11. DEMAND MONITORING AND METERING

11.1 Scope and Purpose

The implementation of a water efficiency or demand management plan should be monitored to ensure that the level of savings required to meet long range demand and strategic supply objectives is being achieved. In addition, the findings of the performance evaluation will provide the cost effectiveness information required for management to efficiently allocate funding and resources. Two types of monitoring and methods of implementation are recommended – the first to monitor the performance of an overall program and the second to evaluate the performance of individual measures. It should be noted that the data requirements for the initial development of a water efficiency program are similar to those for performance monitoring of overall programs.

11.2 Overall Program Evaluation

The first approach is to quantify overall conservation performance in any community where a program is being implemented. This approach will capture the collective impacts of pricing, water use restrictions, public information programs, attitude changes, naturally occurring conservation and water efficiency initiatives. It will also track the persistence or attrition of savings from specific programs for all future periods monitored.

The basis of the overall system performance monitoring system should be the forecasting/tracking models similar to those used to analyse historical water demand in the pilot communities. These models can be used to establish a baseline or pre-conservation level of water use based on historical activity, which can then be compared with water use after conservation measures have been put in place to derive a percentage performance. The models are best applied to particular customer categories, but can be applied to pilot areas, groups of individual customers, or the entire community.

11.3 Specific Program Evaluation

The second approach is used to quantify savings associated with the individual conservation programs proposed for any community. Except for the broad based public education and information measures, these programs apply to individual customers and can be evaluated on a before and after basis as well as by comparison with non-participant control groups of similar customers. This approach addresses the water-saving effects of individual measures in their specific application, which can be related to the cost of implementing the program to evaluate financial payback or cost effectiveness.

There are several statistical tests that can be uses to measure the difference in before and after conditions. The recommended method is the *matched pair test for two sample means*. This test compares the before and after water use for each participant customer in a conservation measure, calculates the mean difference, and the probability that the difference (savings) is statistically significant. It is best to simultaneously apply this test to a control group of non-participants of the same general characteristic and compare results to remove the effect of weather (or other causes) that might have caused a reduction in water use in both the test and control groups.

11.4 Breakdown of Customer Categories

11.4.1 Approach

As mentioned above it is important to the future development and monitoring of the program to have an effective customer category classification system. The most appropriate approach would be to utilise a similar system in all communities in Queensland. The general rule is to classify customers into "homogeneous groups" such as detached residential, multi-unit residential (permanent or holiday), tourist, commercial, public, irrigation and industrial. Such a breakdown is sufficient for summary data, however a finer categorisation may be necessary for detailed work. There is not a great deal of homogeneity, however, in many of the classifications. Multi-family comes in all sizes; commercial has small retail stores with little water demand as well as commercial pools, carwashes, small and large office buildings; the public category has major office buildings and local primary schools, small medical clinics and large hospitals, and so forth.

There are two approaches that are most commonly used to identify specific customer groups, which are then rolled-up into broader categories for reporting and for rating purposes. These are as follows:

1. **Rating Systems** - The rates section of most Councils establish the customer categories as the basis for various rates and charges. These codes are generally in the customer records database and can be linked via property data to billing databases.
2. **Water Billing Systems** - When water meters are recorded by the meter reader and entered directly to a hand held computer it is relatively easy to set up the property data with a code to identify the particular land use as the meter is being read. There is little judgement required with the standard codes and changes of land use can be readily identified. Changes to the use of buildings can be reliably and quickly updated using this method.

The preferred method is using the Water Billing System to capture the required data as the rates databases are often not changed unless a zoning change occurs. Therefore for commercial and industrial properties the land use is not always accurately known.

11.4.2 Typical Summary Customer Categories

Whatever the list may be for achieving local requirements, there should also be a summary list of customer categories that is not unwieldy and can be reported by all Councils to assist in the planning and assessment of water efficiency measures. A suggested list of customer categories for *Summary Reporting* is as follows:

- Residential Single Dwelling
- Residential Multi-Family – Permanent (number of dwelling units desirable) or Holiday / Tourist accommodation (number of dwelling units desirable)
- Commercial
- Public
- Institutional (including public hospitals, schools etc)
- Industrial
- Agricultural
- Total

The summary level of reporting should not be excessive. It is not the planning tool for the communities, it is only the basic classification for reporting to be used for fundamental common comparisons among the participants over time.

11.4.3 Customer Record Structure

For water and sewerage system, land-use, and community planning, it is usually desirable to have 30 to 50 customer classifications. If sewerage system planning is to be integrated with the water system for common customers, serious consideration should be given to establishing the customer categories on the basis of wastewater discharge characteristics, which could increase the number of classification to as many as 80 or 90 in a very large, diverse community. This may seem like overkill to the small community, but the customer type is just one 2 or 3 digit field in a customer record. If all the communities in the state use the same coding, they can have the same content in their summary reports.

The customer classifications provided in **Table 11.1** are aimed at the water supply side of planning. A practical way to develop a list of customer categories for Queensland is to start with a list, such as that below, and circulate it to all the Councils for their additions or deletions. Customer code numbers must be assigned that include the capability for roll-ups into summary groups. The first digit, for example, could designate the summary category, and the second and third digits designate the specific customer type. In this case there should be no problem with the number of classifications, smaller communities simply use the ones that are appropriate to them, and all communities will have data rolled-up into the same summary categories.

The more difficult aspect of the process is the design (or redesign) of customer records and the reporting software. Identical software is not required, of course, but whatever system is used must have a certain minimum level of capability to be able to adjust to a new or changed field and the ability to report in a prescribed manner.

Table 11.1: Suggested List of Customer Categories

Category	Property Descriptions
Residential Single Dwelling	- Single Family Dwelling - Duplex Dwelling
Residential Multi-Family	- Multi-unit –Permanent - Multi-unit - Holiday - Large Apartment Complex - Caravan Parks - Retirement Village
Commercial	- Car Sales - Auto Repair and service stations - Banks - Car Washes - Churches - Fast Food Outlet - Golf Courses - General Offices - General Shops - Shopping Centres - Health Care Facilities - Hotels and Motels - Laundries - Pools - Restaurants - Tourist Resort - Other Commercial
Public	- Council Offices - Libraries - Depots - Treatment Plants - Parks and Gardens - Sporting Facilities - Other
Institutional	- City and State government - Education-primary & secondary - Education colleges - Parks and Recreation - Other
Industrial	- General/Light - Manufacturing - Individual large industrial firms
Agricultural	- Irrigation - Stock Watering

11.5 Metering Practice

The adoption of user pays principles for water pricing requires, in addition to the determination of an equitable and reasonable pricing structure, the installation and

maintenance of a water metering fleet. Accurate data is also required from meters for planning purposes as discussed in the preceding sections. Maintenance of meter fleets is a major issue, as water meters tend to be accurate for only a limited volume of throughput. For 20mm domestic meters this volume is of the order of 5,000kL which is equivalent to between 5 and 12 years of usage, depending on the community.

Table 11.2 summarises the current position of the communities involved in this study. It should be noted that most authorities currently have a program in place.

Table 11.2: Water Meter Practice Summary

Urban Community	Size of Fleet	Average Age of Meters (years)	Bench Testing Program	Replacement Rate		Annual Budget
				No.	%	
Toowoomba	30,700	15	No	3,000	10	$150,000
Maroochy	27,500	8	Yes	1,000	3.6	$50,000
Emerald	2,900	10+	No	350	12	$23,000
Mackay	20,400	12+	Yes	3,700	18	$250,000
Ingham	4,020	11	No	350	8.7	$23,000

The following issues are raised regarding the current replacement programs:

- As the meter fleets are now fully used for determination of water bills in all centres accuracy is a concern of fleet managers. The issue in areas such as Mackay is that the fleet is old and contains imperial meters (currently being replaced) as well as older displacement meters with questionable accuracy.
- In most communities the existing meter fleets are reaching the replacement volume or age and replacement programs are being implemented. These programs are prioritised by reviewing areas with poorly performing meters based mainly on complaints.
- Only two communities currently have bench testing programs in place.

To achieve efficiencies in meter replacement it is necessary to understand the performance of the meter fleet. This understanding can only be achieved through the implementation of comprehensive meter fleet asset management. The consequences of a poorly developed program of meter maintenance are that meter accuracy is lowered in certain areas and the levying of charges without cross subsidy becomes difficult. Considering that meters tend to read low as they age (the deterioration may be up to 1.0% per annum), the newer metered properties may be paying 10% more than those with a 10 year old meter.

A secondary consequence of an under performing meter fleet is that the calculation of unaccounted for water using the Integrated Flow approach becomes less accurate. Again the bench testing of meters is needed to enable accurate adjustments to be made during the leakage calculations.

Based on the approaches adopted by the authorities surveyed there is recognition that accuracy in metering is an essential component of an equitable pricing policy. Attempts

are being made to implement asset management in the maintenance and replacement of meters, however there also appears to be some reticence to provide the funding and staffing required to develop a comprehensive program for meter maintenance. This aspect of system maintenance would benefit from a separate management plan as the assets are valued in excess of $5m in areas such as Toowoomba and Maroochy, and the maintenance and legal issues are significant.

Part of the approach to meter fleet management is the identification of meters that are possibly providing erroneous data through detailed and automated analysis of a series of meter readings. Where the reading is outside the normal expected range it may be appropriate to develop exception reporting to either provide a message on the water bill regarding the increase in consumption (noting that an internal leak may have occurred and advising how to read the meter), or to identify the meter as a low reading meter for bench testing. The latter may also be used for determining areas where the water meters may be reaching their performance limit.

Best practice in the management of a water meter fleet would include the following aspects:

- Development and maintenance of a register of water meters using unique identifiers. Information such as the location, date of installation, contract/job number, cost etc should be recorded.
- Implementation of a planned bench testing program to determine the performance of the meters throughout their planned life.
- Development of a planned replacement program to enable long term costs to be included accurately in the financial planning and setting of water prices.
- As suggested above these aspects should be included in a separate management plan as part of the total Management Plan process.

11.6 Summary of Findings and Recommendations

Review of the current systems for monitoring water demand in the pilot communities indicate that:

- Monitoring Data – Billing Systems
  - Water meter billing data linked to land use data is difficult to access in most local authorities.
  - Land use categorisation in many existing water billing databases does not allow for use of consumption data in water efficiency modelling and general system planning.
  - Land use categorisation is best achieved through field entering of codes during meter reading.
- Monitoring Data – Bulk Systems
  - Daily total production or demand is needed to undertake overall system performance assessment.
  - The accuracy of bulk flowmeters needs to be the focus of managed calibration programs in all areas.

- Water Meter Fleet Management
  - Fleet management is currently an ad-hoc process, which may affect the equity aspects of user pays pricing strategies.
  - Asset management plans are required for the maintenance of meter fleets. These plans should include an annual bench-testing program to develop a full understanding of the accuracy of the meter fleet.

The following recommendations are made regarding demand monitoring and metering systems:

- A standard land use classification system should be adopted for Queensland Land Governments to enable demand analysis and standard reporting and performance comparison.
- Management Plans be developed and implemented for water meter fleet management.