (eg. 33.8% for 300 kL/a customers) and smaller increases (7.6% to 14.8%) for customers using 800 kL/a or more. The current tariff structure is a true user pays structure with a fixed charge of $120 and a volumetric rate of $0.55/kL applied to all water consumed.

Emerald experienced a 20% decrease in water use coincident with the implementation of user pays pricing in 1998/99.

Table 5.2: Emerald Annual Water Bills for Selected Years and Usage Levels

Year	Annual Usage Level (kL/a)				
	300	*500*	*800*	*1,200*	*1,500*
1992-93	$320	$320	$340	$670	$920
1996-97	$312	$312	$384	$600	$720
1998-99	$213	$323	$488	$735	$873
1999-00	$285	$395	$560	$808	$945
% Change / Annum for Selected Periods					
1993-1997	-0.6	-0.6	3.1	-2.7	-5.9
1997-1999	-17.4	-17.4	6.3	10.7	10.1
1999-2000	33.8	22.3	14.8	9.9	7.6
1993-2000	-1.6	3.1	7.4	2.7	0.4

5.5.3 Ingham

Similar to Emerald, Ingham adopted a high allowance of 750 kL/a in 1988-89, which was lowered to 650 kL/a by 1994-95. The fixed and excess charges were increased by only 2.6% per annum during this period for customers using less than the allowance and by 7.3% or more for customers using excess water. In 1995-96 Hinchinbrook Shire eliminated the allowance, increased the standing charge by 39%, and decreased the usage charge by 29%. As shown in **Table 5.3**, the effect of this action was an increase of over 100% for all customers using 800 kL/a or less. Increases for large volume customers were smaller but substantial, for example, 29% for those using 1,500 kL/a.

The adopted rate structure differed from Emerald, for example, in that the fixed charge of $205 (in 1999-00) accounts for 66% of the annual bill for a 300 kL/a customer, compared $120 for Emerald or only 42% of the annual bill. Both rate structures are user pays structures, but with a significantly different emphasis on the source of revenue. This issue is discussed later in this section of the report.

Based on the data available it is estimated that Ingham experienced a reduction in water use of around 20% following the implementation of user pays in 1995-96. This reduction has not been climate corrected and therefore can only be considered to be a estimate of the actual reduction during this period. The reduction has however been sustained based on consumption data analysis during the period 1995-99.

Table 5.3: Ingham Annual Water Bills for Selected Years and Usage Levels

Year	Annual Usage Level (kL/a)				
	300	*500*	*800*	*1,200*	*1500*
1988-89	$120	$120	$133	$245	$308
1994-95	$140	$140	$203	$392	$497
1995-96	$285	$345	$435	$570	$645
1999-2000	$310	$380	$485	$643	$730
% Change / Annum for Selected Periods					
1989 to 95	2.6	2.6	7.3	8.1	8.3
1995 to 96	103.6	146.4	114.3	45.4	29.8
1996 to 00	2.1	2.4	2.8	3.1	3.1
1989 to 00	9.0	11.0	12.5	9.2	8.2

5.5.4 Maroochy

As shown in **Table 5.4**, Maroochy Shire adopted a major price increase in 1993/94. This increase was effected in conjunction with the introduction of the user pays structure, with an approximate increase of 80 to 100% per account. Since that time changes to the pricing structure have been small in comparison, averaging 3% per annum. The current level of fixed charge is $151 and the usage rate is $0.87/kL.

The price increases relating to the introduction of user pays increased the water bill for the low users (< 500kL/a) by up to 111%. The water bills of the higher users were also significantly increased but these changes were lower than for the minor consumers.

Table 5.4: Maroochy Annual Water Bills for Selected Years and Usage Levels

Year	Annual Usage Level (kL/a)				
	300	*500*	*800*	*1,200*	*1,500*
1992/93	$164	$268	$424	$622	$763
1993/94	$346	$490	$706	$994	$1,210
1994/95	$346	$490	$706	$994	$1,210
1995/96	$364	$520	$754	$1,066	$1,300
1997/98	$387	$553	$802	$1,134	$1,383
1999/2000	$412	$586	$847	$1,195	$1,456
% Change / Annum					
1993 to 94	111.0	82.8	66.5	59.8	58.6
1994 to 96	9.1	10.1	10.8	11.3	11.5
1996 to 97	2.5	2.5	2.5	2.5	2.5
1993 to 00	15.9	11.8	9.5	8.5	8.4
1994 to 00	3.2	3.3	3.3	3.4	3.4

5.5.5 Toowoomba

The city of Toowoomba employed an allowance of 324 kL/a from 1988-89 through to 1995/6, which is approximately the median level of use for domestic customers. The fixed charge during this time ranged from $285 in 1988/89 to $325 in 1995/6. In 1996/7 the allowance of 324 kL/a was changed to the first tier break point with all volume below that level charged at $0.38/kL and excess volume at $1.10/kL. The standing charge was simultaneously lowered from $325 to $235. This rate structure is a legitimate user pays structure, but is similar to that adopted in Ingham, with 65% of the annual bill for a 300 kL/a customer coming from the fixed charge.

Water demand in Toowoomba since the introduction of user pays in 1996, is 9.6% below that of the four previous years. This result is probably due to the large price increase between the 1st and 2nd price tiers i.e. $0.42/kL and $1.10/kL. The pricing approach could therefore be considered a conservation pricing structure as it forces the customer to consider the effect of using greater than the 324kL/a. The drawback however is that the meters are only read on a 6 monthly cycle which may not provide sufficient feedback to customers to allow water use to be reduced.

As indicated in **Table 5.5**, changes to the pricing policy in Toowoomba did not involve the significant increases to water bills that were evident in other communities. The increase was around 10% for the higher users and 5% for the lower users.

Table 5.5: Toowoomba Annual Water Bills for Selected Years and Usage Levels

Year	Annual Usage Level (kL/a)				
	300	*500*	*800*	*1,200*	*1,500*
1988-89	$286	$421	$646	$983	$1,172
1995-96	$325	$484	$754	$1,113	$1,384
1996-97	$340	$524	$824	$1,224	$1,524
1999-00	$349	$552	$882	$1,377	$1,652
% Change / Annum for Selected Periods					
1989 to 96	2.4	3.1	3.4	3.1	3.8
1995 to 97	4.6	8.3	9.3	10.0	10.1
1989 to 00	2.0	2.8	3.3	3.6	3.7
1995 to 00	1.5	2.8	3.4	3.8	3.9

5.5.6 Comparison of Current Water Charges

It is useful to compare the current pricing structures for the pilot areas, particularly for residential customers, most of who use less than 400 kL/a. The respective rates and bills are presented in **Table 5.6** for users of 100 kL/a and 400 kL/a.

Table 5.6: Composition of Residential Water Bills

Area	Composition of Water Bills					
	Fixed Charge	*Usage Rate (kL/a Block)*	*Total Water Bill*			
			100kL/a	*% Fixed*	*400kL/a*	*% Fixed*
Emerald	$120	$0.55 (> 0)	$175	68%	$340	35%
Ingham	$205	$0.35 (> 0)	$240	85%	$345	59%
Mackay	$235	$0.44 (301-1,500) $0.61 (> 1,500)	$235	100%	$279	84%
Maroochy	$151	$0.87(> 0)	$238	63%	$499	30%
Toowoomba	$235	$0.38 (0 - 324) $1.10 (> 324)	$273	86%	$441	53%

Analysis of the different tariffs shows that:

- *Toowoomba* has the highest water bill for the lower level residential user group. This results from the highest fixed charge of $235, which relates to 53% of the water bill for a 400kL/a user and higher for lower users. This approach might be characterised as a full user pays approach focussed on revenue stability from the high fixed charge.
- *Maroochy* has the highest usage rate at $0.87/kL and a comparatively modest fixed charge at $151. The fixed charge represents the smallest percentage of the total water bill for users below 400 kL/a for any of the pilot areas. This approach might be characterised as being full user pays approach that favours the small user. On the other hand the approach provides reasonable reward to the user to reduce the water bill through conservation. The pay for use aspect is apparent in the 400 kL/a usage block where Maroochy has the highest bill among the 5 communities.
- *Mackay* has the second highest fixed (or in this case minimum) charge with a 300 kL/a allowance and medium charge for higher users from 301 to 1,500 kL. This approach, which fosters revenue stability, might be characterised as neutral, not favouring either the small or larger domestic users. Given the 300 kL/a allowance, it is not a full user pays approach. In addition there is little or no reward to the consumer for conservation efforts.
- *Emerald* has the lowest fixed charge in the group ($120/a) and the second highest usage rate at $0.55/kL. Emerald must be classified as favouring the smaller users. For the 400 kL/a user, Emerald has the lowest bill among the five communities. Similarly to Maroochy, the Emerald approach provides a reasonable incentive and reward to consumers who conserve water as the fixed charge for average usage is only 35% of the water bill.
- *Ingham* has a relatively high fixed charge and the lowest volume charge among the communities, which reflects the low cost structure for water supply in this township. This type of structure is biased towards the high users and toward revenue stability, resulting from a low usage charge and a high fixed

charge. There is only a small incentive, or reward, to lower water usage through the conservation of water.

Emerald and Ingham provide a good comparison of the impacts of two basically different tariff approaches. Emerald has a low fixed charge with a high volume charge, and Ingham has a (relatively) high fixed charge with a low volume charges. These differences can have a profound impact on the revenues and margins of a water authority, as well as on the performance of the customers with respect to conservation.

5.6 Discussion of Existing Strategies

Comments and inferences, drawn from the above rate structure evaluation, are summarised below under key topics. The notion of fairness or equity is integrated in the respective topics as applicable.

5.6.1 General

There has been a strong movement in Australia away from a single fixed charge (minimum charge) associated with an allocation of a specified amount of annual usage. This change is related to the COAG reforms at a national level and to some extent the IPART rulings in NSW. All of the pilot communities except Mackay have replaced the minimum fixed charge and allowance approach to a standing charge with a usage charge. Of the pilots only Toowoomba uses a two block structure with the second block starting at the 325 kL/a. Mackay uses two blocks, however the first block is the allocation of 300 kL and the second block, commencing at 1,500 kL, is directed at non-residential customers.

The single rate pricing structure (as currently in areas such as Maroochy) is considered by some economists to be the fairest of all structures since it charges all customers in the same manner. Opponents of the single unit charge argue that there are costs related to peak demands in the existing water systems (larger pipe capacity) that should be paid for by those who cause the peak demands. Hence, they advocate a two or three block usage rate structure to distribute peaking costs to peak demand users. The counter argument is that the greater volumes of water paid for by the peak users, takes into account payment for the oversized piping required to serve them. This may be a valid counter argument where the bulk water supply is not a critical issue.

If water supply is short, or the cost of marginal peak supply is high, the conservationist argument is that those who cause the peak demand are the cause for the required new capacity and should pay for the capacity in a second or third block rate. A counter argument is that the operation and maintenance costs of larger pipes are less per unit of water delivered than for smaller pipes. A more subtle conservationist argument is that a price signal should be given to users at the high end to give them a choice to avoid the higher price by reducing consumption, which in turn avoids the capital costs of new capacity. A counter argument is that the overall population and account growth is the cause for dwindling excess supplies and that new customers, via developer charges, should pay for the new capacity.

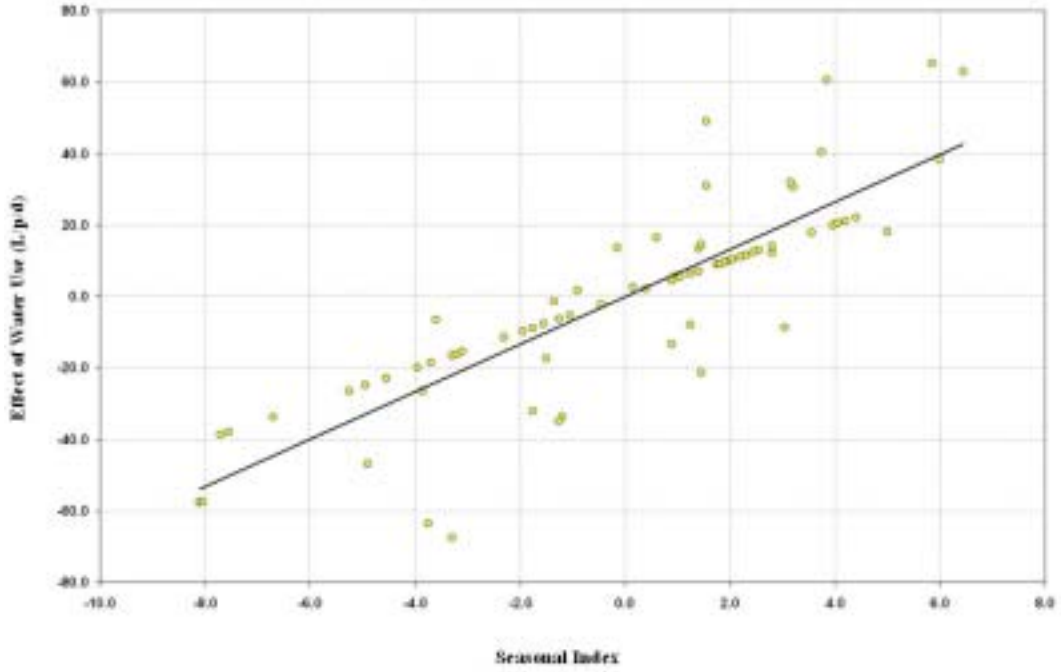
5.6.2 Fixed Charges *versus* Usage Charges

There is no universally applied standard for the derivation of the fixed (or standing) charge. Many authorities start with customer costs in developing the standing charge. Customer costs generally include meter reading, billing and collection, customer accounting, customer service including leak investigation, and other customer costs as defined by the local utility. The logic is that these costs do not relate directly to water production and should be recovered as a separate charge. This logic is a bit arbitrary since there are other costs (legal, executive, information systems, etc.) that don't relate directly to the production of water. As a practical matter, most utilities use discretion in assigning costs to the category that will be recovered by the fixed charge.

Financial managers generally prefer to have a high fixed charge to provide greater revenue stability in times of prolonged wet weather during the normal peaking season. An alternative is to have *wet weather* cash reserves to meet spending requirements during periods of revenue shortfalls.

As discussed in Section 4 of this report, water use is quite sensitive to weather conditions above and below normal. The normal seasonal consumption pattern is defined by means of a *seasonal index* that relates the per capita monthly water use to a combination of climate factors that are defined for an extended period of 10 years or more. The seasonal index provides a normal, or average, weather related demand response for the community. The typical impact of weather on demand is illustrated in **Figure 5.1**. The graph illustrates for a particular authority, that for a departure of +6.0 points (above normal) in the seasonal index, the monthly water use will increase by 40 L/p/d, on average, above normal. Similarly the reverse effect will occur if the seasonal index is negative, or below normal.

Figure 5.1: Typical Response to Climate Variation



Conservationists and advocates for the low water users (often those with lower incomes) support the approach of having all or most of the water revenue derived from the usage rates. Usage rates would be higher in this scenario and water users would be faced with

a stronger economic signal for every potential use of water. This approach may however result in wider variations in revenue during peak seasons and especially in periods when restrictions are in force.

Water is basically an inelastic commodity, which means that water consumption is not strongly affected by price except where significant changes are adopted. Consequently, the effect of lowering fixed charges is usually to reduce demand by a few percentage points during the peak season, and to a lesser degree during the balance of the year. However, seasonal revenue variations could be expected to be greater than with a high fixed charge applied. The effect on revenue from wet weather and from restrictions could be substantial and must be provided for (with cash reserves) if a low fixed charge / high usage charge approach is used.

A number of studies sponsored by AWWA in the US have shown that up to (depending on the utility's source of water, treatment system, etc.) 80 percent of the total cost of water production is fixed. It is not known if any similar studies have been undertaken in Australia, however, similar high levels of fixed cost would be evident in systems such as those utilising bore water with little or no marginal costs (possibly only electricity) for water production. In economics, costs that do not vary with the amount of product produced are referred to as fixed costs. Examples are rent, insurance, taxes, and most general or administrative expenses such as salaries, public relations cost, and so forth. Fixed costs are contrasted with variable costs that vary directly with the amount of product produced. Consequently, if the total cost of production is $1.00, and the water is sold at $1.00 (in a non-profit authority), then each unit of water sold during the peak months and to new customers will contribute about $0.80 to variable margin or burden absorption. It should be recognised that incremental water sales contribute greatly to the revenue stream and growth helps pay for growth in facilities. The other side of this phenomenon must also be recognised. Wet weather or restriction programs that reduce water sales will negatively affect revenues by the same variable margin.

Figure 5.2 helps to demonstrate the differences in the distribution of revenue for a range of fixed and usage charges for a small city. The example assumes that:

- The city has 15,000 customers consuming 4,500 ML per year.
- The required revenue is $6,750,000.
- Fixed costs have been calculated to be $5,400,000 or 80% of total cost.

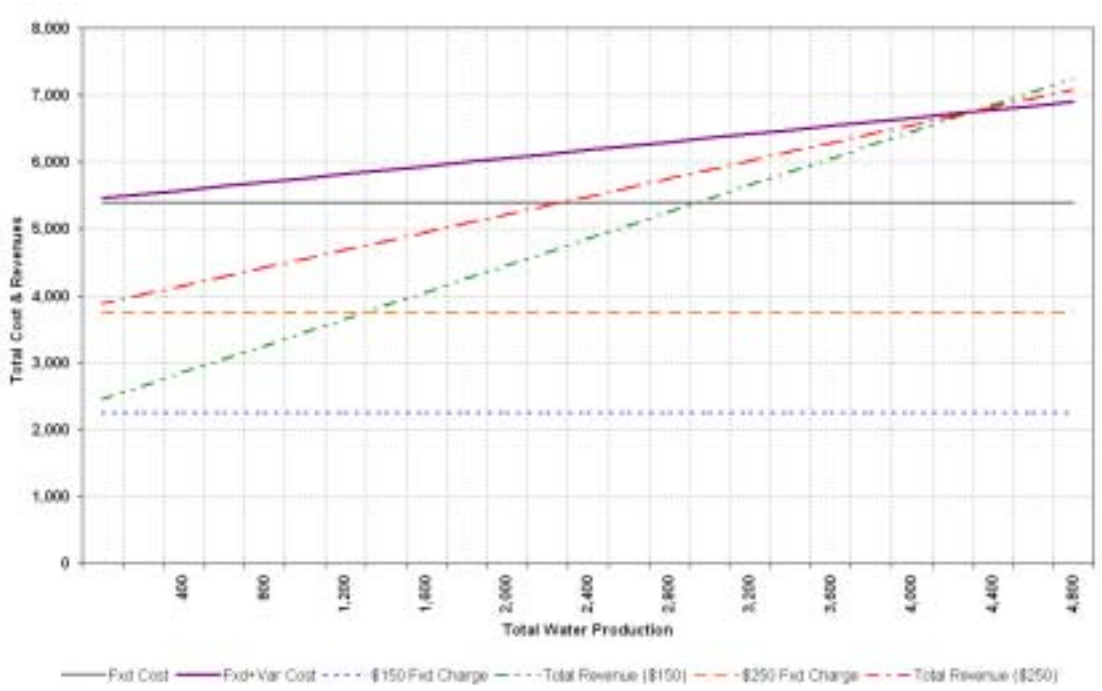
Three different combinations of pricing policy, which will provide a breakeven revenue stream, are illustrated in **Figure 5.2**.

Scenario 1 Assume a $360/a fixed charge (80% of total revenue) and a usage charge of $0.30/kL.

Scenario 2 Assume a $250/a fixed charge (55% of total revenue) and a usage charge of $0.67/kL.

Scenario 3 Assume a $150/a fixed charge (33% of total revenue) and a usage charge of $1.00/kL.

Figure 5.2: Illustration of Different Rate Scenarios to Achieve Target Revenues



The following comments are made regarding the illustration in **Figure 5.2**.

- Scenario 1 (top set of lines) heavily favours the concept of revenue stability and therefore risk minimisation. It is evident that the target revenue will nearly always be achieved no matter what the climatic conditions as the percentage of revenue needed from usage is low compared to the total revenue.
- Scenario 2 (central set of lines) slightly favours conservation as it provides to the consumer an incentive to conserve water. Conservation efforts under this scenario provide a significant reward to the user i.e. a saving of $0.67 for each kL saved.
- As the fixed charge decreases to the Scenario 3 level (bottom set of lines), the risk of falling short the target revenue due to climate related demand reductions increases. Similarly the risk of over-shooting the target is higher. The obvious advantage in this scenario is that a conservation message is given by the pricing structure.

Since most utilities are risk averse, financial managers are more interested in stability than the possibility of generating excess or shortfall revenues and therefore Scenario 1 or 2 are adopted. Proposals for lowering of fixed charges to provide a conservation message through providing maximum reward for participation need to be developed with these considerations in mind. Risks should be fully investigated taking into account the response to varying climatic conditions.

5.6.3 Billing Practices

The current billing practices in each community vary primarily in the frequency of billing. Emerald, Ingham and Maroochy bill quarterly whilst Mackay, and Toowoomba bill twice per year. The most important issue relating to the frequency of billing is the

opportunity for feedback to the customers of their performance with respect to water use.

A community survey conducted in the Grafton / Coffs Harbour region in 1999 confirms that the typical water customer is not highly knowledgeable as to the cost of water. This general lack of knowledge about the cost of water has a bearing on customer sensitivity to changes in tariffs. Switching to a monthly, bimonthly or even quarterly meter reading and billing cycle would provide the basis for awareness of the relationship between water use and water bills. Without timely feedback that provides data on water use, there is not likely to be a measurable or sustained response from nominal changes to the tariff structure. If the meter reading / billing system cannot be changed in the short term, perhaps the annual meter readings could be broken down (using the monthly seasonal index) into typical monthly volume. Water usage could then be billed monthly (with graphics) so that the customers will see the opportunities for reducing peak irrigation use and their future water bills.

Current practice does not provide consumption history on water bills. Such information is required by customers to enable them to properly select the most effective measures to reduce their water usage, and to monitor their effectiveness over time.

A best practice billing approach is to include sufficient information on the water bill to provide:

- Feedback on consumption over the past period or same period last year, on a period and per day basis.
- Comparison with the average usage in the particular customer category.
- A graphic of the consumption over the past year possibly with a comparison against the system average (this approach would provide the data from the above two points).
- Messages about how to check the meter for accuracy and undetected leaks where a significant change in consumption has occurred.

Many of these approaches are undertaken in the energy industry, and with changes to computer systems, should be feasible at present or in the near future.

5.7 Price Responsiveness

5.7.1 Price Elasticity

Price elasticity is a measurement of the responsiveness of demand to a change in the price of a product. Technically, it is the percentage change in demand divided by the percentage change in price. It is always a negative value ranging from 0 (perfectly inelastic) to – ∞, which is perfectly elastic. In the water supply, legitimately calculated elasticity values range from –0.01 to about –0.5. The calculated elasticities for internal and external water use are greatly different, consequently elasticities should always be evaluated separately for summer and winter consumption, data permitting. Internal use elasticity tends to be in the range of –0.01 to -0.20 or -0.25. External use elasticity

tends to be in the range of –0.20 to –0.50, and occasionally a little higher, especially if water use is purely irrigation.

***Example**:*

Assume elasticity to be –0.2 which means that a 10 % increase in price will lead to a 2 % decrease in quantity consumed by virtue of the equation **$\%\Delta q/\%\Delta p = -0.2$**. If this elasticity holds true, beginning with a price of $1.00 per unit of water and a volume usage of 1,000 L/p/d, a new price of $1.10 (+10%) will then lead to a reduction in use to 980 L/p/d (–2%).

5.7.2 Evaluation of Community Responses

Price responses (elasticity), related to the rate changes for the 5 pilot communities cannot be accurately calculated for a number of reasons:

- Only bulk production data is available and water use must be disaggregated by customer group to reflect a homogeneous pattern of use. If domestic use comprised most (say, 90% or more) of the production, a valid analysis might be possible.
- The pricing changes that took place included allocations until at least 1995/6 in most cases, which does not allow a direct price / quantity evaluation. The demand response following the removal of the base allowance could only be analysed if the customer sectors could be isolated.
- Restrictions, voluntary or mandated, were imposed or implied (with the introduction of user pays pricing) in some of the communities preventing a bona fide evaluation of the price responses.

5.7.3 Price Response Observations

Price elasticity is a perennial topic of discussion in the water industry, particularly in times of supply constraints that prompt restrictions and concerted conservation efforts. In non-crisis times, price or demand elasticity can be an important variable influencing water use.[4] The effects of price are often misunderstood, however, leading to inappropriate actions and unintended results.

5.7.4 Nominal Rate Increases

Water is an essential commodity for which no substitute exists. Furthermore, water is generally inexpensive and a small proportion (<1.0%) of average household income. Rate increases must be 10 percent or more (in real dollars) to show any impact on water consumption if no other non-price factors are present. Moreover, an occasional increase of 10 or 15 percent to meet a one-off cost increase, such as a large new debt service payment to finance major new facilities, will not evoke a significant or sustained response. The number and amount of prior rate increases also makes a difference. If water rates are currently high and significant reductions in consumption have already occurred then additional rate increases will have lower elasticity (response) than prior increases. The demand hardens as discretionary applications for water diminish.

[4] Weber, Jack A., Forecasting Demand and Measuring Price Elasticity, Journal AWWA, May 1989

5.7.5 Portability of Factors

Results of price or demand elasticity studies in one community, at one point in time, are rarely directly transferable to another community, or to another point in time. For example, one water authority might be a very low cost producer with traditionally low water rates (e.g. Ingham), while another authority may have very high cost water with traditionally high rates (e.g. Maroochy, Toowoomba). Chances would be good that a 15 percent increase in price would have little effect on consumption in a community with the low rates and some effect in the community with high rates. They could even respond similarly if the traditional prices have been ingrained in their budgets and lifestyle. There are many determinants in these situations such as different rate structures, household income, weather, lot size, urban/rural, management/customer rapport, public education and many more that cannot be normalised in the recipient location to make the portability of elasticity factors tenable.

It is simply coincidental if the elasticity of one authority could be transferred to another. Nevertheless, under some conditions there will be a price response, and there needs to be a means of estimating the reduction. The logical way is to take a visual or judgmental average from other studies that are deemed to be similar to the particular instance being investigated. The wise practitioner will first build excess cash reserves as a safety valve and attempt to err on the high side in estimating the elasticity factor to use. The higher the actual elasticity, the greater the reduction in consumption and the lower the revenue after an increase.

5.7.6 Price Elasticity During Droughts

Calculation of price elasticity factors during drought crisis periods, when temporary drought rates might have been adopted, will not yield an elasticity that can be attributed solely to price. The calculated elasticity will include the downturn as a function of price unless all (or most) of the other influences are accurately quantified and included in the analysis. These other non-price influences simply cannot be accurately quantified, so the price elasticity factors will reflect some measure of composite causes of the overall effect during a drought or crisis period. The most useful approach to measuring the water saving response during a drought is to evaluate the overall response in prior droughts for the utility and other utilities with similar characteristics. Consideration must be given to the severity of prices, restrictions, and media involvement that may have occurred in each prior situation and what is planned in the current situation.

5.8 Restriction Responses

Toowoomba is the only community in the study area that engaged in a restrictions program that is fully documented. Toowoomba City Council's program included a few months of odds-evens watering in 1993 and the introduction of sprinkler hours of use regulations in 1996. In the regression analyses undertaken for Toowoomba, the odds-evens program was marginally statistically significant (at the 9% level[5]) but the

[5] There was a 9% chance that the measured effect of odd-even watering occurred by chance. It is desirable that the probability of occurrence by chance be 5.0% or less.

sprinkler restrictions were significant with a virtual zero probability of occurrence by chance. The savings in water use for the two measures was -55 and -32 L/p/d respectively, which equates to 15.7% and 9.4% of average water use during the respective periods. These water saving figures are not considered statistically reliable, the odds-evens program because of its short duration and low level of statistical significance and the sprinkler restrictions because these were undertaken coincidentally with the introduction of user pays in 1996. Further data would be required to prove the level of savings for these measures, particularly for the analysis of the odd-even program.

The history of restrictions in the pilot communities is sparse and the combination of restrictions with the introduction of user pays pricing in many of the other areas of Australia prevents sound analysis of the direct impacts of restrictions. Results of a study, conducted by members of this project team in Cary, North Carolina, that did not include price changes is offered as an illustration of the magnitude of impact that is feasible from restrictions. A brief summary of the restriction program and the methods of analysis is given below:

- Cary is a town of 95,000 people in North Carolina, USA that is in the process of expanding capacity. In the meantime, severe shortages occur whenever consumption nears its peak. In 1999, restrictions were strictly enforced during the period 10 June to 27 July. An adjacent town, Apex, is served by Cary but did not employ restrictions of any kind. Apex was used as a control case to aid in the measurement of Cary's response since both towns were subjected to the same weather conditions.
- Regression models were undertaken for both towns using daily data for an eighteen month period prior to the restrictions. These models identified the water use pattern associated with weather variables and days of the week and the patterns projected through the restriction period.
- The differences between the actual and projected water use was attributed to the restriction program (and other customer behaviour efforts) for Cary. The difference between the Cary and Apex results was also attributed to the restriction program in Cary.

Findings of this analysis included:

- The regression analysis method achieved an R^2 of 0.82, which means that the weather variables explained 82 percent of the daily variation in water use during the period of analysis. This is highly reliable for a data series of this type and supports using this method to define restriction savings.
- The daily savings for Cary ranged from 0 to 30 percent with an average of 14.5 percent. This is contrasted with Apex, which had a daily average water use increase of 7.5 percent, using the same method of evaluation.
- This analysis suggests that in a crisis situation, the firmly enforced use of restrictions can achieve reductions in water use in the range of 15 to 30 percent.

The above results demonstrate that restrictions can be a highly effective means of reducing water use during key crisis periods of reasonably short duration. Chronic

shortages should be addressed by increases in supply, usually combined with conservation measures.

5.9 Evaluation of Alternative Pricing Structures

5.9.1 Water Pricing Structures

Different types of pricing structures were identified in Section 5.3. The one selected by any authority will depend on the need for constraint in water use and preferences of each community for meeting their needs. Following are some broad recommendations from which specific actions can be undertaken.

- The preferred model would probably be the two-part tariff comprising a fixed charge and a single usage block. The fixed charge may be varied by the meter size. This approach is generally adopted by all of the pilot communities except for Mackay. It is understood that Mackay may adopt a similar policy in the near future.
- An inclining block structure would produce the greatest opportunity for water conservation in the residential sector. If, in fact water conservation is the objective, as is the case in Toowoomba, the inclining block structure should be the preferred model.
- The use of a combination of tariffs for different customer categories should be a viable component of a user pays structure. For example, the use of inclining block for residential consumers with a single usage rate for non-residential consumers may be advantageous.
- Consideration needs to be given to setting the fixed charge at the lowest level consistent with achieving revenue stability. In such case, the risks relating to achieving revenue targets due to climate issues needs to be carefully considered. This approach would provide the customer with incentives in the form of financial rewards to practice water conservation.

5.9.2 Opportunities

The amount of any rate increase required is directly related to cost increases, but can also be related to strategy. For example, funding new capacity for new customers from developer charges rather than from water rates will significantly affect water rates for existing customers. Similarly, changing the rate structure, even with the same total revenue, can significantly affect selected customer bills. For example, eliminating the fixed charge and recovering all revenue from one or more usage charges would shift a larger proportion of total water revenue from small to larger volume customers. This section of the report reviews the effects of structural changes in revenue collection. In addition, some comments are also applicable to the magnitude of change.

In most communities, the residential customers are responsible for the highest demand peaking characteristics. Consequently, two block, or two tiered tariffs are often applied only to residential detached (or separately metered attached) customers. A further

reason for applying the two block tariff only to residential customers is that most communities do not want to discourage commercial enterprises from locating in their community. This might appear like a subsidy of the commercial sector, but many studies have been done which show that the increase water sales, jobs, and additional spending can, in fact, result in lower than otherwise water rates and a win-win situation for the community. Consequently, if a two block pricing structure were to be used, this structure should only be applied to detached residential customers. However, the single usage rate applied to non-residential customers can be separately set to maintain the current revenue proportionality between the groups.

5.9.2.1 Example of Two Block (or Two Tiered) Structure Impact

To illustrate the methodology used to determine the pricing levels and verify the impact of the change from a single usage rate to a two block pricing structure an illustration has been developed using water billing data from Mackay. The critical data required for such an analysis is consumption for the residential sector in blocks (number of accounts with consumption in 50kL amounts 100 –150, 150 – 200 etc). This data set was only available from Mackay based on the 1998 annual water billing summary. As Mackay currently does not have a user pays policy in place a typical pricing structure was adopted for the example. This structure assumed a fixed charge of $180 /a and a usage rate of $0.44/kL.

The point at which the second block starts is usually set at a level that allows 100 percent of typical cooking and sanitary needs, and a survival level of use for turf and garden irrigation. Typical internal and external uses per account in the Mackay area are 164 kL/conn/a and 136 kL/conn/a respectively. The total is 302 kL/conn/a. The level of use actually chosen for the second block is often set between the typical indoor use and the typical total use, that is, between 164 and 302 kL/conn/a as an added inducement to reduce discretionary water use, primarily outside or peak use.

There is any number of alternative combinations of rates for the two blocks that will generate the same revenue ($5,496,000) as the base case. A combination of $0.50 for the first block and $0.733 for the second block was selected for detailed evaluation in **Table 5.7**.

Table 5.7: Summary of Potential Revenue (Example Only)

Description	Alternative Tariff – Two Rate Blocks			
	Standing Charge	*First Block*	*Second Block*	*Total*
Residential Customers		13,860	4,140	18,000
Monthly Charge / Use Rate	$120	$0.500	$0.733	
Water Use at Rate (ML/a)		2,146	3,089	5,235
Revenue (millions $)	$2.160	$1.073	$2.263	$5.496

Table 5.8: Comparison of Single and Two Usage Block Pricing Structures (Example Only)

KL/a Blocks	Current Bill (1)	% of Billings	*Standing Charge*	*First Block (2)*	*Second Block (3)*	***Proposed Bill***	Difference $/Annum
100	$224	1.9%	$120	$50	$ -	$170	-$54
150	$246	6.2%	$120	$75	$ -	$195	-$51
200	$268	14.1%	$120	$100	$ -	$220	-$48
250	$290	26.4%	$120	$125	$ -	$245	-$45
300	$312	41.0%	$120	$150	$ -	$270	-$42
350	$334	57.1%	$120	$150	$36	$306	-$27
400	$356	65.1%	$120	$150	$73	$343	-$13
450	$378	77.2%	$120	$150	$110	$380	$2
500	$400	83.1%	$120	$150	$146	$416	$17
550	$422	89.0%	$120	$150	$183	$453	$31
600	$444	93.1%	$120	$150	$220	$490	$46
650	$466	96.2%	$120	$150	$256	$526	$61
700	$488	98.0%	$120	$150	$293	$563	$75
750	$510	99.1%	$120	$150	$329	$599	$90
800	$532	99.6%	$120	$150	$366	$636	$105
850	$554	99.9%	$120	$150	$403	$673	$119
900	$576	100.0%	$120	$150	$439	$709	$134

(1) Based on an assumed $180 fixed charge and $0.44/kL usage charge.

(2) ≤ 300 kL/a @ $0.500 / kL

(3) > 300 kL/a @ $0.733 / kL

The comparison in **Table 5.8** shows that the combination of a relatively low standing charge ($120/a) and two usage rates shifts more of the water revenue burden to the larger users. The reduction in the water bills at the low end, representing a maximum percentage decrease of 24% ($54/$224), is not likely to stimulate additional water use for at least two reasons. The volume at the very low end often represents low density rather than water savers, and additional water use (for those who really save on the changes) will boost the water revenue. The breakeven between the existing and two block scenarios is in the 450 kL/a block, which encompasses 77% of all detached residential water use. The penalties for high water use are not excessive until about the 650 kL/a block, but at this point only about 7% of customers face the deterrent charges. In the highest block, the two block structure results in a 23% rate increase ($133 / $576), however, there is no significant volume at this level to affect aggregate demand.

The key to success with the multi-block tariff is awareness of the dollar impact on the part of water users so that they must make an economic decision to use or not use water in specific circumstances. This is difficult with annual, half yearly or even quarterly billing. An alternative would be monthly or bi-monthly billing of quarterly or annual meter readings that reflects the seasonal usage.

It is our view that the differences in annual water bills from the two block rates will not yield a high reduction in water use, especially since the increases in water bills are not large with the rate combination used in **Table 5.7**. As there is little volume affected by

the upper block rate, the effect on overall volume would be small even if the upper block reductions were in the 9% to 14% range. Such a reduction equates to an elasticity of –0.2 or –0.3, which would be expected in this situation on the basis of the marginal rate change from $0.50 to $0.733 per kL.

A more effective approach might be to initiate the second block at 250 kL/a rather than at 300 kL/a. This would affect about 85 percent of total accounts and require a different combination of block rates. Two different combinations would be: $0.500 and 0.687 and $0.400 and $0.722. With the latter of these rate combinations, the water bills for customers with low volume would reduce to more than the scenario in Table 5.7 and the bills for larger customers would increase less because of the greater volume in the second block. This level of increase in the upper blocks is not likely to generate a measurable impact on water use.

A further complication in this process is the justification of the differential between the two blocks. Most water agencies attempt to justify the differential on the basis of incremental supply costs, which is usually not too difficult a task. Some simply call the differential a price incentive to reduce water use. When a customer is paying from 20 to 100 percent more for water in an upper block, there should be a sound basis for the rates.

5.9.3 Comments on Impact of Two Block Structure

There is ample evidence among the five communities that the combination of a low fixed charge and relatively higher usage charge has more impact on water use than the high fixed and low usage rate combination. In addition it is evident that implementation of user pays as a single action is not the prime mover for water use reductions. Rather the large impacts result from the public education/information program that surrounds the introduction of the structure and from the reality of real water supply problems that are presented to the customers with requests for constraint accompanied by the user pays rate structure.

The implementation of a two block structure is usually related to supply issues and is generally aimed at the high water users. As this structure usually only applies to the residential sector as this category of customers have discretion over external usage in particular, the issue of cross subsidy must be addressed. The community therefore requires a further driver for the adoption of higher pricing on a single sector. This driver is usually that the higher end user is the cause of the next increment of cost and therefore should be funding the increases rather than the lower level consumers.

5.10 Queensland Pricing Model

Based on the results of the demand and pricing impacts analyses it is clear that user pays pricing is being broadly interpreted in Queensland with a wide range of approaches and resulting pricing structures. In some cases the implementation could be rated as being successful, however there are issues such as the setting of the fixed charge and the impact of changes to the variable rate, which would benefit from a more uniform approach. Many of the smaller authorities in Queensland have limited resources and therefore find difficulty understanding the overall concepts and issues relating to the

introduction and maintenance of user pays pricing policies. It is an important step to be able to have the ability to test various alternatives and to demonstrate the results to the local council and community representatives.

The suggestion by QDNR to develop a spreadsheet based model to enable the impacts on revenue and customers of alternative pricing structures has significant merit. As shown in this study, the benefits of introducing a user pays pricing structure relate to at least 10% water savings, as evidenced in those pilot communities where the introduction has been combined with a public education campaign. The costs of developing such a model are estimated at around $30,000, with additional costs of $30,000 to distribute and promote the approach.

The aims of such a model would be as follows:

- To develop a *Consumption Based Charging Model* to assist Local Governments in the analysis of alternative charging mechanisms and to calculate the impact on the revenue as well as the possible impact on the customer by category.
- To develop a concise set of guidelines providing guidance and discussion of issues relating to the implementation of consumption based charging.
- To provide a detailed step by step user guide for the model.

5.11 Summary of Findings and Recommendations

In summary, the following conclusions are drawn with respect to pricing policy and related issues in the communities studied:

- Pricing Structures – Current Approaches
  - The use of a fixed charge and a single block usage rate has been adopted in Maroochy, Emerald and Ingham. Mackay has adopted an allowance of 300kL and a usage rate for higher consumption.
  - An inclining two block structure is in use in a Toowoomba with the second tier being some 250% higher than the first tier.
  - The highest standing charges are in Toowoomba and Ingham where the charge represents approximately 65% of the average annual bill.
  - Emerald and Maroochy have the lowest standing charges of around 30-40% of the average water bill.
- Billing Practices
  - Billing systems in all areas provided only basic billing information.
  - Billing frequency is quarterly in Emerald and Ingham and bi-annually in the other areas.

The following recommendations are made with respect to water pricing and billing practices:

- Pricing Structures
  - Consideration needs to be given to setting the fixed charge at the lowest level consistent with achieving revenue stability. This would provide the water consumer with the maximum reward for water conservation.
  - Inclining block (or two tiered) structures should be investigated for residential consumers to encourage conservation and reduce the demand of higher users in areas where water shortages or major works are being proposed.
  - The frequency of billing needs to be at least quarterly to provide feedback to consumers. A longer billing cycle results in the reduction of price related conservation over time.
  - The development of a water pricing model is recommended to assist in the preliminary assessment of user pays options for smaller communities.

- Billing Practices
  - Billing systems need to be upgraded to enable the production of water bills which provide more comprehensive water usage information to consumers.
  - The ability to extract data from billing databases needs to be enhanced to enable financial modellers and planners to effectively utilise data.
  - Water bills should enhanced to provide data in a similar way to the approach adopted by the energy industry. Bills should be capable of displaying:
    - Graphical and numerical representation of past accounts
    - Comparisons with average demand to provide performance feedback
    - Full cost of water, fixed plus usage charge
    - Conservation messages relating to the particular customer category.