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BATHURST REGIONAL COUNCIL

Bathurst Regional Council

Water Conservation and Demand Management Strategy

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DLM Environmental Consultants Pty Ltd

Strategies for a Water Efficient Future

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FOREWORD

This current drought, which began in the Murray-Darling Basin in 1997/98, has focussed attention on water use and water conservation like nothing before. The impacts of climate change are also affecting the way communities think about and use water. Climate change may also impact on Council in terms of planning for future augmentation works.
Restrictions on water use have now become quite commonplace and Bathurst Regional Council is keen to explore every option to reduce demand.

This Water Conservation and Demand Management Strategy has been prepared to provide options for Council to consider in addressing and managing demand.

A range of demand management options are discussed and modelled, leading to a suggested list of actions for Council to consider.

Acknowledgements

DLM Environmental Consultants Pty Ltd acknowledges the considerable contribution of Bathurst Regional Council staff, particularly, the Manager Bathurst Water and Waste Authority, Mr David Swan and the Water & Sewer Manager, Mr Russell Deans.

Note:

This Strategy is to be reviewed and revised every two years.
The next review is scheduled for 2011

Executive Summary

Introduction

The Bathurst Water Conservation and Demand Management Strategy addresses:

- General concepts of water conservation and demand management
- Modelling of a range of demand management scenarios specific to the current water consumption patterns in the City
- The links to issues identified in Council's Integrated Water Cycle Management Plan
- Current water conservation initiatives implemented by Council

leading to a suggested list of additional actions that Council may consider implementing to enhance its existing programs

Water Conservation and Demand Management Options

A range of demand management options is discussed in the Report, including:

- Water use efficiency
- Pricing policy
- Use of rainwater tanks
- Residential greywater reuse
- Stormwater collection and reuse
- Reuse of reclaimed water
- Groundwater use
- Water sensitive urban design

Modelling

Modelling of the current water consumption trends in Bathurst was undertaken utilising the Department of Water and Energy's "Demand Side Management Decision Support System Software (Version S1.1), 2006"

This assessment considered the following aspects:

- analysis of the current water production (water treatment) records to estimate Unaccounted for Water (UFW)
- determination of current water consumption by customer category
- Analysis of the historical water production records to determine a starting point for water demand forecasting and to estimate the current peak to average demand ratio.
- Development and analysis of integrated scenarios, each containing different water demand management measures. The Traditional Scenario, which provides baseline data against which the impacts of different water demand management measures can be compared, was also assessed.

- Analysis of the water management scenarios. The following aspects have been assessed:
    - preliminary cost/benefit ratios and water savings for the individual water demand management measures that were included in the integrated scenarios; and
    - water demand and effluent generation forecasts for the next 30 years for each of the scenarios.

Water Consumption Profile

Total water consumption in Bathurst in 2008/09 was 5780 ML. The population of Bathurst according to the 2006 census is 32,700 people and the City is growing at a steady 0.9% pa.

Per capita water consumption is relatively high by State and National standards, at 737 litres per person per day.

Unaccounted for water, since 1995/96, has averaged 13%. (Unaccounted for water (UFW) includes unbilled authorised consumption, unauthorised consumption, apparent losses and real losses). System losses in 2008/09 have been assessed at approximately 10% of the water treated at the Water Filtration Plant; which is quite high and may reflect the age of much of the existing water supply infrastructure.

There is some doubt about the actual system losses. As a result, in order to measure these losses, Council is working with the Water Directorate to establish system zones and to install appropriate metering equipment.

Peak day usage is 2.1 times average day usage.

Water Demand & Wastewater Flow Forecasts

Four integrated demand management scenarios were modelled in this investigation. The modelling has indicated that:

i) Conservation pricing for residential users, dual reticulation for all new residential development and BASIX, with both rainwater use and dual reticulation will deliver the greatest benefits in terms of **water savings**.
Permanent low level water restrictions and rainwater tanks for all new residential development will also yield significant water savings.
Conservation pricing is shown to yield the highest annual water savings with clearly the highest utility and community **benefit/cost ratio.**

ii) Full uptake of the demand management initiatives modelled may deliver significant water savings – up to 1,317 Ml/year (or 23% reduction) for Scenario 4 initiatives.

iii) The results indicate that the capacity of the Water Treatment Plant will not be reached until 2038. Implementation of demand management initiatives is expected to extend the life of the plant (in terms of capacity) well beyond the 30 year planning horizon.

iv) the capacity of the Sewage Treatment Plant is expected to be reached in 2025 (under the Baseline Scenario). Life expectancy could be extended to 2029 (under Scenario 3) and 2032 (under Scenario 4).

Summary

Council has demonstrated a commitment to water conservation in the City and has implemented a range of initiatives which, based on the general reduction in water consumption since 2003/04, has been quite successful, particularly with a consistent growth in population of 0.9%.pa

These initiatives include most of the elements which the model predicts will deliver the greatest savings at the best benefit/cost ratio, namely, BASIX requirements for all new homes, conservation pricing, and rainwater harvesting.

Recommendations

To further improve water conservation in the City, the following additional actions and programs are recommended for consideration:

- Implementation of a City wide leak detection program, particularly targeting the old areas of the City and budgeting to repair leaks and/or replace leaking infrastructure
- Developing a schools based water use education program
- Developing an annual (spring and summer) media campaign (newspaper, radio and television)
- Introduction of permanent low level water restrictions; aimed at eliminating hose down of paths and driveways and restricting garden and lawn watering to low evaporation times of the day
- Increasing the ratio of second tier to first tier charges for consumption from the current 1.5 multiplier to, say, 2.0; to send a stronger message of water use restraint to ratepayers; or decreasing the allowance for first tier use from the current 250 kL to, say, 200 kL (with appropriate consideration of customer service obligations)
- Further investigating cost effective options for increased effluent reuse within the City, particularly in the watering of parks and reserves relatively close to the Wastewater Treatment Plant
- Developing and providing an audit program for businesses and industries (including high water users like motels, hotels and laundries) aimed at investigating leaks and other ways these businesses can reduce their water consumption.

TABLE OF CONTENTS

Tables

Figures

Appendices

A: INTRODUCTION AND BACKGROUND

A1: BACKGROUND

Over the 50 years leading up to this current drought, urban water use in Australia increased by nearly 3% pa. Over this period, the major increases in water usage have been on gardens and lawns, swimming pools and evaporative air conditioners.

In 2006, Australia ranked 7th in terms of our "total water footprint (per capita)", BUT, 1st in terms of domestic internal water consumption (ahead of Canada and the USA). [Source: *Water Resource Management, 2006*].
Annual average per capita water consumption in Bathurst has been assessed at 737 L/assessment/d, or 283L/capita/d. This is relatively high by state and national standards.

Household water use in NSW in 2007/08 averaged 170 kL per property (compared with 241 kL in Bathurst). Average consumption in "inland" NSW averaged 230 kL.
Australia wide, average annual household consumption in 2004/05 was 103 kL/person, a decrease of 8% over the 2000/01 consumption (due to the drought and limited water availability in many parts of the country.
It is now widely accepted that due to increasing urban populations, recurrence of drought and the potential impacts of climate change, there will be increasing pressure to reduce urban water consumption in the future.

There is, therefore, a perceived need to introduce water conservation and demand management initiatives in Bathurst.

It should be noted, however, that Council will need to structure its pricing policy to accommodate reductions in water use in the City. The water supply business will need to ensure sufficient funds are collected to ensure the capacity to carry out necessary maintenance and repairs, as well as to meet the planned capital works commitments. This should be addressed in Council's Financial Management Plan and 30 year Capital Works Programs.

It is also important to note that Council has significantly upgraded its water supply and distribution systems in recent years (to accommodate growth). This will ensure that major upgrades are deferred for a considerable time. The achievement of additional water consumption reductions will serve to further defer any major capital works.

A2: WHAT IS DEMAND MANAGEMENT?

Essentially, demand management is the implementation of initiatives and measures to control and/or reduce water consumption.
Typically, a Demand Management Plan will include a range of management measures, including:

- cost-reflective pricing;
- universal customer metering in order to implement pricing measures;
- operational measures, such as reticulation leakage detection and repair programs and pressure reduction;
- a communication strategy, including a community education campaign;
- customer advisory services;
- incentives for installation of water efficient equipment and landscapes and retrofitting of water efficient equipment;
- reduction of water use by the water utility itself;
- regulation of the efficiency of water using appliances, especially in new buildings and for garden watering;
- use of reclaimed water to reduce the need for fresh water supplies;
- water use restrictions, either on a temporary or permanent basis.

These measures can be short term or long term. Short lead time initiatives include:

- water restrictions
- pricing
- Retrofitting programs.

Longer term options include:

- overall reform of pricing structures
- leak detection and water loss correction
- water efficiency measures in new buildings.

Implementation of demand management measure provides benefits for customers, the environment and the water utility itself.

Some of these benefits included:

- deferral of major capital works (augmentations)
- protection of the water resource(s)
- financial benefits to customers
- energy savings
- reduced wastewater flows (with associated operational cost savings).

Bathurst Regional Council has implemented a number of water conservation initiatives. These are discussed in Section E.

A3: BATHURST'S WATER SUPPLY AND SEWERAGE SYSTEMS

Bathurst Regional Council serves a population of 32,700 (13,892 assessments) with water supply and sewerage services. (Source: DWE Annual Performance Reports, 2007/08)

Raw water is drawn from the Macquarie and Campbell Rivers and two (2) bores (to supply Hillview Estate with a non-potable supply).
Council has two (2) storage dams with a total capacity of 31.8 gigalitres (Chifley Dam and Winburndale Dam).

The water supply system also includes:

- a conventional water treatment plant (capacity: 60 ML/d)
- 17 service reservoirs (total capacity: 91 ML)
- 10 pump stations
- 47 km of trunk water mains
- 293 km of reticulated water mains

The sewerage system comprises:

- a tertiary standard treatment plant (intermittent extended aeration, with biological nutrient removal; capacity: 55,000 EP), with discharge to the Macquarie River
- 15 pump stations
- 10 km of pressure mains
- 345 km of gravity trunk and reticulation sewers

B: WATER CONSERVATION AND DEMAND MANAGEMENT: GENERAL CONCEPTS

B1: BACKGROUND

There is a strong desire from Council to critically review water supply demand management in Bathurst. Either consumption needs to be reduced or alternative water supply options (reclaimed water, rain water and/or storm water harvesting, grey water reuse) and/or systems introduced. The first option, reduced consumption, is clearly the primary objective and provides the best environmental outcomes.

A range of alternative water source options are presented and modelled in this Report including harvesting via rainwater tanks, re-use of grey water, stormwater harvesting, reclaimed water re-use and groundwater use.

This Section of the Report (Section B) discusses a range of demand management options which Council already has programs for or may wish to consider in future programs.

Some of Council's existing programs are discussed in this Section. More detail on Council's initiatives are contained in Section E: "Current Water Conservation Initiatives"

Council also publishes on its website (www.bathurst.nsw.gov.au/environment/sustainable-products-a-services-guide) a Guide to Sustainable Products and Services, where residents can access information on a range of available products and services, including:

- Green building practices
- Sustainable building and renovations, including rainwater tanks, solar panels and building products
- Sustainable urban developments
- Independent assessment of environmentally sensitive products
- Energy and water efficiency rebates
- Adapting to climate change and reducing impacts

Section C presents the results of modelling for this range of options and ranks them in terms of potential water savings and benefit/cost ratio.

B2: STRATEGIC OBJECTIVES

In relatively recent times, water authorities and their communities have become truly aware of the importance to our survival of water and of its limited availability.
The way in which we address these challenges will govern how we deliver:-

- healthy landscapes and environment
- community health
- community lifestyle
- future growth and development of the City
- long term sustainability of our water resources

There are a range of issues which can affect our current thinking about water consumption, such as:-

- water use minimisation in our urban environment
- water efficiency options
- demand management, including pricing reform
- alternative systems and approaches to water use including:
    - integrated urban water planning
    - grey water reuse
    - use of rainwater tanks
    - recycling water reclaimed from sewage treatment processes
    - urban water harvesting
    - use of groundwater
    - water sensitive urban design and development.

The importance of on-going community education and awareness programs (including school based programs) cannot be over emphasised.
Such campaigns should contain relevant, readily understood information and should incorporate printed (brochure type) material, fact sheets, media messages and school kits.
It is also important that the material is updated regularly to include current water use statistics; restrictions; water availability, etc.

B3: DEMAND MANAGEMENT STRATEGIES

B3.1: INTRODUCTION

Demand management initiatives can provide better value for money for customers as well as improved environmental outcomes. The aims are to assist consumers to use water more efficiently, to reduce wastage and system losses and to enable better communication with the community.

A key benefit of demand management is the potential deferment of capital investment in new capital works, as well as reduced operating costs.

B3.2: DEMAND MANAGEMENT OPTIONS

Water Demand Management involves the adoption of policies and financial investment to ensure efficient water use by all consumers within the community. There are a range of demand management options available including:-

- cost reflective pricing
- universal metering to enable implementation of the pricing policy. (all connected customers to the Bathurst supply system are metered
- operational measures, including leakage detection, repair program and pressure reduction
- community education and awareness programs designed to encourage voluntary restrictions and reduction in usage.

- customer advisory services, the use of incentives for installation of water efficient appliances and gardens/landscapes and/or retrofitting of water in-efficient equipment.
- regulation of the efficiency of water using appliances especially in new buildings and for garden watering.
- use of reclaimed water to reduce the reliance on and need for treated water supplies.
- water restrictions, either on a temporary or permanent basis.

B3.3: BENEFITS OF DEMAND MANAGEMENT

Demand management offers benefits to both customers and the Water Utility, including financial benefits, protection of the environment, energy savings, customer service and the reduction of wastewater flows.

Measures such as pricing reform, community education and advisory services aim to enable customers to achieve a balance between expenditure on water supply and the benefits they obtain from the supply.

B3.3.1: FINANCIAL BENEFITS

Well planned and implemented demand management measures can reduce costs significantly, primarily through avoiding or deferring the need for new capital works and also by reducing operating costs associated with pumping and water treatment. The potential for deferral of capital works is illustrated in Figure 1 below.

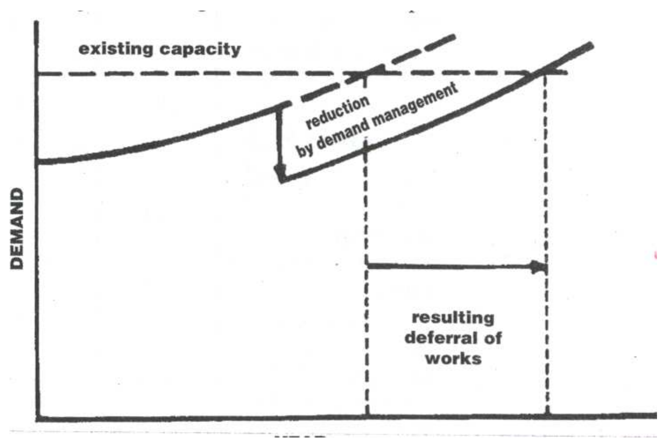


Figure 1: Deferral of Capital Works through Demand Management

(Adapted from NSW Public Works, 1991).

In country NSW, the State wide median annual residential consumption per property has been progressively reduced over the last 12 years from 300 kilolitres per property per year to 173 kilolitres per property per year (in 2007/08). The coastal average residential usage was 150 kL, whilst the inland average (reflecting the generally hotter, drier, conditions, was 230 kL). Although direct comparisons should not be made with State wide "averages", Bathurst's current residential consumption is close to the inland average, at 241 kilolitres per property per year. This has been achieved without the need to impose water restrictions; whereas most other inland centres have been forced to apply restrictions because of reductions in available source water.

B3.3.2:   REDUCED DEMANDS ON THE ENVIRONMENT

Reducing water demand reduces the urban footprint and our impact on the environment.

B3.3.3:   CUSTOMER SERVICE AND GOOD MANAGEMENT

Demand management is essential for effective and efficient management and can be a way to improve the level of customer service through improved customer contact and advisory services. Increasing the water usage component of the bill and reading meters and billing four (4) times per year enables customers to exercise more control over their water costs. (Larger customers' meters are read monthly, with bills also issued on a monthly basis)

Council is currently introducing a pricing regime which recovers 75% of costs via **consumption charges,** which is a powerful demand management initiative.

B3.3.4   ENERGY SAVINGS

A significant proportion of energy usage is for heating water for showers, restaurant use, glass and dish washing and washing down food premises. Some estimates are that hot water usage can be reduced by almost one third using cost effective water efficiency measures.

B3.3.5: REDUCING WASTEWATER FLOWS

Implementation of demand management measures will also reduce the volume of flow received by Council's Wastewater Treatment Facilities.

This will be of benefit by way of potentially deferring augmentation of treatment and re-use facilities resulting in substantial energy savings and therefore reduced greenhouse gas emissions.

The anticipated reductions in sewage flows may also adversely impact on cleansing velocities in gravity sewers, to some extent (resulting in an increase in flushing frequency), as well as increased concentrations of contaminants in the flows received at the Sewage Treatment Plant (which may require monitoring and adjustment of treatment processes)

B4: WATER USE EFFICIENCY

B4.1: INTRODUCTION

Urban water consumption is a combination of the way consumers use water and the efficiency of the appliances and equipment they use.

In addressing water use efficiency, a number of areas and issues need to be addressed and considered, including:

- Standards and water efficiency labelling
- Flush toilets
- Shower heads
- Flow regulators
- Taps
- Urinals
- Washing machines
- Dishwashing machines
- Outdoor water use
- Grey water re-use
- Waterless toilets
- Rainwater tank use
- Commercial/industrial water use efficiencies

Each of the above will be addressed in the following sub-sections.

B4.2: STANDARDS AND WATER EFFICIENCY LABELLING

Standards Australia has published efficiency standards for certain water-using equipment under the direction of the Water Efficient Appliances and Plumbing Committee of the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ). These standards form the Water Efficiency Labelling and Standards (WELS) Scheme.

This scheme covers the following products:

- Showerheads;
- Taps;
- Aerators;
- Flow restrictors;
- Dishwashing machines;
- Clothes washing machines;
- Water closets;
- Urinals;
- Domestic garden equipment.

These standards have been developed into a labelling scheme for water-using appliances, similar to that which operates for the energy rating of appliances.

The standards are outlined in a set of guidelines published by the Australian Government (www.waterrating.gov.au/publications). Appliances are rated according to water efficiency, or ratings (eg 'A', 'AA' and 'AAA'.), as well as water consumption or flow figures.

B4.3: FLUSH TOILETS

Flush toilets typically use 50 kilolitres of water per household per year which is approximately 16% of residential water use.

The market in flush toilets has been changed considerably in Australia by the introduction of the 6 litre/3 litre dual flush toilet suite. Until the late 1980s the standard flush volume was around 11 litre. The major water authorities then agreed to regulate for a 9/4.5 litre dual flush which had become widely available, in new and replacement installations. Now, with the development of the 6 litre/3 litre model, there is agreement from most major water authorities to require their use in all new and replacement installations.

Approximately 40% of Australian households own a dual flush toilet. The 6 litre/3 litre toilet has now become the de facto standard in new and replacement installations and is responsible for a substantial improvement in water efficiency.

Potential water savings for various capacity toilet cisterns are shown in Table 1.

Table 1: Potential water use and savings for various capacity toilet cisterns (Beith and Horton 1989)

Toilets	Water usage (litres per person per day)	Percentage reduction
11 litre full flush	55	STANDARD
9 litre full flush	45	18
11 litre/6 litre dual flush	35	36
6 litre full flush	30	45
9/4.5 litre dual flush	27	51
4.5 litre full flush	23	58
6 litre/3 litre dual flush	18	67

Bathurst Regional Council has funded, or is helping to fund, a number of programs to assist residents to reduce their water and energy use.

One such program is the 4-Star Toiletsmart program which, in partnership with Caroma – Dorf provides a simple way to replace old, single flush toilets with modern, low volume, single flush units, at a reduced (subsidised) price

B4.4: SHOWER HEADS

Shower heads use on average 50 kilolitres of water per household per year. Approximately 20% of Australian households own a water efficient shower head. AAA rated shower heads can save more than 25 kL/a for an average household.

The flow rate, or water efficiency of a shower head is not the only important criteria in its use. The 'feel' or user-comfort of a particular shower head and water pressure combination is important. The water efficient shower heads vary in spray pattern from those that provide a misty spray pattern from those that provide a misty spray to a needle-like spray. Others have a pulsating 'massaging' flow.

The factors that affect the comfort of a shower are:

- The velocity of the spray;
- The evenness of the annular spread of the spray;
- The difference in temperature of water from the top to the bottom of the spray

As with the Toiletsmart program, Council also participates in the 3-Star Showerhead exchange program by providing, at no cost to residents, a 3-Star WELS rated (9L/min) showerhead to replace more water inefficient units.

B4.5: FLOW REGULATORS

Flow restrictors are devices which can be inserted as a disc or threaded fitting in the shower arm connection. Flow restrictors are in fact often used on shower heads to reduce the flow, and most water efficient shower heads rely upon a flow regulator to reduce the flow and the shower head design to improve the spray pattern for user comfort.

This means that if a flow regulator is not matched to an appropriate shower head, a poor quality shower can result. This will depend on the shower head design, the pressure, the flow rate of the regulator and user preferences.

Flow restrictors are a less expensive alternative to a water efficient shower head. However, performance may result in them being removed after a short time, which reduces the impact of the demand management measure and creates customer resistance to the use of other measures.

B4.6: TAPS

Taps can be used either in a flow or volume situation. Examples of a flow situation are when a tap is used for hand washing or teeth brushing (as in a vanity tap), in which case the flow rate is not a major consideration and may be restricted without loss of convenience. In a volume situation the tap is used for delivering a volume of water as quickly as possible (as in a laundry tub or bath) and a flow regulator is not appropriate.

The simplest flow regulator is a tap aerator, incorporated in the tap spout, which mixes air with the water stream, providing the same level of service with the flow reduced by an amount dependent on the aerator. Most taps currently on the market are fitted with aerators. It is now possible to purchase aerators which incorporate a flow regulator.

Other types of flow regulators can be incorporated in the valve seat itself. Some companies have developed programs which involve the installation of such flow regulators in all water outlets in, for example, a hotel, hospital or other commercial or industrial installation. Although the main aim of such a program is to balance the pressure and flow rate in all the outlets, the water and energy savings can be substantial. These flow regulators often need to be installed by trained personnel.

Flow regulators for taps cost in the range of a few dollars to $50, and can reduce flow rates by over 50%. This can represent excellent value for a water efficiency measure.

In public places, slow release push button taps or centre return taps can help to reduce the water wasted through taps being left on. Knee, elbow or foot actuated taps are also common and overcome the usage difficulty of centre return taps. They are useful in circumstances where hygiene is a priority.

Ceramic taps are often used in situations where a quick response is needed ('quarter turn taps'). These taps have the advantage of providing a rapid shut-off and excellent wearing properties. They can also be useful where users have difficulty turning taps off tightly as a result of arthritis. Water hammer can be a problem in areas with high water pressure, and these taps are more expensive than most.

Many installations such as hospitals and nursing homes install thermostatic mixing valves to reduce the risk of scalding. These valves also help to reduce the unnecessary water use that occurs during temperature adjustment. These fittings are now being sold into the domestic market.

The use of electronic taps and electronic mixing valves with pre-set temperatures is not widespread but they are of potential use in hotels, hospitals or similar installations.

B4.7: URINALS

Urinals can be operated in a variety of ways, from cyclic flush, through to the traditional pull cord or button operation, to the 'demand-responsive' type controller which can sense the number of people visiting the toilet area or using the urinal.

Cyclic flush urinals are still in use in a number of places, and they can be one of the largest single water consuming devices in a commercial installation. A cyclic flush urinal, supplied by two 12 litre cisterns which are operating 24 hours a day, as many still do, can use nearly 2 ML/a. They should be the first target of any commercial and industrial advisory strategy, since many building owners and managers are unaware of the volume of water being wasted.

Many authorities have banned their use in new and replacement installations, and others have required all existing premises to install or retrofit demand-operated cisterns.

In many cases the motivation for installing a cyclic flush cistern is the belief that it results in reduced smell from the urinal in circumstances where users neglect to flush eg. in hotels or public buildings. The low price of water has also been a factor. The smell problem is often splash related, and is not adequately solved by cyclic flushing in any case, but can be addressed by signs, deodorising, frequency of cleaning and 'smart' controllers in high usage situations where the cost can be justified.

Aside from the pull cord operated cistern, urinal controllers come in various types:

- A pressure operated controller, which detects a drop in the supply pressure resulting from a nearby tap or cistern being activated and passes a pre-set amount of water into the cistern.

- A counter operated controller, operated by either an electrical or pneumatic door switch or a beam across the door, counts the number of people entering the toilet and allows a pre-set amount of water into the urinal for each count. These systems have the advantage that they can be retrofitted to existing cisterns, but they do require some cabling or piping work and installation of control equipment. These systems also do not distinguish between those people entering the toilets to use the urinal as distinct from the pans or hand basins.

- Sensor-operated systems use infra-red or microwave sensors to determine whether a person is using the urinal. There are also sensors which are operated by the salt content of the urine in the bowl.

- Waterless urinals are now available and are readily installed onto existing plumbing. They operate using replaceable sealed cartridges containing a fluid lighter than urine which provides an atmospheric barrier to the sewage system. This allows urine to pass through to the sewage system without relying on water for flushing. Cleansing is achieved by spraying with disinfectant.

B4.8: WASHING MACHINES

More than 90% of households own a clothes washing machine. The water efficiency of clothes washing machines is expressed in terms of the volume of water required to wash and rinse a dry kilogram of clothes. Rinsing efficiency is a large factor in the overall water use efficiency.

Front loading machines are considerably more efficient than top-loading ones. Typically, a top loading machine uses 150 litres per wash and a front loading machine 100 litres. At an average frequency of use of 6 times per household per week, this amounts to a saving of about 15 kilolitres per household per year. Ownership of top-loading automatic machines outnumbers front-loading machines by over 10 to 1, and top-loaders also have the largest share (90%) of new sales, with front-loaders at 3-4%. The market resistance to the purchase of front loading machines is because they are generally more costly.

B4.9: DISHWASHING MACHINES

The water efficiency of dishwashing machines is expressed in terms of the litres of water required to wash and rinse a standard place setting in a standard wash cycle. Water consumption in dishwashers varies between 1.6 litres and 4.8 litres per place setting. The machines which use less water have a more efficient spray pattern during the wash and rinse cycle.

B4.10: OUTDOOR WATER USE

Outdoor water use is typically about twice that of domestic water use. A great deal of outdoor water use is not efficient, either through wasteful practices, poor design of landscapes, inefficient equipment or a combination of these.

Typical outdoor water uses include:

- garden and lawn watering
- washing of cars, houses, pathways and garden tools
- maintenance and filling of pools and other recreational uses.

Hoses fitted with a nozzle use less water, use the energy of the water more efficiently and generally allow greater control of where and when water is used. Use of fire hoses for outside water use must be discouraged.

Garden mulch is a means of reducing water use by reducing evaporation, moderating soil temperatures, discouraging weed growth and preventing soil compaction. Re-use of grass clippings for this also recycles the nutrients removed from the lawn. Alternatively, allowing grass clippings to remain on the lawn also has this effect.

Windbreaks are worthwhile in open locations as the wind plays a large part in the losses from evaporation.

B4.11: GREY WATER RE-USE

Grey water reuse systems collect and re-use water from the bath, hand basin, shower, laundry and kitchen. There is a large variety of possible designs and systems. The processes involved can vary from a simple diversion valve from the laundry sink waste pipe, to sophisticated systems which store, treat and disinfect grey water for re-use as toilet flushing water or for irrigation.

Grey water re-use is covered more extensively in Section B7.

B4.12: WATERLESS TOILETS

Waterless toilets, which include composting toilets and vermiculture (worm-based) systems for treating and processing human wastes, are experiencing renewed interest from the community and from various government authorities. Their main application has been in circumstances where no reticulated sewerage system is available and where septic systems are not considered suitable.

As for grey water treatment and re-use, the regulatory and research environment for these technologies has historically been inadequate, although this is improving. As overseas and some Australian experience indicates, they have an important role as an appropriate waste treatment technology with very low environmental impact and zero water use.

B4.13: RAINWATER TANKS

It has been common in rural areas for many years to provide water for domestic purposes from tanks fed from roof catchments. For reasons of personal preference tank water supplies are also used in some towns in conjunction with reticulated potable water supply. Such tank supplies are secondary sources and require a lesser security of supply than the primary source.

The use of rainwater tanks and the requirements applying to situations where a potable supply is provided, as in Bathurst, is covered in Section B6

B4.14: COMMERCIAL/INDUSTRIAL WATER USE EFFICIENCY

In many commercial premises the types of water using appliances are similar to those in a domestic situation, but the usage patterns may be different. For example, a motel has toilets, showers; hand basin taps but also has large kitchen facilities and possibly a laundry. An office building has toilets; hand basin taps and kitchen sink taps, but may also have urinals. A school may have a significant outdoor water use for irrigation.

The types of equipment and efficiency of the appliances already discussed in this Section have relevance to these customers in most cases. Often the financial benefits that accrue to commercial customers from the installation of water efficient equipment is greater than that for domestic customers as a result of higher marginal water prices for such customers. The magnitude of the water savings is often greater due to the more intensive use of equipment.

B4.15: PRESSURE REDUCTION

In some places the water supply pressure is greater than is required for normal requirements. In hilly areas local variations in pressure can also be quite large.

It has long been assumed that increased water supply pressure will result in an increased demand for water through increased leakage and also through greater flow rate through certain fixtures used in a flow rather than volume mode (hand basin taps and most shower heads). Excess pressure also reduces the efficiency of many sprinkler heads and other irrigation systems unless they have been set up and designed for the high pressure. Other problems relate to increased leakage through hot water system pressure relief valves, and the reduced life of solenoid valves.

B4.16: SUMMARY RECOMMENDATION

It is recommended that Water Efficiency initiatives be promoted as part of Council's on going Water Conservation Campaign and that the viability of incentives be further investigated, particularly via government grants and/or subsidies.

B5: PRICING POLICY

B5.1: INTRODUCTION

Implementation of an appropriate pricing policy & structure is arguably, the most critical aspect of any demand management strategy.

The price of water is a strong driver in controlling the water used in a community.

B5.2: CURRENT PRICING STRUCTURE

The pricing system currently used by Bathurst is a two-part, inclining block tariff.

A two-part tariff implies an access charge and a usage charge based on the volume of water used, as measured at the customer's meter.

An inclining block tariff, (as applied to the usage charge) is a set charge per kilolitre, up to a certain limit, and then a significantly high charge per kilolitre is applied. The aim is to reward low water users and discourage use above a pre-determined (reasonable) level.

Current (2008/09) charges applying in Bathurst are:

Access Charge:	Varies with size of connection		
	Base Charge: Based on 20mm service: **$235.00**		
Residential Usage Charges:	Filtered Water:	up to 250 kL:	**$0.76/kL**
		> 250 kL:	**$1.15/kL**
	Raw Water:	up to 250 kL:	**$0.56/kL**
		> 250 kL:	**$0.95/kL**

Council has recently adopted charges for **2009/10** and these are shown below. The 2009/10 charges have been used in the demand management modelling (Refer Section C)

Adopted 2009/10 charges:

Access Charge:	Varies with size of connection		
	Base Charge: Based on 20mm service: **$125.00**		
Residential Usage Charges:	Filtered water:	up to 250 kL:	**$1.25/kL**
		> 250 kL:	**$1.88/kL**
	Raw Water:	up to 250 kL:	**$0.56/kL**
		> 250 kL:	**$0.95/kL**

There has been a substantial reduction in the Access Charge, with a consequent increase in Usage Charges (Except for Raw Water, which has stayed the same as it was in 2008/09).

This is very much in line with best practice, demand management, pricing (user pays principle)

Council also supplies raw water to Hillview Estate from two bores; to provide a non-potable supply. Some industries also receive non-potable water from Winburndale Dam

B5.3: OBJECTIVES OF A PRICING POLICY

A sound pricing policy aims to satisfy the following objectives: -

i) To allocate resources efficiently by properly reflecting the cost of supply

ii) To generate sufficient revenue for the business, including covering the cost of the following : -

   * operations
   * maintenance
   * administration
   * depreciation of existing assets
   * a return on investment for existing capital assets
   * a return on equity to the Council as owner of the business
   * community service obligations (e.g. pensioner rebates)

iii) The Pricing Policy should also : -

   * be simple to understand & administer
   * reflect variations in system costs

B5.4 UNITS AND FLATS

In the case of strata title units, the ideal is to meter supply to each unit. If this is not possible, then each strata title unit should be treated as a single residential assessment with a 20mm service connection. The water consumption for each unit should be calculated as the total consumption for the block of units divided by the number of units in the block. As a result, each unit within the block will receive the same water supply bill.

In the case of a Community Title or a Company Title property, then each such property must be disaggregated into the appropriate number of units and treated as described above for strata title units.

This is required in order to avoid the imposition of excessive water usage charges for such properties.

B5.5: NON-RATEABLE PROPERTIES

The decision as to whether or not to provide a community service obligation (CSO) to non-rateable properties such as schools, hospitals, churches, etc. is a matter for determination.

Some Authorities provide a CSO for all non-rateable properties. However, over 70% of Authorities in NSW provide no water supply CSO's to non-rateable properties.

If a CSO is provided to non-rateable properties, it is recommended that the CSO be only provided to reduce water supply access charges. Consideration may also be given to reducing the 2nd tier consumption charges for these customers (perhaps apply a uniform consumption charge). This would need to be closely monitored to ensure that there is no wastage and are efficient water use is encouraged).

B6: USE OF RAINWATER TANKS

B6.1: OVERVIEW

In country areas, rainwater tanks are often the main (or in some cases, the only) source of water for domestic purposes.

The quality of the water collected in rainwater tanks can be variable, and may contain harmful contaminants. However, provided that the rainwater is clear and has little taste or smell, it is probably safe for use and unlikely to cause illness. In some cases, where a treated supply is not available, rainwater tanks may provide better quality water than surface water or groundwater (bore water) supplies.

With a growing community awareness of the benefits of water conservation (particularly during this drought and in terms of protecting the health of our rivers) rainwater tanks are increasingly being seen as an alternative source of water:-

- With lower environmental impact than reticulated supplies
- Utilisation of a water source that is currently "wasted"
- An alternative, chemical free, supply for garden watering.

As part of the New South Wales Government's commitment to sustainable resource management, the installation of rainwater tanks <u>in urban areas</u> has been approved for the following purposes:-

- **Garden and lawn watering**
- **Toilet flushing**
- **Washing machine cold tap use**
- **Washing cars**
- **Filling ornamental pools**
- **Topping up swimming pools**

However, where there is a reticulated drinking (potable) water supply available, NSW Health does not recommend the use of rainwater for:

- **Drinking**
- **Cooking or other kitchen purposes**
- **Personal washing, such as baths, showers, hand basins and bidets**

(Reference: NSW Health; "Rainwater Tanks where a Public Water Supply is Available", 2007

The NSW Government's BASIX (Building and Sustainability Index) program, which is designed to ensure that homes are built to be more energy and water efficient, requires the installation of rainwater tanks at all new homes(and where alterations & additions valued $50,000 more are carried out (www.basix.nsw.gov.au). The aim of the BASIX program is to bring about a 40% reduction in water use.

B6.2: RAINWATER TANK REBATE SCHEME

The Rainwater Tank Rebate is available for the installation of any new rainwater storage system in residential properties in NSW, subject to the following eligibility requirements:

- The tank(s) must have a minimum 2000 litre capacity and be purchased in full and installed between 1 July 2007 and 30 June 2009.
- Households **not connected to the mains supply** are eligible for a rebate for the purchase of the **tank only**.
- Rainwater tanks installed to comply with BASIX (the Building Sustainability Index) for new homes, major renovations or a pool installation are not eligible for a rebate.

The rebate is based on the size of the tank and whether it is plumbed into your toilet or washing machine.

Tank(s) Capacity	Tank Rebate	Connection to toilet(s)	Connection to a washing machine(s)	Maximum total
2000-3999 litres	$150	$500	$500	$1150
4000-6999 litres	$400	$500	$500	$1400
7000 litres and above	$500	$500	$500	$1500

B6.3: INFORMATION

- Bathurst Regional Council website: **www.bathurst.nsw.gov.au/environment/water-sewer/304-rainwater-tanks-and-rebates**
- **www.environment.nsw.gov.au**
- CUPDR Circular No.18 Guidelines for Plumbing associated with Rainwater Tanks in Urban Areas.
- NSW Health, Guide to Rainwater Tanks. **:** **www.health.nsw.gov.au/policies/gl/2007**

B7: RESIDENTIAL GREYWATER REUSE

B7.1: OVERVIEW

The re-use of grey water in domestic situations is becoming more common of late in light of the current drought situation. There appears to be a general community wide expectation that Councils should not only allow, but should encourage the use of grey water.

Current requirements of NSW Health for Grey water Re-use are contained in the document *"Grey water Re-use in Sewered Single Domestic Premises".*

In simple terms, grey water is the wastewater generated in the bathroom, kitchen and laundry (that is, those components of domestic wastewater (sewage) which have not originated from the toilet).

Given the need to conserve our treated water, there are obvious advantages in using alternate water sources, like grey water, for use in watering lawns and gardens. This will reduce the demand on the Council's potable supply.

Reuse of grey water should, therefore, be supported and encouraged by Council to help conserve water.

However, this has to be accomplished without adversely impacting on community health, the environment or the amenity of residential areas and must be completely in accordance with requirements set down by NSW Health.

Grey water can contain pathogenic micro-organisms including bacteria, protozoa, viruses and parasites at levels sufficient to present a health risk. Therefore, caution must be exercised when considering the use of grey water. This can be achieved by avoiding human contact with grey water, or treating and disinfecting it to remove and/or destroy harmful micro-organisms.

It should also be noted that grey water contains oils, fats, soaps, detergents, heavy metals, nutrients, salts and particles of hair, food and lint which can adversely affect the operation of a grey water irrigation system as well as potentially harming soil structures.

[Reference: NSW Guidelines for Grey water Re-use in Sewered, Single Household Residential Premises, DEUS, 2007].

B7.2: CHARACTERISTICS OF DOMESTIC GREY WATER

The characteristics of grey water produced by a household will vary according to the number of occupants, the age distribution, lifestyle, health status and water usage patterns.

There are essentially three different grey water streams, they are:

- Bathroom grey water (bath, basin and shower) contributes about 55% of the total grey water volume. Bathroom grey water can be contaminated with hair, soaps, shampoos, hair dyes, toothpaste, lint, body fats, oils and cleaning products. It also has some faecal contamination (and the associated bacteria and viruses) through body washing.

- Laundry grey water contributes about 34% of the total grey water volume. Wastewater from the laundry varies in quality from wash water to rinse water to second rinse water. Laundry grey water can have faecal contamination with the associated bacteria and viruses, lint, oils, greases, chemicals, soaps, nutrients and other compounds.

- Kitchen grey water contributes about 11% of the total grey water volume. Kitchen grey water is heavily polluted with food particles, cooking oils, grease, detergents, and other cleaning products such as dishwashing powders. The detergents and cleaning products may be alkaline and contain chemicals that are harmful to soil structure, plants and groundwater. The solid food particles and fats can solidify and are not readily broken down by soil organisms. This can result in blockages in the land application system. It can also cause the soil to become water repellent.

It is for these reasons that kitchen wastewater is not suited for reuse in grey water treatment systems and is not approved by NSW Health for grey water systems.

B7.3: HEALTH AND SAFETY CONSIDERATIONS

All forms of grey water are capable of transmitting disease.

Pathogens from grey water may spread by direct contact (ie, touching grey water or inhaling infectious water droplets) or indirectly by consumption of contaminated food or water.

To minimise the risk to public health and prevent a nuisance from grey water reuse, the following requirements apply:

- Grey water systems (including bucketing) must dispose of grey water below the ground surface unless treated and disinfected to an appropriate standard.
- Sufficient land area must be available for the safe and confined re-use of grey water.
- The system must be designed and operated to exclude human and animal contact with the grey water except as required to maintain the system.
- No cross connection with the potable water supply is allowed.
- Grey water must not be allowed to enter any stormwater drainage system.
- Grey water shall not be used in a manner that will result in direct contact with vegetables or other edible plants. It may be used to irrigate fruit plants where the fruit does not make contact with the grey water.

- No opportunity for mosquito breeding is to exist in any part of a grey water system, i.e. in conveyance, treatment, storage, soil application.
- If irrigated via sub-strata drippers or above ground sprays each irrigation area shall have signage along the boundaries of disposal areas effectively cautioning those entering the area that grey water is being use for irrigation.

It is generally accepted that householders, unless dedicated to wastewater reuse practices, do not usually maintain the systems adequately.

It is essential; therefore, that Council applies its on-site wastewater management strategy (adapted to consider the impacts of grey water reuse) and rigidly enforces operating licences by way of regular inspection and audit.

B7.4: ENVIRONMENTAL CONSIDERATIONS

To minimise negative impacts on the environment from grey water reuse, the following requirements apply:

- Grey water must be contained within the confines of the premises on which it is generated and not be permitted to runoff onto neighbouring properties.
- Only products with very low phosphorus content should be used. Phosphorus content can range from a low content of 0.05% up to 10% in various detergents. Native plants (not all) are sensitive to additional phosphorus. Plants of the Proteaceae family (such as grevillea, hakea, banksia and silky oak) are susceptible to excess phosphates. These plants are not ideally suited to grey water reuse.
- Grey water tends to be slightly alkaline, with a pH range of typically between 6.5 and 9.0, and the extensive use of grey water for irrigation could cause the soil to become progressively more alkaline. Shade loving and acid loving plants do not like the alkalinity of grey water. These include azaleas, camellias, gardenias, begonias, and ferns.
- Washing powders that contain sodium salts as bulking agents should be used sparingly. High levels of sodium can produce saline grey water. Sodium can damage soil structure, reducing the air space, giving it a greasy texture and poor drainage capability. Products which use potassium salts or liquid concentrates should be used as they produce better quality, less saline grey water.
- Detergents and powder cleansers contain boron and should be used sparingly, as boron can be toxic to plants in high concentrations and can also be toxic to animals. The USA Environmental Protection Agency (1992) recommends the maximum concentration of boron be 0.75g/L for long term use on sensitive plants.
- Try to avoid the use of:
  - bleaches or softeners
  - detergents that advertise whitening, softening and enzymatic powers

- detergents with ingredients which include: boron, borax, chlorine, bleach, sodium perborate and sodium trypochlorite (salts), acids etc.

➢ The following materials should not enter a grey water system

- Paints, automotive oils and greases etc
- Any matter designated as trade waste or industrial liquid waste.

➢ In sandy soils where the phosphorus retention index (PRI) of the soil is less than 5 the grey water systems should be installed more than 100 metres away from a wetland, stream flow (including stormwater drains) or other water sensitive ecosystems.

➢ System flow rates on coarse sandy soil/gravel should be carefully designed to avoid grey water leaching into groundwater or surface water bodies.

B7.5: GREY WATER REUSE OPTIONS

Grey water reuse methods can range from low cost methods such as the manual bucketing of grey water from the laundry trough or bathtubs, to primary treatment methods that coarsely screen oils, greases and solids from the grey water before irrigation via small trench systems, to more expensive secondary treatment systems that treat and disinfect the grey water to a high standard before irrigating via micro-drip or spray systems. The choice of system will be dependant on a number of factors including whether a new system is being installed or a disused wastewater system is being converted because the property has been connected to sewer.

B7.6: GREY WATER IRRIGATION OPTIONS

The appropriate grey water irrigation method is dependent on the level of treatment provided. Table 2 below sets out the available reuse options:-

Table 2: Grey Water Reuse Options (Source: NSW Health)

Treatment	**Grey Water Reuse Application**
Untreated Grey water	• Bucketing • Sub-surface disposal recommended
Coarsely filtered untreated grey water (excluding kitchen grey water) - GREYWATER DIVERSION DEVICE (PRIMARY TREATMENT)	• Sub-soil irrigation • Sub-surface irrigation
Treated and disinfected grey water (to a standard of 20 mg/L BOD_5, 30 mg/L SS and 30 cfu thermotolerant coliforms / 100 mL - GREYWATER TREATMENT SYSTEM (SECONDARY TREATMENT)	• Sub-soil irrigation • Sub-surface irrigation • Surface irrigation
Treated and disinfected grey water (to a standard of 20 mg/L BOD_5, 30 mg/L SS and 10 cfu thermotolerant coliforms / 100 mL) - GREYWATER TREATMENT SYSTEM (ENHANCED SECONDARY TREATMENT)	• Sub-soil irrigation • Sub-surface irrigation • Surface irrigation • Toilet flushing • Laundry use

B7.7 COUNCIL'S GREYWATER REUSE POLICY

Council's Greywater Reuse Policy has been developed in accordance with the requirements of NSW Health and the Department of Water and Energy (as discussed above).

The Policy is accessible on Council's website at www.bathurst.nsw.gov.au/engineering/water-and-sewer/greywater-reuse-policy.

Council clearly recommends that residents investigate all methods to reduce water consumption, prior to consideration of greywater treatment and reuse options. The need for individual water balance assessments to determine the amount of greywater generated at the property, compared to the volume which can be beneficially reused, is stressed.

B8: STORMWATER COLLECTION AND RE-USE

B8.1: INTRODUCTION

Urban stormwater is runoff from urban areas, including major flows during and following rain, as well as "dry" weather flows.

"Dry" weather drainage flows generally originate from groundwater, garden watering, wash down, leaking pipes, and illegal discharges. In some instances, overflows from the sewerage system or from septic tanks may also form part of the stormwater flow.

In most cities, urban stormwater runoff is considered a nuisance - to be disposed of as quickly as possible. Drainage systems have typically been developed to minimise the risk of flooding.

It is now becoming more accepted that a new approach to stormwater management is required - one that considers issues of stormwater quality & aquatic ecosystem health, as well as stormwater quantity.

This implies an approach which recognises the environmental impacts of urbanisation, the linkages between land & water management & the importance of community needs & values.

> **"Stormwater is a resource. (We need to) harvest stormwater as a water supply and infiltrate or retain it to support urban aquifers, waterways & vegetation".**
> **Rocky Mountains Institute, 1995**

Reference: Managing Urban Stormwater – Harvesting & Re-use, DEC, 2006.

B8.2: ISSUES TO CONSIDER

In contemplating the re-use of harvested stormwater, there are a number of issues to consider, including: -

- water quality. The same issues relating to grey water re-use and/or use of tank water apply to stormwater re-use river flow objectives. Contemporary approaches to stormwater management also include ensuring that water supply systems allow for environmental flows in streams; the sustainable management of extractions for irrigation and the "mimicking" of natural flow regimes in managed streams. These approaches recognise that stormwater management needs to identify both the environmental values of streams as well as the opportunities to utilise stormwater as it passes through the urban water cycle.

- flood mitigation. It is crucial to ensure that any works associated with harvesting & re-using stormwater do not adversely impact on the primary requirement of flood control.

- public health & safety. Management plans to ensure that public health & safety are not compromised need to be developed as part of any re-use strategy.

- integrated water cycle management. Consideration should be given to development of schemes which combine the re-use of, say, stormwater, treated effluent & even groundwater.

- economic sustainability. The capital and on-going operation & maintenance costs of proposed schemes need to be carefully considered to ensure not only affordability, but also economic sustainability.

- other issues; which may need to be considered include the potential for rising water tables and salinity problems.

In the broader context, it is acknowledged that Bathurst already harvests stormwater runoff, via Chifley and Winburndale Dams.

B9: RE-USE OF RECLAIMED WATER

B9.1: INTRODUCTION

Over half of the water supplied to urban areas ends up as wastewater. As a source of supply wastewater is the most reliable source available. It is the last to be impacted by droughts and it is the only source of supply that increases with population.

Wastewater re-use provides a number of benefits including:-

- improving the reliability of water supply;
- increasing the available capacity of water supply and/or wastewater systems;
- deferring or avoiding the need for augmentation of water supply systems;
- allowing lower standards of treatment than required for discharge;
- allowing the quantity and quality of water supplied to closely meet that required for an intended use;
- reduction in nutrient loads to waterways;
- potential to improve baseline flows in waterways, if reclaimed water is used to substitute for riparian extractions;
- facilitating decentralisation of water supply and wastewater management.

Reclaimed water reuse also has drawbacks which include high cost (separate delivery systems are required and additional treatment may be needed, depending on the use), potential harmful effects of non-potable water on industrial equipment and products, and the need to prevent contamination and human contact with reclaimed effluent.

B9.2: ENVIRONMENTAL AND PUBLIC HEALTH FACTORS

It is important to ensure that reuse options themselves do not have significant adverse environmental effects or cause health risks that the community might not consider acceptable.

Effluent used for irrigation of public areas such as sporting fields and golf courses, or used for irrigation of food crops, must meet appropriate microbiological standards to protect public health. Better knowledge of health risks due to improved methods for detecting viruses and parasites, is resulting in a more stringent level of design of reuse systems, including a higher cost to install more effective disinfection systems.
Better knowledge of health risks has also led to concerns regarding public liability and difficulty in securing public liability insurance.

Section 60 approval from the Department of Water and Energy is required for all proposed reuse schemes. Applications for approval are required to include full details of the proposed scheme(s), risk assessment in accordance with the National Guidelines, demonstration that treatment processes will achieve the required log reductions for pathogens (bacteria, virus and rotifers) for the reuse situation (for example, more stringent log reductions are required for residential non-potable reuse than, say, for agricultural reuse) etc.

B9.3: GUIDELINES, STANDARDS & APPROVALS

The public health issues associated with the use of reclaimed water for irrigation, industrial use and domestic non-potable use are covered by guidelines set out by the National Water Quality Management Strategy.
Relevant NSW Guidelines also include:

- Management of Private Recycled Water Schemes, DWE, 2008
- Use of Effluent by Irrigation, DECC, 2004

B9.4: USES AND MARKETS FOR RECLAIMED WATER

The key uses for reclaimed water are:

- agricultural irrigation;
- urban landscape irrigation;
- industrial applications;
- recreational and environmental uses;
- non-potable urban uses;
- groundwater recharge;
- potable re-use;
- on site re-use.

B9.4.1: AGRICULTURAL IRRIGATION

Reclaimed effluent can provide a reliable supply of water for irrigators, especially during drought periods, and can be used to substitute for river extractions, thus improving base stream flows. The nutrients in effluent can provide a source of fertiliser.
Irrigation demands for reclaimed water have high seasonal variability. Demand is a function of crop type, growing period, evapotranspiration and rainfall.

Re-use schemes need to be designed around these parameters to avoid possible soil degradation and contamination of nearby surface water or groundwater and damage to crops and soil structure from excess nutrients and salts.

In general, secondary treated effluent, with appropriate disinfection, provides a suitable quality for irrigation purposes.

B9.4.2: URBAN LANDSCAPE IRRIGATION

The main urban landscape markets for reclaimed water reuse are parks, public gardens, racecourses, golf courses, school grounds, roadway median strips and cemeteries. However, as with agricultural irrigation, demand has high seasonal variability, the market is located closer to sources of effluent, and these applications typically have a high dependence on town water.

For reclaimed water to supply this market, two supply options are available:-

- provide seasonal storage to match the constant supply of treated effluent with highly variable demands, (this is not normally cost-effective); or
- supplement reclaimed water with town water during peak demand.

As with agricultural irrigation, secondary treated and disinfected effluent is adequate for this market. The level of disinfection used depends on whether the public may come in contact with the effluent during irrigation.

B9.4.3: INDUSTRIAL APPLICATIONS

Industry could provide an important market for non-potable reclaimed water as it typically provides a constant demand for water of a quality equal to or lower than that required for river discharge.
Major water uses for industry include:-

- cooling system make-up;
- process water and boiler feedwater;
- once through cooling;
- wash down water;
- miscellaneous use, such as site irrigation, mine site revegetation and dust control.

The potential for industrial water re-use lies with those applications that can tolerate a lower than potable water quality. Cooling tower make-up can account for 50 percent of the water use of many industries. For secondary treated sewage effluent to be used for this application, some on-site treatment may be needed to control biological growth, scaling or corrosion.

B9.4.4: RECREATIONAL USES

Recreational use markets might include:-

- recreational impoundments;
- fisheries.

Human health is the main factor to be considered for this use.

B9.4.5: ENVIRONMENTAL USES

Environmental use markets include:-

- lakes and ponds;
- wetland enhancement; and
- stream flow augmentation.

Development of algae is the main factor to be considered for such uses.

B9.4.6: NON-POTABLE URBAN USES

Non-potable reclaimed sewage effluent can be used for a range of urban and residential applications including:-

- toilet flushing;
- outdoor use such as garden watering and car washing;
- air conditioning; and
- fire protection.

For residential non-potable re-use, outdoor use has a high seasonal variability while toilet flushing provides a constant demand.

B9.4.7: GROUNDWATER RECHARGE

Recharging groundwater aquifers with treated sewage effluent can be used to replenish groundwater reserves, control salt water intrusion and provide subsidence control. Aquifers may be recharged either by infiltration or injection.
Secondary treated effluent is generally suitable for recharge via infiltration as the infiltration process provides further filtering. As recharging by injection does not receive this pre-treatment of infiltration, it requires treatment to near drinking water quality. Possible contamination of ground water is an important issue to be considered.

B9.4.8: POTABLE RE-USE

Health authorities in Australia do not favour potable reuse due to concerns about the risk to public health. Potable reuse has not been approved by Australian health authorities and there is currently no clear process for such an approval to take place. Therefore, potable reuse is regarded as a future opportunity, rather than a presently available option.

B9.4.9: ON-SITE RE-USE

Where an activity generates wastewater and has a market for reclaimed water, the most logical point for treatment is on-site. This provides the water users with the dual benefits of saving on raw water costs and on sewage discharge costs.

Bathurst currently utilises 20 – 25% of water reclaimed from the Wastewater Treatment Plant for on-site reuse.

B9.5: CONCLUSIONS

There are a range of benefits that can accrue by the judicious re-use of water reclaimed from Wastewater Treatment processes, including economic returns from irrigated agriculture and the potential conservation of potable water supplies via urban re-use.

B9.6: INVESTIGATIONS INTO REUSE OPTIONS

A Report into effluent reuse was prepared for Council by consultants, Environmental Resources Management (ERM) in May 2006. (Reference: *Bathurst Effluent Reuse Scheme, Pre-Feasibility Report*, ERM, May 2006).
The Report considered a number of options, namely:

- do nothing
- irrigation of existing irrigated agricultural properties
- irrigation of agricultural properties not currently irrigated
- irrigation of golf course, racecourse, playing fields and education/research facilities
- irrigation of Council parks, gardens and sporting fields
- provision for irrigation of future residential developments in Tyers Park and Kelso
- supply to existing residential areas (retrofitted with non-potable supply/distribution infrastructure)

Four (4) zones were identified for further consideration, namely:

<u>Zone 1</u>: Golf course, Agriculture Station, Bathurst TAFE, St. Stanislaus College and South Bathurst Public School (all currently irrigated with untreated water from Winburndale Dam).

<u>Zone 2</u>: Eastern side of the Macquarie River, involving agricultural land, a turf farm, Tyers park Racecourse, Showgrounds and Sportsground (all currently irrigated with licensed river water and bore water)

<u>Zone 3</u>: Agricultural land up to 10 km north and north east of the Sewage Treatment Plant (currently using river water for irrigation).

<u>Zone 4</u>: Agricultural land along the Campbells River, up to 30 km from the Treatment Plant.

The preliminary results of the study are presented below:

Item	Zone1	Zone 2	Zone 3	Zone 4
Cost Estimate	$1.56m	$2.79m	$4.08m	$9.34m
Cumulative Cost	$1.56m	$4.35m	$8.43m	$17.77m
Land area required	70 ha	230 ha	300 ha	300 ha
Cumulative area	70 ha	300 ha	600 ha	900 ha
% Reuse	11	34	25	20
Cumulative % Reuse	11	45	70	90

The report recommends that the reclaimed water be supplied at “nominal cost”
Whilst it is recognised that this is only a pre-feasibility study, other options that have not been considered are: industrial reuse and increased on-site reuse (on acquired adjacent land).
All of the proposed schemes are prohibitively expensive, especially if supply at cost recovery prices is not considered.
It would be sensible to consult with potential users, in terms of establishing their willingness to enter into an agreement to supply; and what price they would be willing to pay, before proceeding further.

For most of the options, except for agricultural use, significant costs would be incurred in the additional treatment required to satisfy the log reductions required under the National Guidelines for Reuse. These costs have not been included in the estimates.

B10: GROUNDWATER USE

B10.1: INTRODUCTION

Many communities and rural properties would not exist with out adequate, reliable groundwater.

Over one million people in more than 600 communities around Australia rely on groundwater reserves for their water supply.
Bathurst Regional Council utilises groundwater as a non-potable supply to Hillview Estate at Walang (Peak day demand: 96 kL/d)

Groundwater in the broad sense is all water which occurs within the 'hydrologic cycle' below the land surface. It is a pervasive resource, interacting with the land surface, streams and lakes, but because it occurs below the earth's surface, its occurrence and movement are generally poorly understood.

Groundwater plays a significant role as a resource which is necessary to sustain life; either as a source of water for human use or as water which helps sustain life in surface waters such as streams and wetlands in dry periods. In the broader context, it also forms a major component of many water supply systems where aquifers are used as sole water supply sources or to balance surface water surpluses and deficiencies. Underlying each of these uses is the economic value of groundwater, particularly where it forms a resource which would need to be replaced, at some cost, should that groundwater become polluted.

B10.2: GROUNDWATER AS A WATER SOURCE

Groundwater is commonly used as a source of domestic, recreational, rural and industrial water in Australia. Groundwater availability is for many rural people the reason for their existence in their current location and enterprise.

For example, many agricultural industries have developed in isolated areas due to the availability of good groundwater sources. These industries vary from pastoral activities in western Queensland to grape growing in South Australia. The development of these parts of the Australian landscape is directly linked to groundwater.

In fact, about 18% of Australia's total water use is derived from groundwater sources.

B10.3: SOME FEATURES OF GROUNDWATER

the extent of the resource is often difficult to specify

the quality of groundwater can be directly affected by overdrawing on the aquifer's water

the flow of contaminants to an aquifer may take years or decades before being noticed the cleansing of the water in aquifers is often slow and contaminants can accumulate quickly

the cost of cleaning up groundwater, once polluted, is often extremely high, if indeed it is technically possible.

B10.4: GROUNDWATER CONTAMINATION SOURCES

Typical groundwater contamination sources include:-

- industrial effluent and manufacturing wastes
- leaking underground storage tanks and pipelines
- landfill stockpiles or contaminated soil producing leachate
- intensive agricultural fertiliser and pesticide use or waste generation
- contamination from septic tanks and from sewage and wastewater lagoons
- mining industry processes and wastes
- contamination from wells
- urban stormwater
- atmospheric fallout
- inter aquifer contamination by alteration of flow
- fire fighting accidents
- emergency response wastes during and after chemical fires
  and
- energy generation and town gas sites.

In addition, contamination incidents due to accidental spillage are a concern throughout Australia.

B10.5: GROUNDWATER USE CATEGORIES

Groundwater may be used beneficially for a number of purposes, including:-

- ecosystem protection
- recreation and aesthetics
- raw water for drinking water supply
- agricultural water
- and
- industrial water.

B10.6: GROUNDWATER QUALITY

The quality of water in aquifers can be highly variable. Contaminants can include:-

- salinity (measured as Total Dissolved Solids)
- iron (and other heavy metals)
- pesticides and herbicides
- petroleum hydrocarbons
- nitrates
- ammonia
- sulphur compounds
- solvents
- etc.

B11: WATER SENSITIVE URBAN DESIGN

B11.1: INTRODUCTION

Water sensitive urban design (WSUD) is an integrated approach to incorporating water management systems into buildings, urban transport routes and public open spaces.

It is based on the principles of water efficiency and reuse, and, more importantly, it treats water as a resource rather than a waste product.

WSUD is a holistic management strategy that takes into account urban planning, design, landscape architecture, water consumption/demands and available water supplies from all sources, including effluent reuse, stormwater re-use and groundwater to minimise the impact of urbanisation on the natural water cycle.

The aim is to combine land use planning with water cycle management during the planning stage of a project, as opposed to at the end of the planning process.

WSUD can create new solutions and efficient systems that are more attractive to prospective purchasers, increase the value of adjacent land and avoid or defer expensive new infrastructure or augmentation costs.

B11.2: DESIGN FEATURES & OBJECTIVES OF WSUD

New urban developments should be based on water sensitive design principles; aimed at minimising the impact of the development on the total water cycle and maximising the multiple use benefits of the stormwater system.

Objectives & associated design features of WSUD can include: -

- preservation of existing topographic & natural features, including water courses & wetlands
- protection of surface water & groundwater resources
- integration of public open space with stormwater drainage corridors, maximising public access, passive recreational activities and visual amenity
- balancing the water demands of a site/development with the available water supply
- managing the water balance - utilising grass swales, absorption pits, infiltration trenches, retention/retention basins
- maintaining or enhancing water quality - utilising gross pollutant traps, oil & grit separators, water pollution control ponds, sediment traps, wetlands etc

- encouraging water conservation - by utilising rainwater tanks, stormwater reuse, grey water/effluent reuse.
- protecting & enhancing natural water systems - utilising trash racks, constructed wetlands etc.
- improving aesthetic design elements, incorporating social & ecological objectives - using grass swales, reed beds, constructed wetlands etc.

Typical urban designs increase stormwater runoff by 30% or more, because of the high proportion of impervious surfaces. WSUD provides a balance between infiltration & runoff which is closer to the pre-development balances. WSUD & building design, which better control & manage the flow & retention of stormwater in the urban landscape will reduce garden & landscape water use needs, at little or no extra cost.

B11.3: PRINCIPLES & TECHNIQUES

The broad principles of water sensitive urban design include: -

- minimising impervious areas
- minimising use of formal drainage systems (eg pipes)
- encouraging infiltration (where appropriate)
- encouraging stormwater reuse.

Water sensitive urban design principles can be adopted at a range of development scales, including: -

- the overall extent of proposed development areas
- the road and block layout within a development
- development forms on individual blocks

Potential water sensitive design techniques include: -

- inclusion of natural habitats (eg watercourses) within the development area, primarily within open space areas. This includes the provision of buffer zones adjacent to watercourses and other water bodies
- integration of major (above ground) stormwater systems as positive features within the urban design rather than purely functional elements to be 'hidden' (eg avoiding back fences adjacent to drainage reserves)
- adoption of water sensitive road development standards. These can include reduced pavement widths and the use of grass swales in place of kerb and gutter and piped stormwater drains

- use of compact development forms. For example, reducing individual block sizes and increasing communal open space (and stormwater drainage) areas to achieve the same density as a standard residential development
- water sensitive car park design. This can include substitutes for impervious surfaces such as pavers or reinforced grass, particularly in infrequently used parking areas. Runoff can also be managed by grass swales instead of kerb and gutter and piped drainage systems. Infiltration of runoff can also be considered.

C: DEMAND MANAGEMENT MODELLING

C1: INTRODUCTION

C1.1: BACKGROUND

Bathurst Regional Council (BRC) is responsible for the management and operation of water supply and sewerage in the Bathurst Local government area.

This Demand Management Strategy identifies and addresses the potential for the introduction of demand management measures in the BRC service area over the next 30 years.

C1.2: METHODOLOGY AND DATA

The following aspects have been undertaken as part of this assessment:

- analysis of the current water production (water treatment) records to estimate Unaccounted for Water (UFW)
- determination of current water consumption by customer category
- Analysis of the historical water production records to determine a starting point for water demand forecasting and to estimate the current peak to average demand ratio.
- Development and analysis of integrated scenarios, each containing different water demand management measures. The Traditional Scenario, which provides baseline data against which the impacts of different water demand management measures can be compared, was also assessed.
- Analysis of the water management scenarios. The following aspects have been assessed:
    - preliminary cost/benefit ratios and water savings for the individual water demand management measures that were included in the integrated scenarios; and
    - water demand and effluent generation forecasts for the next 30 years for each of the scenarios.

Water production and consumption data for the various customer categories were sourced from BRC's data base and other sources. The relevant data are summarised in Table 3.

The DWE Demand Side Management Decision Support System Software-Simplified (Version S1.1) (DEUS, 2006), supplemented with additional data, was used to assess the water management scenarios.

Table 3: Data Used in Modelling

Item	Source	Comments
Climate	Climate data (daily rainfall, evaporation & maximum daily temperature) from the Bathurst Airport Weather Station was used. Monthly Evaporation data from the Bathurst Agricultural station (No. 063005)Weather Station was reviewed	The historical demand was not climate corrected (insufficient reliable historical water production data) Climate data is included here for information only.
Population Data	Population data for Bathurst was accessed from the 2006 Bureau of Statistics Census Tables.	The total population of Bathurst was reported as 32,700.
Demographic Data	From Council's customer data base.	A population growth rate of 0.9 % pa was used.
Daily Water Production ML/d	Daily meter readings of water treated at the Water Treatment Plant.	Daily data is available from 1995/96.
Water Consumption	Water consumption records were obtained from Council's data base.	Consumption data was allocated across the key customer categories.
Water Losses	Recorded consumption (billing records) and production data from the Treatment Plant was used.	Water losses were assessed as the difference between treated and consumption billed for.
Other Data	Relevant data was sourced from Council's data bases.	• Pumping & treatment costs for both water supply and sewerage. • Augmentation costs for planned 30 Year Capital Works. • Water Prices (volumetric charge per kilolitre).

C2: CURRENT WATER PRODUCTION AND CONSUMPTION

C2.1: WATER CONSUMPTION PROFILE

Council's bulk supply is drawn from the Macquarie and Campbell Rivers and bores.

The total usage within the City in 2007/08 was 5,780 ML (including losses)

Details of customers supplied are shown in Table 4.

Table 4: Population Supplied with Filtered Water (2007/08)

Population (Served with Water)	32,700
Assessments	
- Total	13,890
- Residential	12,380
- Non Residential	1,510

Water consumption data for the various customer categories was provided by Council and is reproduced below.

The following categories are included in Council's customer data base:

• Residential Single	Residential dwellings
• Residential Multi	Residential Strata and multi flats, aged units and boarding houses.
• Commercial	Workshops, offices and retail, hotels and motels, caravan parks, bowling and golf clubs, private recreation, agriculture and vacant businesses.
• Industrial	Heavy and light industry, industrial vacant and strata.
• Institutional	Educational establishments, hospitals (private and public), Council buildings, Church and religious buildings and public buildings.
• Parks and Open Space	Public open space
• Rural	Rural and village residential
• Other Treated Water Users	Uncategorised water uses.

Water consumption, by customer categories for the **2007/08** billing period, are shown in Table 5 below:

Table 5: Potable Water Consumption by Customer Category (2007/08)

Category	*No. of Accounts*	*Consumption (ML)*	*%*
Residential Single	12,383	3,188	55.2%
Commercial	910	1036	17.9%
Industrial	450	887	15.3%
Public	117	57	1.0%
Parks & Open Space	-	0	0%
Rural	30	30	0.5%
Other	-	4	0.1%
Unaccounted for Water (Losses)	-	578	10.0%
Totals	13,890	5,780	100%

C2.2: UNACCOUNTED FOR WATER

Unaccounted for water (UFW) **is the difference between the water treated at the Filtration Plant and actual metered consumption**. It can include unbilled authorised consumption, unauthorised consumption, apparent losses and real (system) losses.

Data for the period from 1995/96 to 2007/08 indicates a range of UFW results – from 2% to 21%. The average UFW over the period was 13%; as shown in Table 6.
The latest recorded water loss (10%) has been used in the modelling.
In order to quantify and monitor the level of Unaccounted for Water (UFW) in Bathurst, Council has been working with the Water Directorate Water Loss Management Team to identify appropriate zones and metering requirements.
To date, the following work has been undertaken:

• Appropriate zones have been identified;
• A review of available metering has highlighted where additional bulk water meters
are needed;
• Additional meters have been purchased; and,
• Council is in the process of installing these additional bulk water meters, in order to be able to measure flows and pressures and establish where, if any, system losses are occurring.

So far, investigations have concentrated on smaller areas, with the following results:

• Eglinton (500 houses): Flows dropped to zero over night, indicating no losses.
• Ashworth Estate (100 houses): Flows dropped to zero over night, again, indicating no losses.

Investigations are continuing.

Table 6: Water Production, Consumption & Losses

Year	Treated Water Production (ML/annum)	Billed Consumption ML/annum)	Losses %
1995/96	6659	6013	10%
1996/97	6813	5366	21%
1997/98	6691	5706	15%
1998/99	6383	5354	16%
1999/00	6234	5366	14%
2000/01	6137	NA	-
2001/02	6299	NA	-
2002/03	6715	NA	-
2003/04	6674	5338	20 %
2004/05	6292	6173	2%
2005/06	6248	5393	14%
2006/07	6977	5766	17%
2007/08	6209	5047	7%
Annual Average	**6487**	**5625**	**13%**

C3: ANALYSIS OF HISTORICAL WATER PRODUCTION

C3.1: INTRODUCTION

Analysis of historical water production for Bathurst was based on actual, observed production data.

Due to the limited daily production and annual consumption data available, it is considered that there is not likely to be a significant difference between the observed and climate corrected data.

The MODELLED data has therefore, not been climate corrected. It should also be noted that the period covered by the modelling (1995/96 to 2007/08) represents a period of extreme drought conditions.

This may tend to skew the results towards a lower than "normal" consumption trend.

C3.2: CLIMATE DATA

Key climate characteristics are summarised in Table 7.

Rainfall is relatively low; at an average of 633 mm; although rainfall is quite uniform throughout the year (on a month-by-month basis)

Average annual evaporation exceeds annual rainfall by nearly 720 mm annually.

The data presented is long term (1909 to 2009) except for evaporation, which is recorded from 1966.

Table 7: Climate Data

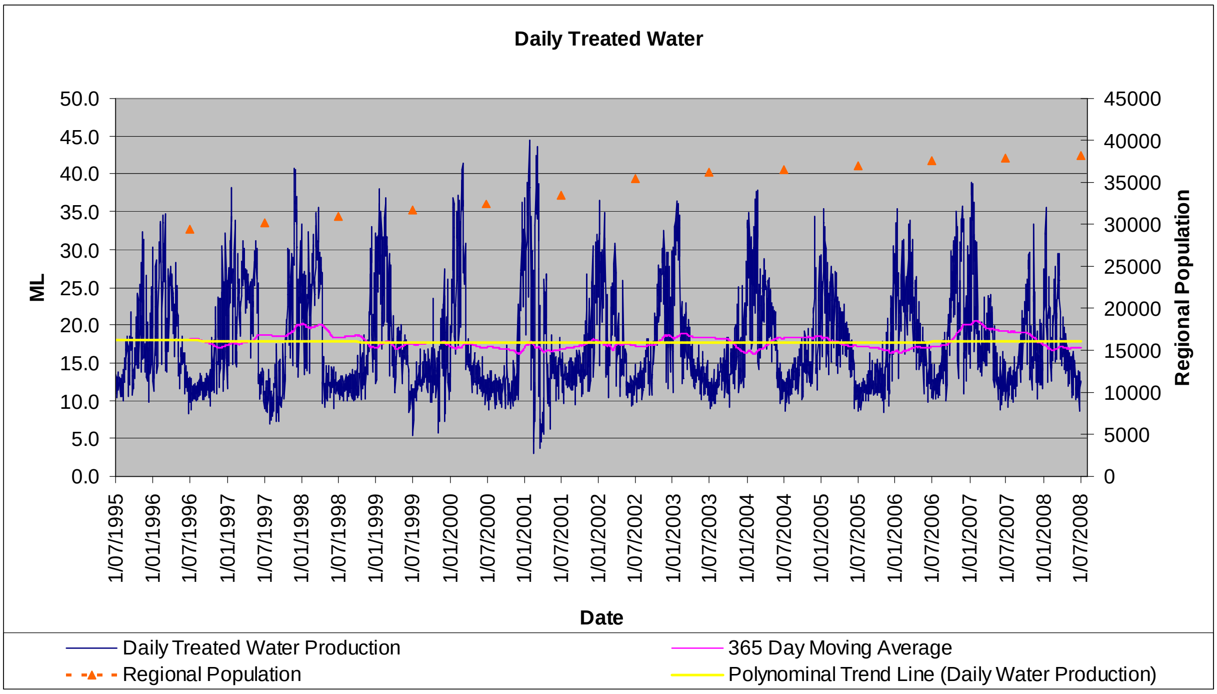
Month	Mean Daily Maximum Temp. °C	Mean Daily Minimum Temp. °C	Mean Monthly Rainfall mm	Monthly Evaporation mm
	(1909 to 2009)	(1909 to 2009)	(1908 to 2009)	(1966 to 2009)
January	27.9	13.3	68.6	210.8
February	27.2	13.3	57.9	162.4
March	24.6	10.8	49.0	139.5
April	20.1	6.7	41.8	87.0
May	15.6	3.4	42.1	52.7
June	12.1	1.6	43.7	33.0
July	11.2	0.5	48.5	37.2
August	12.3	1.3	49.1	55.8
September	16.3	3.4	46.2	84.0
October	19.9	6.2	60.9	124.0
November	23.2	8.9	61.0	156.0
December	26.3	11.6	63.8	204.6
Annual	19.8	6.8	633.0	1350.5
2008/09 DATA				
June 2008	14.6	4.1	36.8	41.5
July	12.2	0.0	37.8	47.3
August	11.2	0.2	47.4	63.6
September	17.7	3.4	91.8	106.7
October	22.1	6.5	61.2	135.2
November	23.2	9.0	116.5	149.3
December	25.4	11.2	170.8	183.4
January 2009	30.5	12.6	18.6	224.0
February	28.5	14.0	74.6	168.2
March	26.0	10.3	24.8	153.6
April	20.2	7.9	52.2	84.4
May	17.1	3.6	4.6	58.5
Annual	20.7	6.6	737.1	1415.7
Variation to Long Term Average.	+ 4.5%	-2.9%	+16.4%	+4.8%

(Source: Bureau of Meteorology)

C3.3: MODEL RESULTS

Figure 2 below shows the observed potable water production for Bathurst from 1 July 1995 to 30 June 2008. Population growth for the period is superimposed on the graph.

Figure 2: Total Annual Treated Water Production

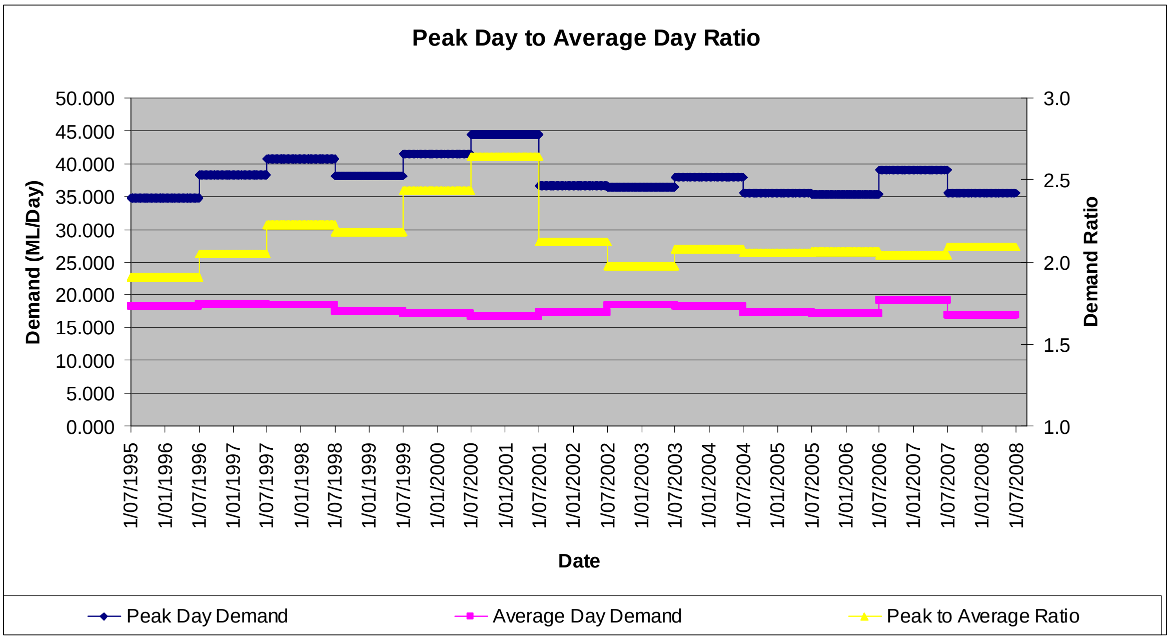


The trend is fairly constant over the period. There is a downward movement in 2001/02 and again in 2007/08.

C3.4: PEAK DAY TO AVERAGE DAY DEMAND RATIOS

The observed peak to average day demand ratios are shown in Figure 3 below.

Figure 3: Peak Day Average Day Ratio



The observed peak day to average day demand ratio ranged from 1.9 to 2.6 for the period 1995 to 2008, with an average value of 2.1.
The peak to average demand ratio for 2007/08 was 2.1.

C4: WATER DEMAND AND WASTEWATER FLOW FORECASTS

C4.1: INTRODUCTION

The purpose of forecasting future water demands and wastewater flows is to determine the future requirements of Bathurst Regional Council as a service provider and its ability to supply its customers in terms of both the source of water and the capability of the water supply and sewer infrastructure.

Water demand and wastewater flow forecasts for the next 30 years were estimated for several water management scenarios. The scenarios included the Traditional Scenario, which provides baseline data against which the impacts of different water demand management measures could be compared; and four integrated scenarios. An integrated scenario consists of one or more individual water demand management measures, including source substitution measures.

The scenarios were assessed to:

- Estimate preliminary cost/benefit ratios for the water demand management measures that were included in the integrated scenarios; and
- Develop water demand and effluent generation forecasts for the next 30 years (2008/09 to 2038/2039) for each of the scenarios.

The DWE Demand Side Management Decision Support System Software-Simplified (Version S1.1) supplemented with additional data, was used to assess the scenarios. The DWE model estimates costs/benefits for the water demand management measures that were included in the integrated scenarios, costs/benefits of each scenario and annual water demand and wastewater flow forecasts.

C4.2: DATA

The following data were inputted to the DWE model to calculate the Traditional Scenario:

- Demographics;
- Current water use;
- Evaporative cooling;
- Assumed residential internal water use;
- Details of current infrastructure and planned upgrades; and
- Details of current water prices.

Data for 2007/08 and 2008/09 was used. The data used are summarised as follows (also refer to Table 1 and Section 2).

C4.2.1 DEMOGRAPHICS

The demographic data are shown in Table 8.

Table 8: Demographic Data Used in Model

Element	
Current Year	2009
Current population served with water	32700
People per residential assessment	2.6
Assumed change in people per residential assessment	-5.0% pa
Anticipated population growth	0.9% pa

(Note: 1. The Model calculated the number of persons per residential assessment
2. The populations were obtained from the 2006 Census.)

C4.2.2: WATER USE DATA

The Model requires current water use data as well as segregation of water use into customer categories.

The data used is summarised below in Tables 9 and 10.

Table 9: Water Use Data

Element	
Current annual water supplied (treated water)	6490 ML/a
System Losses	10%
Peak to average day water demand ratio (2007/08)	2.1
Change in baseline per capita demand over next 30 years	0%
Total length of water mains in system	359 km

Table 10: Water Used By Paying Customers & Other Users (2007/08)

Customer Category	% of Total Water Consumed	Total number of accounts	Proportion of Customers Connected to Sewerage	Consumption per Account (L/d)
Residential	55.2%	12,383	100%	737
Commercial	17.9%	910	100%	3,146
Industrial	15.3%	450	100%	5,437
Public	1%	117	100%	1,367
Parks and Open Space	0%	0	0	0
Rural	0.5%	30	0	2,665
Other	0.1%	0	0	0
Unmetered	10%	0	5	0
Total	100.0%			

C4.2.3: EVAPORATIVE COOLING

Council has advised that there are no known evaporative coolers in Bathurst.

C4.2.4: RESIDENTIAL INTERNAL WATER USE

For the purpose of the model it has been assumed that 63% of treated water is used internally.

Residential Internal Water Use -	
Assumed level of internal residential water use per person	170.0
Calculated percentage of indoor residential use:	63%

Table 11: Residential Internal Water Use

C4.2.5: OPERATIONS AND TREATMENT COSTS

The Model requires current water and sewerage operating and treatment costs and these are reproduced in Table 12 below:

Element	
Current Annual Water Pumping Costs	$106,662
Current Annual Water Treatment Costs	$1,131,070
Current Sewage Pumping Costs	$43,763
Current Annual Sewage Treatment Costs	$1,083,252

Table 12: Operating & Treatment Costs (2007/08)

(**Note:** 1. Water & sewer pumping costs are power costs only
2. Water & sewage treatment costs include chemicals, power, load based fees and biosolids disposal)

C4.2.6: FUTURE INFRASTRUCTURE WORKS

Planned future **major** water and sewerage infrastructure projects **as required by the Model** and shown in Tables 13 and 14 below.

Council's 30 Year Forward Capital Works Programs are appended to this Report for information.

Specifically, these works will include:

a) Water Supply

- Development of a Management Plan for Chifley Dam; (completed)
- Construction of a new pipeline from Chifley Dam to Bathurst; (Report completed – report concludes that pipeline not required until 2030; at the earliest)
- Upgrading works at Winburndale Dam;
- Augmentation of capacity of Water Filtration Plant (scheduled for 2023; depending on demand);
- An additional 6 ML Service Reservoir (in 2019; depending on demand). [Council has developed a water model to enable closer assessment of timing for these planned works]

Items scheduled which are relevant to Demand Management include:

- IWCM education and awareness program;
- Rain water tank rebate scheme;
- Grey water treatment and reuse – retrofit program;
- Washing machine rebate scheme;
- Commercial properties – toilet retrofit program.

b) Sewerage

- On-going refurbishment of the Sewage Treatment facilities;
- Major upgrade works at Gilmour Street Pump Station;
- Upgrading of a number of sewer mains (Seymour Street, Rankin Street, Stanley Street, Durham Street, Gilmour Street;
- On-going infiltration / inflow assessment and rectification.

Type	Element	Reason	Replace existing?	Current capacity	Augmented capacity	Cost
Headworks	Service reservoirs	Peak flow	No (augmentation)	88 Ml	100 Ml	$3,000,000
Bulk water transfer	Pump stations & mains	Peak flow	No (augmentation)	52 Ml	65 Ml	$1,200,000
Water treatment	Water treatment plant	Peak flow	No (augmentation)	48 Ml	60 Ml	$5,000,000

Table 13: Planned Future Major Water Infrastructure Projects

Type	Element	Reason	Replace existing?	Current capacity	Augmented capacity	Cost
Sewage treatment	Sewage treatment plant	Peak flow	No (augmentation)	55,000 EP	72,000 EP	$4,000,000
Sewage transfer	Pumping stations/transfer mains	Peak flow	No (augmentation)	55,000 EP	72,000 EP	$1,500,000

Table 14: Planned Future Major Wastewater Infrastructure Projects

C4.2.7: WATER PRICING

The water pricing data used in the Model is shown in Table 15 below:

Element	**2007/08**	**2008/09**	**2009/10**
Residential Filtered Water up to 250 kL/a > 250 kL/a	 $0.60 $0.92	 $0.90 $1.15	 $1.25 $1.88
Residential Raw Water Up to 250 kL/a > 250 kL/a	 $0.45 $0.75	 $0.46 $0.95	 $0.56 $0.95
Access Charge: Varies Base: 20 mm service	 $269.00	 $235.00	 $125.00

Table 15: Water Charges

C4.3: UNDERLYING ASSUMPTIONS

The simplified version of the Model makes a number of assumptions regarding water use. These are set out in Table 16 below.

Type of Data	Derivation	Water Use Assumed
Internal residential consumption	Totals used are broadly based on the Perth Domestic Water Use Study (Water Corp., 2003). Adapted for increased levels of leakage and a lower market penetration of some fixtures and appliances.	Can be set by the user in the Setup Sheet. Typically from 170 to 190 L/d. 180 L/d is the recommended number for regional NSW.
Breakdown in Internal residential consumption	Breakdown used from the Perth study (Water Corp., 2003). Combined bath and shower use in the Perth study was assumed split 95% for showers, 5% for baths. Adjusted for change in the level of leakage outlined above.	Toilets 19.0% Baths 1.9% Showers 36.1% Taps/Sinks 11.4% Dishwashers 1.9% Washing Machine 24.7% Leakage 5.0%
Breakdown in internal use in commercial and public sectors	Breakdown used from the North American Commercial and Institutional End Uses Study (AWWARF, 2000)	Toilets 26.5 Urinals 6.6 Showers 4.0% Taps/Sinks 20.1% Dishwashers 3.8% Washing Machine 34.0% Internal Leakage 5.0%
Outdoor Use – Non-Residential Customer Categories	There is little data on levels of non-residential use in different climatic zones. In the absence of this information, assumptions are required that are reasonable. In this case, the approach has been to use some standard assumptions for some types of users and for others to provide a link to the level of residential use.	Outdoor use for non-residential customer categories is assumed to be: • 50% of the proportion of residential use for commercial and public users. • 90% for parks and open space uses. • 25% of the proportion of residential use for industrial users.

Table 16: Outline of Information Used in the Development of the End Use Model

C4.4: IWCM SCENARIOS

C4.4.1: SCENARIOS

(a) IWCM Scenarios

The scenarios used in the modelling are shown in Table 17 below:

Management Measure	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Community Education	X	X	X	X
Permanent Low Level Restrictions on Water Use				X
Conservation Pricing for Residential Users				X
Non-Residential Water Audits			X	X
System Water Loss Management	X	X	X	X
Rainwater Tanks for all New Residential Development				X
Dual Reticulation for all New Residential Development				X
BASIX - Fixture Efficiency with Rainwater Use			X	X
BASIX - Fixture Efficiency with Dual Reticulation			X	X
Evaporative Cooling Unit and Cooling Tower Audit		X	X	X

Table 17: IWCM Scenario

The year 2009 was adopted as the starting year for estimating future water demands for each of the scenarios.

The rationale for adopting the integrated scenarios in the above table is as follows:

Scenario 1: Continuing community education, system water loss management and on-going Government initiatives.

Scenario 2: Additional low cost management measure -conservation pricing.

Scenario 3: Includes water audits for non residential customers, fixture efficiency with the use of rain water and dual reticulation.

Scenario 4: Includes rainwater tanks and dual reticulation for new developments.

Definitions of these demand management measures (Source: DEUS, Demand Side Management Decision Support System) are reproduced in Table 18 below:

Table 18: Descriptions of Water Demand Management Measures

[Refer also to Part A of this Strategy]

Community Education (basic)	Council would provide materials, training and technical assistance to implement a basic ongoing community education program.
Community Education (intensive)	Council would provide materials, training and technical assistance to implement a comprehensive ongoing community education program.
Residential Retrofit Program	During an audit or upon request, a Council approved plumber would install a retrofit kit in an existing residential premise. The kit could contain a low flow shower head, tap flow restrictors and a cistern weight for older style toilets
National Mandatory Water Efficiency Labelling Scheme (Already in place – therefore, not modelled)	A mandatory water efficiency labelling scheme (WELS) for toilets, washing machines, shower roses, taps, urinals and dishwashers was introduced in 2005
BASIX	The NSW Governments program to achieve a 20% reduction in water use in new residences
Rainwater Tanks on all New Residential Development	Council would mandate the need for rainwater tanks on all new development. For supply to toilet flushing, washing machine use and outdoor use
Dual Reticulation for New Subdivisions	Council would require all new subdivisions to be fitted with dual reticulation systems with recycled water to be used for toilet flushing and irrigation
Permanent Restrictions on Water Use	Council would introduce a water waste regulation to prohibit irrigation during times of the day with highest evaporation; mandate the use of trigger nozzles when washing cars; prohibit the practice of hosing down hard surfaces
Conservation Pricing	Involves an inclining block tariff for single family, residential customers, with the price per kL for the second tier charge at least 2 times base price. The first tier limit generally based on internal use requirements only.
Active Leak Detection & Repair	Introduce a more active detection and repair program
Non-residential Water Audits	Allows for water audits for non-residential customers
Grey Water Reuse	Residences would install grey water treatment & recycling facilities for outdoor use

C4.4.2: ASSESSMENT OF SCENARIOS

Estimates of preliminary costs/benefit ratios and water savings for individual water demand management measures and water demand and effluent regeneration forecasts for each of the scenarios are presented below.

Management Measure	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Community Education	X	X	X	X
Permanent Low Level Restrictions on Water Use				X
Conservation Pricing for Residential Users				X
Non-Residential Water Audits			X	X
System Water Loss Management	X	X	X	X
Rainwater Tanks for all New Residential Development				X
Dual Reticulation for all New Residential Development				X
BASIX - Fixture Efficiency with Rainwater Use			X	X
BASIX - Fixture Efficiency with Dual Reticulation			X	X
Evaporative Cooling Unit and Cooling Tower Audit		X	X	X

Table 19: Scenarios Assessed

Management Measure	B/C Ratio		Average Annual Water Saving (ML/year)
	Utility	Total Community	
Community Education	3.9	9.3	80.5
Permanent Low Level Restrictions on Water Use	14.3	14.3	167.8
Conservation Pricing for Residential Users	202.9	203.4	384.5
Non-Residential Water Audits	9.6	4.2	23.3
System Water Loss Management	0.1	0.1	29.4
Rainwater Tanks for all New Residential Development	5.4	0.1	187.3
Dual Reticulation for all New Residential Development	14.1	0.3	230.1
BASIX - Fixture Efficiency with Rainwater Use	10.2	0.7	260.1
BASIX - Fixture Efficiency with Dual Reticulation	17.7	1.0	302.8
Evaporative Cooling Unit and Cooling Tower Audit	0.0	0.0	4.3

Table 20: Water Savings and B/C ratios for Demand Management Measures

The data in the above table shows that conservation pricing for residential users, dual reticulation for all new residential development and BASIX, with both rainwater use and dual reticulation would, have the greatest benefits in terms of water savings.

Permanent low level water restrictions and rainwater tanks for all new residential development would also provide significant water savings.

Conservation pricing is shown to yield the highest annual water saving, with clearly the highest utility and community B/C ratio.

Permanent low level water restrictions would deliver the next best B/C ratio for the community (except for BASIX which is mandatory anyway).

C4.4.3: FUTURE WATER DEMANDS

- Total Water Demand Forecasts

The average (2008 to 2038) water demands and water savings for each of the IWCM scenarios are summarised in the table below:

IWCM Scenario	Total Water Used	Average Water Saved	
	(ML/Year)	(ML/Year)	%
Baseline	5835		
Scenario 1	5725	110	1.9
Scenario 2	5721	114	2.0
Scenario 3	5182	653	11.2
Scenario 4	4518	1317	22.6

Table 21: Average Annual Water Demands and Assessed Water Savings

The results indicate that significant water savings can be realised by implementing water conservation and demand management initiatives.

Savings of up to nearly 23% are achievable (according to the Model) depending on which of the scenarios is adopted. Clearly, Scenario 4 is predicted to yield the highest savings.

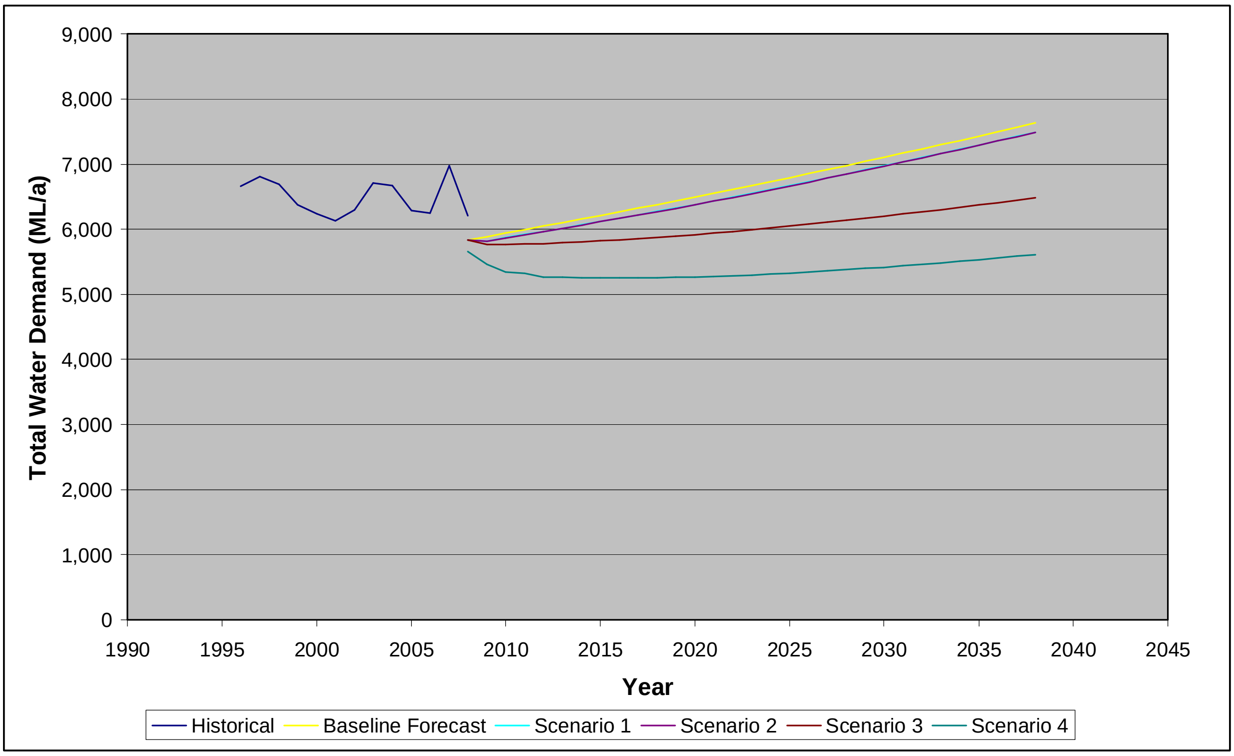


Figure 4: Total Water Demand Forecasts

- Peak Day Demand Forecasts

  The Peak Daily Demand forecasts for the scenarios considered are shown in Figure 5.

  The Peak Daily Demands are used to determine when the capacity of the Water Treatment Plant will be exceeded.

  The results indicate that the Plant (capacity 48 ML/d) will have sufficient capacity until 2038 under the baseline forecast. Implementation of the demand management measures listed in the four scenarios will extend the life of the Plant, particularly Scenario 4.

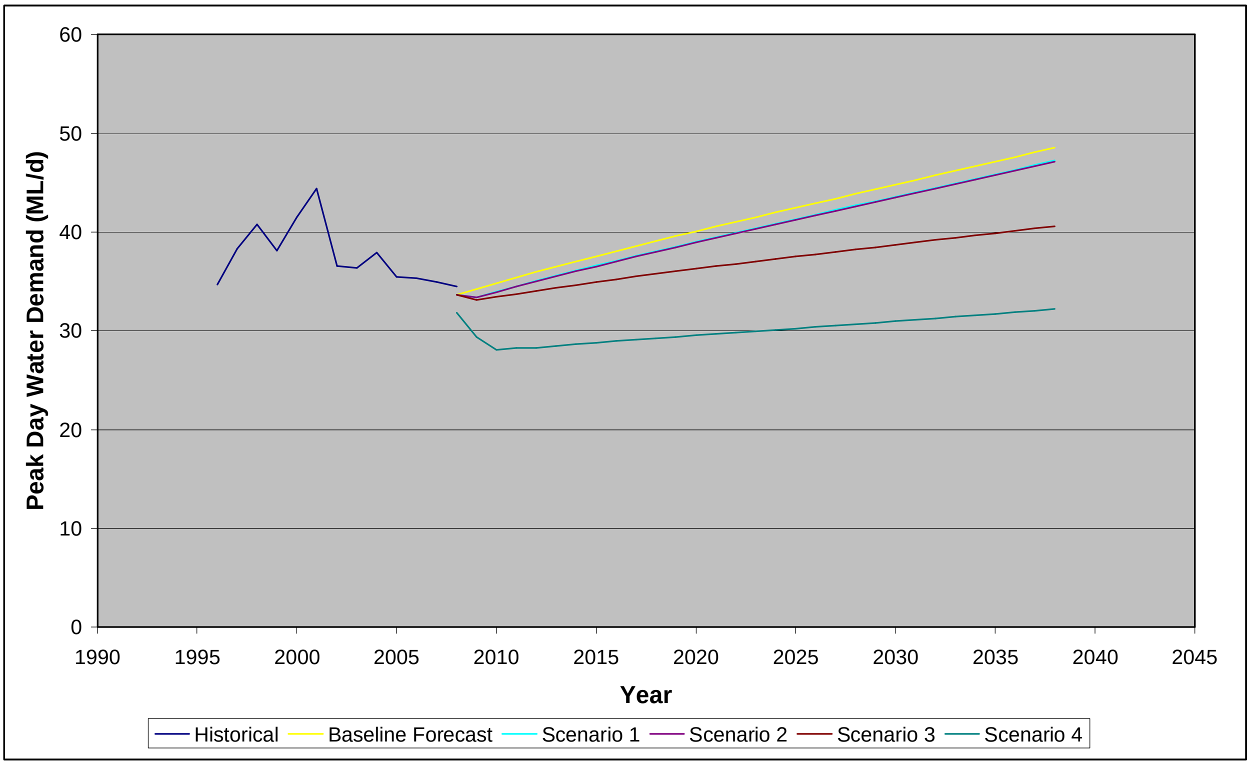


Figure 5: Peak Day Demand Forecasts

- Total Per Capita Water Demand

  Figure 6 shows the impact of the various demand management scenarios on per capita water demand to 2038. There is a reduction in demand under all scenarios, which becomes particularly significant under Scenarios 3 and 4.

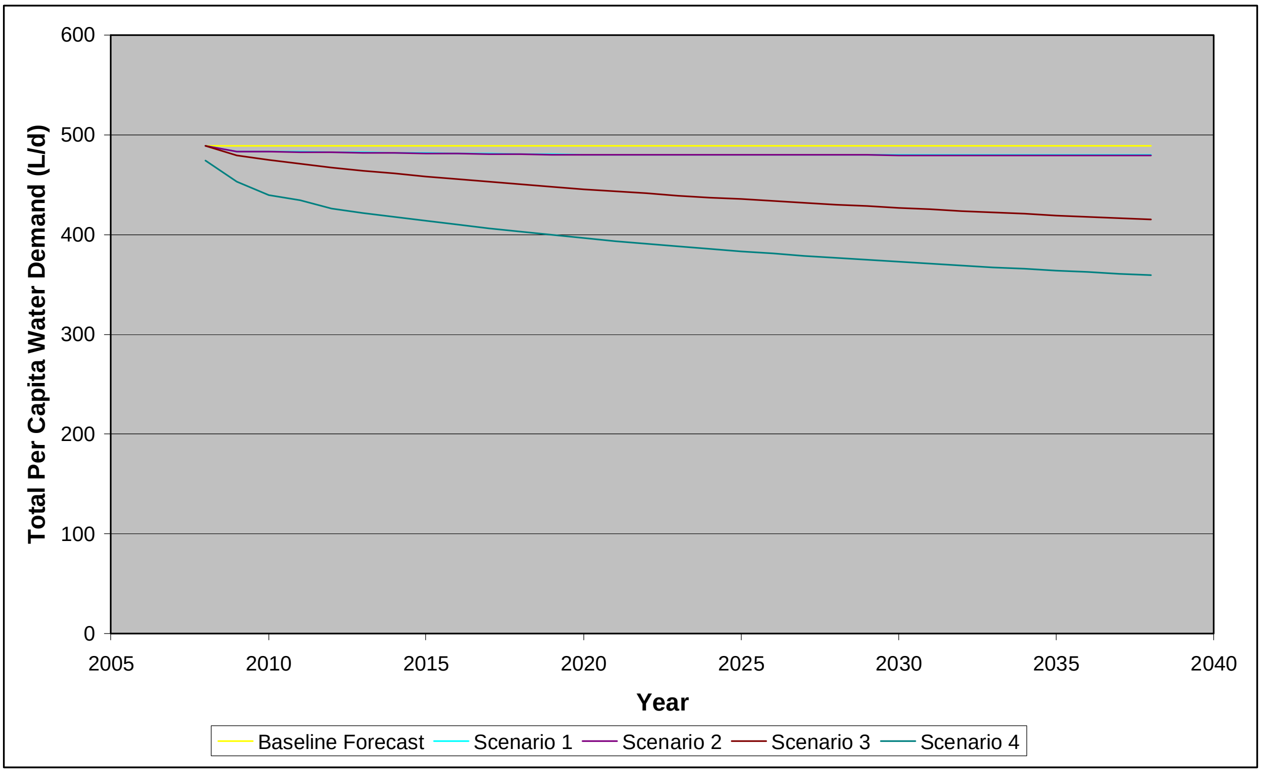


Figure 6: Total Per Capita Water Demand Forecast Scenarios

- Future Wastewater Flows

  Wastewater Flows to the Sewage Treatment Plant have been modelled for the various scenarios considered.

  Average daily flows are shown in Figure 7 and peak wet weather flows are shown in Figure 8.

  For an existing Plant capacity of 55,000 EP (or 13.2 ML/d), capacity is predicted to be reached in 2025 under the Baseline Scenario. Implementation of demand management measures may extend the service life until 2029 (under Scenario 3) or 2032 (under Scenario 4).

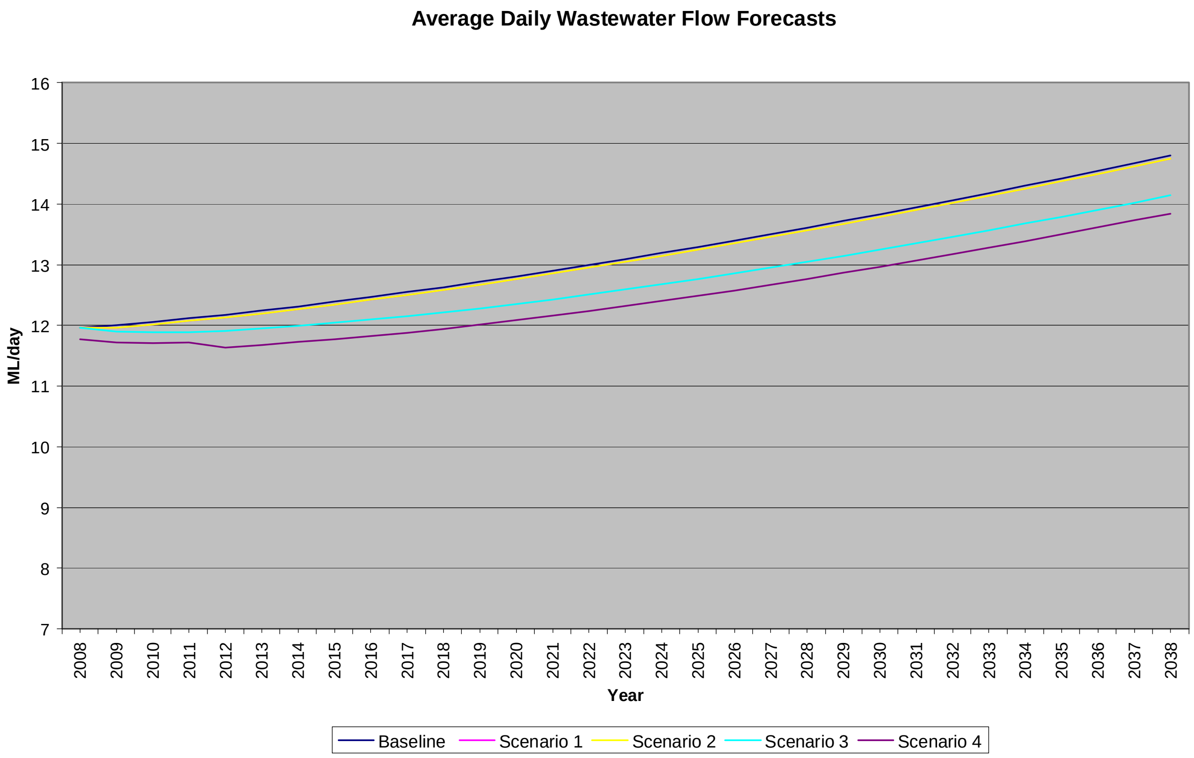


Figure 7: Wastewater Flows Scenarios

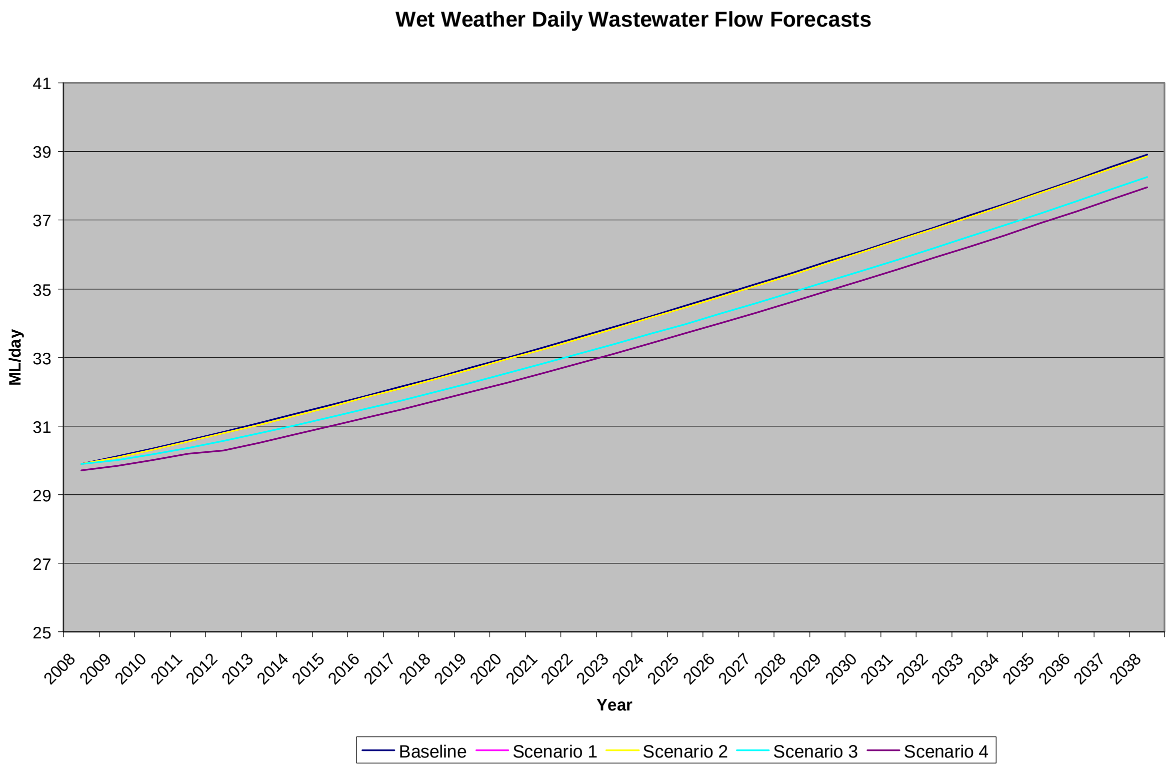


Figure 8: Wastewater Wet Weather Flows Scenario

D: IWCM IDENTIFIED ISSUES

Council's Integrated Water Cycle Management Strategy (MWH, February 2009) has identified a number of "options/issues" in relation to water conservation.

Those relevant to this Water Conservation and Demand Management Strategy are listed in Table 21 below.

Option	Rank (out of 53 options considered)	Order
• Continue & expand the rainwater tank rebate program	10	3
• BASIX: mandatory use of rainwater tanks connected to toilets, cold laundry & external use	21	6
• WELS scheme	Not ranked	-
• Urban water system energy audit	1	1
• On-site grey water recycling promotion	45	14
• Active water supply system leak detection & repair	33	11
• Washing machine rebate scheme	39	13
• On-site grey water recycling retrofit	26	9
• Residential conservation retrofit	4	2
• High water use site audits - residential - non-residential	14	4
• Pricing reform (increase variable charges)	21	6
• Water sensitive urban design development control plans (according to best practice targets)	26	9
• Encourage sustainable development beyond BASIX requirements (incentives)	14	4
• Dual reticulation in new development areas	21	6
• Water sensitive urban design retrofit in key areas (opportunistic)	37	12

Table 22:   IWCM Identified Water Conservation & Demand Management Options

The above rankings were determined by the IWCM Project Reference Group.

All of the above issues were incorporated in the "selected" IWCM Scenario (Scenario 2), which, in total has an estimated present value of $277 million.

E: CURRENT WATER CONSERVATION INITIATIVES

As generally discussed in Section B: "Water Conservation and Demand Management: General Concepts", Bathurst Regional Council has embraced water conservation and has developed a number of programs aimed at providing information to residents about ways of reducing their water consumption, as well as, in some cases, incentives to participate.

The information includes brochures and pamphlets and is made available to residents and businesses via widespread distribution of the material, advertisements and a number of Council websites.

These initiatives include:

- **Active membership and involvement in the Savewater program.**

The Savewater Alliance is a not-for-profit association of water businesses, government agencies and product companies which aims to deliver water conservation programs throughout Australia. The organisation promotes water conservation behaviour change and water saving product purchasing.

Specifically, the Savewater program:

- Manages the savewater.com.au website
- Conducts major water conservation exhibitions
- Manages the annual Savewater awards
- Undertakes programs for businesses and schools
- Conducts ongoing competitions and prize giveaways, as well as quantitative market research.

Members, like Bathurst Regional Council, have their own dedicated website within the Savewater parent website where residents, businesses and schools can readily access information about the Bathurst supply system, as well as, obtain valuable water conservation information, product details and take part in the ongoing rounds of competitions.

Council distributes flyers about the Savewater program with rate notices and ratepayer newsletters.

- **Participation in the 4-Star Toiletsmart program**

The 4-Star Toiletsmart program is a partnership with Caroma – Dorf to provide a simple way for residents to replace old, single flush toilets with modern, low volume, single flush units, at a reduced (subsidised) price

- **Participation in 3-Star Showerhead exchange program**

Under the 3-Star Showerhead exchange program Council provides, at no cost to residents, a 3-Star WELS rated (9L/min) showerhead to replace more water inefficient units.

- **Greywater Reuse Policy**

Council's "Greywater Reuse (Residential Households)" policy outlines the permissible activities for each of the three different categories (manual bucketing, greywater diversion and greywater treatment). The Policy is in total accordance with requirements of NSW Health and the Department of Water and Energy.

The Policy encourages residents to consider all opportunities to reduce water usage, prior to consideration of a greywater reuse system; and to carry out a water balance to compare volumes of greywater generated at the property and amounts that can be beneficially reused on the site.

- **Rainwater Tanks**

Bathurst Regional Council supports the installation of rainwater tanks (for the purposes outlined in Section B6).

Details of rebates available, under the NSW Government's Rainwater Tank Rebate scheme, are made available to residents and are posted on Council's website.

- **General Information**

Council publishes a range of information regarding water conservation and sustainable products and services and has developed a website dedicated to sources of valuable information for residents.

- **Pricing Policy**

As outlined in Section B5, demand management is essential for effective and efficient management. Council is increasing the water usage component of the bill and reading meters and billing four (4) times per year to encourage customers to exercise more control over their water costs. (Larger customers' meters are read monthly, with bills also issued on a monthly basis)

Council is currently introducing a pricing regime which recovers 75% of costs via **consumption charges,** which is a powerful demand management initiative.

- **Effluent Reuse**

Council currently reuses approximately 20-25% of the water reclaimed from the sewage treatment processes. The water is used to irrigate the landscaped areas and surrounds at the treatment plant. There may be scope to reuse more of this water in the future.

F: SUMMARY AND CONCLUSIONS

Bathurst Regional Council provides water supply and sewerage services to a population of 32,700. The City is continuing to grow, with an annual increase in population of around 0.9%.pa

Council has two storage dams (Chifley and Winburndale), with a total storage capacity of 31.8 Gigalitres, and a conventional water treatment plant of 60 ML/d capacity.
Sewage treatment is provided via a tertiary treatment plant of 55,000 EP capacity.

The main conclusions of this Report are:

- Water consumption has reduced from 6,173 ML in 2004/05 to 5,780 ML in 2008/09;
- The average annual water production (water treated) since 1995/96, has been 6,490 ML
- Unaccounted for water (UFW) since 1995/96 has averaged 13%. This is considered to be quite high and a target of 5 – 6% UFW would be more appropriate. System losses in 2008/09 were approximately 10% (7% in 2007/08).
  The UFW percentages have been derived as the difference between the volumes of water treated at the Water Filtration Plant and those volumes that have actually been billed for. Since the actual **water losses** are not known, Council (in conjunction with the Water Directorate) is proceeding with a full water loss investigation, including zoning and installation of zone meters.
- Residential water consumption is relatively high by national standards at 737 L/person/d (2008/09)
- The peak to average day usage ratio is 2.1, which is similar to similarly sized cities throughout NSW
- Council's water usage charges are based on an inclining block tariff, with the first 250 kL provided at $1.25/kL. Thereafter, the charge is $1.88/kL (2009/10 charges)
- In line with best practice pricing policy, Council has budgeted for 75% of revenue for 2009/10 to be derived from residential usage charges

Water demand and wastewater forecasts were modelled using the DWE, Demand Side Management Decision Support System (Simplified Version S1.1). The modelling has indicated that:

i) Conservation pricing for residential users, dual reticulation for all new residential development and BASIX, with both rainwater use and dual reticulation will deliver the greatest benefits in terms of **water savings**.
   Permanent low level water restrictions and rainwater tanks for all new residential development will also yield significant water savings.
   Conservation pricing is shown to yield the highest annual water savings with clearly the highest utility and community **benefit/cost ratio.**

ii) Full uptake of the demand management initiatives modelled may deliver significant water savings – up to 1,317 Ml/year (or 23% reduction) for Scenario 4 initiatives.

iii) The results indicate that the capacity of the Water Treatment Plant will not be reached until 2038. Implementation of demand management initiatives is expected to extend the life of the plant (in terms of capacity) well beyond the 30 year planning horizon.

iv) the capacity of the Sewage Treatment Plant is expected to be reached in 2025 (under the Baseline Scenario). Life expectancy could be extended to 2029 (under Scenario 3) and 2032 (under Scenario 4).

Council has a commitment to water conservation in the City and has implemented a range of initiatives which, based on the general reduction in water consumption since 2003/04, has been quite successful, particularly with a consistent growth in population of 0.9%.pa

These initiatives include most of the elements which the model predicts will deliver the greatest savings at the best benefit/cost ratio, namely, BASIX requirements for all new homes, conservation pricing, and rainwater harvesting.

G: RECOMMENDATIONS

Bathurst Regional Council has a number of water conservation initiatives currently in place, including:

- Appropriate pricing policy in place; including recovery of 75% of revenue via usage charges.
- Participation in water use efficiency programs, like the 4-Star Toiletsmart program and the 3-Star Showerhead exchange program
- Active participation in the Savewater program
- Implementation of a Grey Water Reuse Policy
- Promotion of the use of rain water tanks
- Reuse of effluent
- Supply of water conservation material to ratepayers via newsletters, rate notices and a dedicated website

There are still further opportunities for enhancing water conservation in the City.
It is recommended that Council give consideration to implementing the following additional incentives and programs:

- Implementation of a City wide leak detection program, particularly targeting the old areas of the City and budgeting to repair leaks and/or replace leaking infrastructure
- Developing a schools based water use education program
- Developing an annual (spring and summer) media campaign (newspaper, radio and television)
- Introduction of permanent low level water restrictions; aimed at eliminating hose down of paths and driveways and restricting garden and lawn watering to low evaporation times of the day
- Increasing the ratio of second tier to first tier charges for consumption from the current 1.5 multiplier to, say, 2.0; to send a stronger message of water use restraint to ratepayers; <u>or</u> decreasing the allowance for first tier use from the current 250 kL to, say, 200 kL (with appropriate consideration of CSO and disadvantaged customers)
- Further investigating cost effective options for increased effluent reuse within the City, particularly in the watering of parks and reserves relatively close to the Wastewater Treatment Plant
- Developing and providing an audit program for businesses and industries (including high water users like motels, hotels and laundries) aimed at investigating leaks and other ways these businesses can reduce their water consumption.

H: REFERENCES

- Australian Bureau of Statistics, *Water Account, Australia* (various years)
- Australian Bureau of Statistics, *Household Water Use & Effects of the Drought, July 2005*
- Australian Government, *Water for the Future, Urban Water Use, 2003*
- Bathurst Regional Council, *Management Plan 2008/09*
- Bathurst Regional Council, *Detailed Financial Budget and Revenue Policy 2008-2012*
- Bathurst Regional Council, *Annual Report 2007/08*
- Bathurst Regional Council, *Revenue Policy, Water Service Charges 2008/09*
- Bathurst Integrated Water Cycle Management Strategy , MWH, February 2009
- Birrell, Rapson and Smith for the Water Services Association of Australia, *Impact of Demographic Change and Urban Consolidation on Domestic Water Use, 2005*
- Bureau of Meteorology, *Climate Statistics for Bathurst* (www.bom.gov.au/climate/averages)
- Department of Energy, Utilities and Sustainability, *Water Demand Tracking and Climate Correction, May 2002 (as revised in 2006)*
- Department of Water and Energy, *TBL Performance Reports, Water Supply & Sewerage 2006/07*
- Department of Water and Energy, *Demand Side Management Decision Support System (Simplified Version S1.1, July 2006)*
- Economics@ANZ, *Australia's Water Supply, Consumption and Regulation – Water Use & Regulation 2007*
- Institute for Sustainable Futures, University of Technology, Sydney, *Guide to Demand Management, undated*
- National Water Commission, *Water Use in Australia 2008*
- Water Services Association of Australia, *Water Wise Management: A Demand Management Manual, 1998*
- Victorian Women's Trust, *On Water Mark, 2006*

APPENDICES

APPENDIX A: End Use Model Tables

Demand Management Least Cost Planning - Decision Support System

Baseline Forecasts

Existing Demand Measures:

Community Education

Water Restrictions

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Resident Population Served with water						32,700	32,994	33,291	33,591	33,893	34,198	34,506	34,817	35,130	35,446
Persons per Residential Account						2.64	2.64	2.64	2.63	2.63	2.63	2.62	2.62	2.62	2.62
Annual Average Water Consumption (ML/year)															
Historical	6,715	6,674	6,292	6,248	6,977	6,209									
Baseline Forecast						5834.5	5887.0	5940.0	5993.5	6047.4	6101.8	6156.7	6212.2	6268.1	6324.5
Peak Day Demand (ML)															
Historical	36.34	37.90	35.44	35.32	34.95	34.49									
Baseline Forecast						33.61	34.22	34.81	35.39	35.95	36.49	37.03	37.56	38.08	38.58
Per Capita Demand (L/person/day)															
Baseline Forecast						488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Forecast Waste Water Flows (ML/day)															
Daily Average						11.96	12.01	12.06	12.12	12.18	12.24	12.32	12.39	12.47	12.55
Design Wet Weather						29.89	30.12	30.35	30.59	30.83	31.09	31.34	31.61	31.87	32.15

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Demand Management Least Cost Planning - Decision Support System

Baseline Forecasts

Existing Demand Measures:

Community Education
Water Restrictions

Year	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Resident Population Served with water	35,765	36,087	36,412	36,739	37,070	37,404	37,740	38,080	38,423	38,769	39,117	39,470	39,825	40,183
Persons per Residential Account	2.61	2.61	2.61	2.61	2.60	2.60	2.60	2.60	2.59	2.59	2.59	2.59	2.58	2.58
Annual Average Water Consumption (ML/year)														
Historical														
Baseline Forecast	6381.4	6438.8	6496.8	6555.3	6614.3	6673.8	6733.8	6794.4	6855.6	6917.3	6979.6	7042.4	7105.8	7169.7
Peak Day Demand (ML)														
Historical														
Baseline Forecast	39.09	39.58	40.07	40.56	41.04	41.51	41.99	42.46	42.93	43.40	43.87	44.33	44.80	45.26
Per Capita Demand (L/person/day)														
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Forecast Waste Water Flows (ML/day)														
Daily Average	12.63	12.72	12.81	12.90	13.00	13.09	13.19	13.29	13.40	13.50	13.61	13.72	13.84	13.95
Design Wet Weather	32.42	32.71	32.99	33.29	33.58	33.89	34.19	34.50	34.82	35.13	35.46	35.78	36.12	36.45

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Demand Management Least Cost Planning - Decision Support System

Baseline Forecasts

Existing Demand Measures:

Community Education

Water Restrictions

Year	2032	2033	2034	2035	2036	2037	2038
Resident Population Served with water	40,545	40,910	41,278	41,649	42,024	42,403	42,784
Persons per Residential Account	2.58	2.57	2.57	2.57	2.57	2.56	2.56
Annual Average Water Consumption (ML/year)							
Historical							
Baseline Forecast	7234.2	7299.3	7365.0	7431.3	7498.2	7565.7	7633.8
Peak Day Demand (ML)							
Historical							
Baseline Forecast	45.73	46.19	46.66	47.13	47.60	48.07	48.54
Per Capita Demand (L/person/day)							
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Forecast Waste Water Flows (ML/day)							
Daily Average	14.07	14.18	14.30	14.43	14.55	14.67	14.80
Design Wet Weather	36.79	37.13	37.48	37.83	38.19	38.55	38.91

Demand Management Least Cost Planning - Decision Support System

Scenario 1

New Demand Measures:

Community Education

System Water Loss Management

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Demand Measures Water Savings (ML/year)													
Community Education	0.00	67.76	69.00	70.20	71.37	72.52	73.64	74.74	75.82	76.88	77.93	78.97	79.99
System Water Loss Management	0.00	0.00	0.00	3.37	6.80	10.30	13.85	17.47	21.15	24.90	28.72	32.60	36.54
Calculated Total Savings	0.00	67.76	69.00	73.57	78.18	82.82	87.49	92.21	96.98	101.79	106.65	111.56	116.53
Total Water Savings Scenario 1 (Modelled)	**0.00**	**67.76**	**69.00**	**73.57**	**78.18**	**82.82**	**87.49**	**92.21**	**96.98**	**101.79**	**106.65**	**111.56**	**116.53**
Annual Average Water Consumption (ML/year)													
Baseline Forecast	5834.5	5887.0	5940.0	5993.5	6047.4	6101.8	6156.7	6212.2	6268.1	6324.5	6381.4	6438.8	6496.8
Integrated Scenario 1	5834.5	5819.3	5871.0	5919.9	5969.2	6019.0	6069.3	6119.9	6171.1	6222.7	6274.8	6327.3	6380.3
Total Water Savings	0.0	67.8	69.0	73.6	78.2	82.8	87.5	92.2	97.0	101.8	106.6	111.6	116.5
Peak Day Demand (ML)													
Baseline Forecast	33.61	34.22	34.81	35.39	35.95	36.49	37.03	37.56	38.08	38.58	39.09	39.58	40.07
Integrated Scenario 1	33.61	33.38	33.95	34.50	35.04	35.57	36.08	36.59	37.08	37.57	38.05	38.53	39.00
Per Capita Demand (L/person/day)													
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 1	488.84	483.21	483.16	482.84	482.52	482.20	481.89	481.58	481.27	480.97	480.67	480.37	480.07
Waste Water Flows (ML/day)													
Daily Average Baseline	11.96	12.01	12.06	12.12	12.18	12.24	12.32	12.39	12.47	12.55	12.63	12.72	12.81
Integrated Scenario 1	11.96	11.96	12.01	12.07	12.13	12.20	12.27	12.34	12.42	12.50	12.59	12.67	12.76
Design Wet Weather Baseline	29.89	30.12	30.35	30.59	30.83	31.09	31.34	31.61	31.87	32.15	32.42	32.71	32.99
Integrated Scenario 1	29.89	30.07	30.31	30.55	30.79	31.04	31.30	31.56	31.83	32.10	32.38	32.66	32.95

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Demand Management Least Cost Planning - Decision Support System

Scenario 1

New Demand Measures:

Community Education
System Water Loss Management

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Demand Measures Water Savings (ML/year)														
Community Education	81.00	82.00	82.99	83.98	84.96	85.94	86.91	87.88	88.85	89.81	90.77	91.74	92.70	93.66
System Water Loss Management	36.87	37.21	37.54	37.88	38.22	38.56	38.91	39.26	39.61	39.97	40.33	40.69	41.06	41.43
Calculated Total Savings	117.87	119.21	120.53	121.86	123.18	124.50	125.82	127.14	128.46	129.78	131.10	132.43	133.76	135.09
Total Water Savings Scenario 1 (Modelled)	**117.87**	**119.21**	**120.53**	**121.86**	**123.18**	**124.50**	**125.82**	**127.14**	**128.46**	**129.78**	**131.10**	**132.43**	**133.76**	**135.09**
Annual Average Water Consumption (ML/year)														
Baseline Forecast	6555.3	6614.3	6673.8	6733.8	6794.4	6855.6	6917.3	6979.6	7042.4	7105.8	7169.7	7234.2	7299.3	7365.0
Integrated Scenario 1	6437.4	6495.0	6553.2	6612.0	6671.3	6731.1	6791.5	6852.4	6913.9	6976.0	7038.6	7101.8	7165.6	7229.9
Total Water Savings	117.9	119.2	120.5	121.9	123.2	124.5	125.8	127.1	128.5	129.8	131.1	132.4	133.8	135.1
Peak Day Demand (ML)														
Baseline Forecast	40.56	41.04	41.51	41.99	42.46	42.93	43.40	43.87	44.33	44.80	45.26	45.73	46.19	46.66
Integrated Scenario 1	39.47	39.94	40.40	40.86	41.32	41.77	42.23	42.68	43.13	43.58	44.03	44.49	44.94	45.39
Per Capita Demand (L/person/day)														
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 1	480.05	480.03	480.01	479.99	479.97	479.96	479.95	479.93	479.92	479.91	479.90	479.89	479.88	479.87
Waste Water Flows (ML/day)														
Daily Average Baseline	12.90	13.00	13.09	13.19	13.29	13.40	13.50	13.61	13.72	13.84	13.95	14.07	14.18	14.30
Integrated Scenario 1	12.85	12.95	13.05	13.15	13.25	13.35	13.46	13.56	13.67	13.79	13.90	14.02	14.13	14.25
Design Wet Weather Baseline	33.29	33.58	33.89	34.19	34.50	34.82	35.13	35.46	35.78	36.12	36.45	36.79	37.13	37.48
Integrated Scenario 1	33.24	33.54	33.84	34.14	34.45	34.77	35.09	35.41	35.74	36.07	36.40	36.74	37.08	37.43

Cont'd over page

Demand Management Least Cost Planning - Decision Support System

Scenario 1

New Demand Measures:

Community Education
System Water Loss Management

Year	2035	2036	2037	2038	
Demand Measures Water Savings (ML/year)					
Community Education	94.63	95.60	96.57	97.54	EDUC
System Water Loss Management	41.80	42.18	42.56	42.94	LOSS
Calculated Total Savings	136.43	137.77	139.12	140.48	Calc
Total Water Savings Scenario 1 (Modelled)	**136.43**	**137.77**	**139.12**	**140.48**	BCP1
Annual Average Water Consumption (ML/year)					
Baseline Forecast	7431.3	7498.2	7565.7	7633.8	BAS
Integrated Scenario 1	7294.9	7360.4	7426.6	7493.3	BCP1
Total Water Savings	136.4	137.8	139.1	140.5	BCP1
Peak Day Demand (ML)					
Baseline Forecast	47.13	47.60	48.07	48.54	BAS
Integrated Scenario 1	45.85	46.30	46.76	47.21	BCP1
Per Capita Demand (L/person/day)					
Baseline Forecast	488.50	488.50	488.50	488.50	BAS
Integrated Scenario 1	479.86	479.85	479.85	479.84	SET
Waste Water Flows (ML/day)					
Daily Average Baseline	14.43	14.55	14.67	14.80	BAS
Integrated Scenario 1	14.37	14.50	14.62	14.75	BCP1
Design Wet Weather Baseline	37.83	38.19	38.55	38.91	BAS
Integrated Scenario 1	37.78	38.14	38.50	38.86	BCP1

Demand Management Least Cost Planning – Decision Support System

Scenario 2

Demand Measures:

Existing Community Education
System Water Loss Management

New Evaporative Cooling Unit and Cooling Tower Audit

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Demand Measures Water Savings (ML/year)												
Total Water Savings Scenario 1	0.0	67.8	69.0	73.6	78.2	82.8	87.5	92.2	97.0	101.8	106.6	111.6
Evaporative Cooling Unit and Cooling Tower Audit	0.00	0.75	1.54	2.34	3.17	4.03	4.10	4.17	4.24	4.31	4.37	4.44
Calculated Total Savings	0.00	68.51	70.53	75.91	81.35	86.84	91.59	96.38	101.22	106.09	111.02	116.00
Total Water Savings Scenario 2 (Modelled)	**0.00**	**68.51**	**70.53**	**75.91**	**81.35**	**86.84**	**91.59**	**96.38**	**101.22**	**106.09**	**111.02**	**116.00**
Annual Average Water Consumption (ML/year)												
Baseline Forecast	5834.5	5887.0	5940.0	5993.5	6047.4	6101.8	6156.7	6212.2	6268.1	6324.5	6381.4	6438.8
Integrated Scenario 2	5698.9	5689.5	5756.6	5822.1	5888.4	5955.5	6023.9	6093.1	6163.1	6234.0	6305.7	6378.3
Total Water Savings	135.6	197.6	183.4	171.4	159.0	146.4	132.9	119.1	105.0	90.5	75.7	60.6
Peak Day Demand (ML)												
Baseline Forecast	33.61	34.22	34.81	35.39	35.95	36.49	37.03	37.56	38.08	38.58	39.09	39.58
Integrated Scenario 2	33.61	33.37	33.93	34.47	34.99	35.50	36.02	36.52	37.02	37.50	37.98	38.46
Per Capita Demand (L/person/day)												
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 2	488.84	483.15	483.03	482.64	482.26	481.88	481.56	481.25	480.94	480.64	480.33	480.03
Waste Water Flows (ML/day)												
Daily Average Baseline	11.96	12.01	12.06	12.12	12.18	12.24	12.32	12.39	12.47	12.55	12.63	12.72
Integrated Scenario 2	11.96	11.96	12.01	12.07	12.13	12.20	12.27	12.34	12.42	12.50	12.59	12.67
Design Wet Weather Baseline	29.89	30.12	30.35	30.59	30.83	31.09	31.34	31.61	31.87	32.15	32.42	32.71
Integrated Scenario 2	29.89	30.07	30.31	30.55	30.79	31.04	31.30	31.56	31.83	32.10	32.38	32.66

Cont'd over page

Demand Management Least Cost Planning – Decision Support System

Scenario 2

Demand Measures:

Existing Community Education
System Water Loss Management

New Evaporative Cooling Unit and Cooling Tower Audit

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Demand Measures Water Savings (ML/year)											
Total Water Savings Scenario 1	116.5	117.9	119.2	120.5	121.9	123.2	124.5	125.8	127.1	128.5	129.8
Evaporative Cooling Unit and Cooling Tower Audit	4.50	4.56	4.62	4.68	4.74	4.79	4.85	4.90	4.96	5.01	5.07
Calculated Total Savings	121.03	122.43	123.83	125.21	126.60	127.97	129.35	130.72	132.10	133.47	134.85
Total Water Savings Scenario 2 (Modelled)	**121.03**	**122.43**	**123.83**	**125.21**	**126.60**	**127.97**	**129.35**	**130.72**	**132.10**	**133.47**	**134.85**
Annual Average Water Consumption (ML/year)											
Baseline Forecast	6496.8	6555.3	6614.3	6673.8	6733.8	6794.4	6855.6	6917.3	6979.6	7042.4	7105.8
Integrated Scenario 2	6451.7	6528.8	6606.9	6685.9	6765.9	6846.8	6928.7	7011.7	7095.6	7180.6	7266.6
Total Water Savings	45.1	26.4	7.4	-12.1	-32.0	-52.4	-73.1	-94.4	-116.1	-138.2	-160.8
Peak Day Demand (ML)											
Baseline Forecast	40.07	40.56	41.04	41.51	41.99	42.46	42.93	43.40	43.87	44.33	44.80
Integrated Scenario 2	38.93	39.40	39.86	40.32	40.78	41.24	41.69	42.15	42.60	43.05	43.50
Per Capita Demand (L/person/day)											
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 2	479.73	479.71	479.69	479.67	479.65	479.63	479.61	479.60	479.58	479.57	479.56
Waste Water Flows (ML/day)											
Daily Average Baseline	12.81	12.90	13.00	13.09	13.19	13.29	13.40	13.50	13.61	13.72	13.84
Integrated Scenario 2	12.76	12.85	12.95	13.05	13.15	13.25	13.35	13.46	13.56	13.67	13.79
Design Wet Weather Baseline	32.99	33.29	33.58	33.89	34.19	34.50	34.82	35.13	35.46	35.78	36.12
Integrated Scenario 2	32.95	33.24	33.54	33.84	34.14	34.45	34.77	35.09	35.41	35.74	36.07

Cont'd over page

Demand Management Least Cost Planning – Decision Support System

Scenario 2

Demand Measures:

Existing Community Education
System Water Loss Management

New Evaporative Cooling Unit and Cooling Tower Audit

Year	2031	2032	2033	2034	2035	2036	2037	2038	
Demand Measures Water Savings (ML/year)									
Total Water Savings Scenario 1	131.1	132.4	133.8	135.1	136.4	137.8	139.1	140.5	BCP1
Evaporative Cooling Unit and Cooling Tower Audit	5.12	5.17	5.23	5.28	5.33	5.38	5.43	5.49	COOL
Calculated Total Savings	136.22	137.60	138.99	140.37	141.76	143.16	144.56	145.97	Calc
Total Water Savings Scenario 2 (Modelled)	**136.22**	**137.60**	**138.99**	**140.37**	**141.76**	**143.16**	**144.56**	**145.97**	BCP2
Annual Average Water Consumption (ML/year)									
Baseline Forecast	7169.7	7234.2	7299.3	7365.0	7431.3	7498.2	7565.7	7633.8	BAS
Integrated Scenario 2	7353.6	7441.7	7530.8	7621.1	7712.4	7804.8	7898.4	7993.0	BCP2
Total Water Savings	-183.9	-207.5	-231.5	-256.0	-281.1	-306.6	-332.7	-359.3	BCP2
Peak Day Demand (ML)									
Baseline Forecast	45.26	45.73	46.19	46.66	47.13	47.60	48.07	48.54	BAS
Integrated Scenario 2	43.95	44.40	44.86	45.31	45.76	46.22	46.67	47.13	BCP2
Per Capita Demand (L/person/day)									
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	BAS
Integrated Scenario 2	479.55	479.54	479.53	479.52	479.51	479.50	479.50	479.49	SET
Waste Water Flows (ML/day)									
Daily Average Baseline	13.95	14.07	14.18	14.30	14.43	14.55	14.67	14.80	BAS
Integrated Scenario 2	13.90	14.02	14.13	14.25	14.37	14.50	14.62	14.75	BCP2
Design Wet Weather Baseline	36.45	36.79	37.13	37.48	37.83	38.19	38.55	38.91	BAS
Integrated Scenario 2	36.40	36.74	37.08	37.43	37.78	38.14	38.50	38.86	BCP2

Demand Management Least Cost Planning – Decision Support System

Scenario 3

Demand Measures:

Existing Community Education
System Water Loss Management
Evaporative Cooling Unit and Cooling Tower Audit

New Non-Residential Water Audits
BASIX – Fixture Efficiency with Rainwater Use
BASIX – Fixture Efficiency with Dual Reticulation

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Demand Measures Water Savings (ML/year)												
Total Water Savings Scenario 2	0.0	68.5	70.5	75.9	81.4	86.8	91.6	96.4	101.2	106.1	111.0	116.0
Non-Residential Water Audits	0.0	8.5	17.1	23.3	29.6	27.1	24.6	24.6	24.6	24.6	24.6	24.7
BASIX – Fixture Efficiency with Rainwater Use	0.00	20.04	39.55	58.59	77.20	95.43	113.30	130.87	148.16	165.21	182.04	198.69
BASIX – Fixture Efficiency with Dual Reticulation	0.00	22.39	44.35	65.93	87.15	108.05	128.65	149.00	169.12	189.03	208.76	228.34
Calculated Total Savings	0.00	119.46	171.57	223.77	275.31	317.41	358.11	400.83	443.09	484.95	526.46	567.68
Total Water Savings Scenario 3 (Modelled)	**0.00**	**118.37**	**169.04**	**219.50**	**269.03**	**308.88**	**347.11**	**387.16**	**426.55**	**465.37**	**503.67**	**541.52**
Annual Average Water Consumption (ML/year)												
Baseline Forecast	5834.5	5887.0	5940.0	5993.5	6047.4	6101.8	6156.7	6212.2	6268.1	6324.5	6381.4	6438.8
Integrated Scenario 3	5834.5	5768.7	5771.0	5774.0	5778.4	5793.0	5809.6	5825.0	5841.5	5859.1	5877.7	5897.3
Total Water Savings	0.0	118.4	169.0	219.5	269.0	308.9	347.1	387.2	426.6	465.4	503.7	541.5
Peak Day Demand (ML)												
Baseline Forecast	33.61	34.22	34.81	35.39	35.95	36.49	37.03	37.56	38.08	38.58	39.09	39.58
Integrated Scenario 3	33.61	33.13	33.44	33.75	34.03	34.34	34.65	34.94	35.22	35.49	35.76	36.02
Per Capita Demand (L/person/day)												
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 3	488.84	479.01	474.93	470.93	467.09	464.09	461.28	458.37	455.57	452.87	450.25	447.72
Waste Water Flows (ML/day)												
Daily Average	11.96	12.01	12.06	12.12	12.18	12.24	12.32	12.39	12.47	12.55	12.63	12.72
Integrated Scenario 3	11.96	11.90	11.89	11.89	11.91	11.95	12.00	12.04	12.10	12.15	12.22	12.28
Design Wet Weather Baseline	29.89	30.12	30.35	30.59	30.83	31.09	31.34	31.61	31.87	32.15	32.42	32.71
Integrated Scenario 3	29.89	30.01	30.18	30.37	30.56	30.79	31.02	31.26	31.50	31.75	32.01	32.27

Cont'd over page

Demand Management Least Cost Planning – Decision Support System

Scenario 3

Demand Measures:

Existing
- Community Education
- System Water Loss Management
- Evaporative Cooling Unit and Cooling Tower Audit

New
- Non-Residential Water Audits
- BASIX – Fixture Efficiency with Rainwater Use
- BASIX – Fixture Efficiency with Dual Reticulation

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027
Demand Measures Water Savings ML/year)									
Total Water Savings Scenario 2	116.0	121.0	122.4	123.8	125.2	126.6	128.0	129.4	130.7
Non-Residential Water Audits	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7
BASIX – Fixture Efficiency with Rainwater Use	198.69	215.17	231.52	247.75	263.88	279.93	295.93	311.88	327.79
BASIX – Fixture Efficiency with Dual Reticulation	228.34	247.78	267.12	286.37	305.54	324.66	343.75	362.81	381.86
Calculated Total Savings	567.68	608.65	645.75	682.63	719.33	755.90	792.36	828.76	865.11
Total Water Savings Scenario 3 (Modelled)	**541.52**	**578.97**	**612.40**	**645.46**	**678.20**	**710.66**	**742.88**	**774.89**	**806.71**
Annual Average Water Consumption (ML/year)									
Baseline Forecast	6438.8	6496.8	6555.3	6614.3	6673.8	6733.8	6794.4	6855.6	6917.3
Integrated Scenario 3	5897.3	5917.8	5942.9	5968.8	5995.6	6023.2	6051.6	6080.7	6110.6
Total Water Savings	541.5	579.0	612.4	645.5	678.2	710.7	742.9	774.9	806.7
Peak Day Demand (ML)									
Baseline Forecast	39.58	40.07	40.56	41.04	41.51	41.99	42.46	42.93	43.40
Integrated Scenario 3	36.02	36.28	36.53	36.78	37.03	37.28	37.52	37.76	38.00
Per Capita Demand (L/person/day)									
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 3	447.72	445.27	443.17	441.13	439.16	437.25	435.39	433.58	431.83
Waste Water Flows (ML/day)									
Daily Average	12.72	12.81	12.90	13.00	13.09	13.19	13.29	13.40	13.50
Integrated Scenario 3	12.28	12.36	12.43	12.51	12.59	12.68	12.77	12.86	12.95
Design Wet Weather Baseline	32.71	32.99	33.29	33.58	33.89	34.19	34.50	34.82	35.13
Integrated Scenario 3	32.27	32.54	32.82	33.10	33.38	33.68	33.97	34.27	34.58

Cont'd over page

Demand Management Least Cost Planning – Decision Support System

Scenario 3

Demand Measures:

Existing Community Education

System Water Loss Management

Evaporative Cooling Unit and Cooling Tower Audit
Non-Residential Water Audits BASIX – Fixture Efficiency with

New Rainwater Use BASIX – Fixture Efficiency with Dual Reticulation

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	
Demand Measures Water Savings ML/year)												
Total Water Savings Scenario 2	132.1	133.5	134.8	136.2	137.6	139.0	140.4	141.8	143.2	144.6	146.0	BCP2
Non-Residential Water Audits	24.7	24.7	24.7	24.8	24.8	24.8	24.8	24.8	24.8	24.8	24.8	AUDITp
BASIX – Fixture Efficiency with Rainwater Use	343.69	359.59	375.49	391.41	407.35	423.34	439.37	455.45	471.59	487.80	504.08	BASIX-HR
BASIX – Fixture Efficiency with Dual Reticulation	400.92	420.00	439.11	458.25	477.46	496.72	516.05	535.46	554.95	574.54	594.23	BASIX-HD
Calculated Total Savings	901.45	937.80	974.19	1010.64	1047.17	1083.80	1120.54	1157.43	1194.46	1231.67	1269.05	calc
Total Water Savings Scenario 3 (Modelled)	**838.38**	**869.91**	**901.35**	**932.69**	**963.98**	**995.21**	**1026.42**	**1057.61**	**1088.81**	**1120.02**	**1151.25**	BCP3
Annual Average Water Consumption (ML/year)												
Baseline Forecast	6979.6	7042.4	7105.8	7169.7	7234.2	7299.3	7365.0	7431.3	7498.2	7565.7	7633.8	BAS
Integrated Scenario 3	6141.2	6172.5	6204.4	6237.0	6270.3	6304.1	6338.6	6373.7	6409.4	6445.7	6482.5	BCP3
Total Water Savings	838.4	869.9	901.3	932.7	964.0	995.2	1026.4	1057.6	1088.8	1120.0	1151.3	BCP3
Peak Day Demand (ML)												
Baseline Forecast	43.87	44.33	44.80	45.26	45.73	46.19	46.66	47.13	47.60	48.07	48.54	BAS
Integrated Scenario 3	38.23	38.47	38.71	38.94	39.18	39.41	39.65	39.88	40.12	40.36	40.60	BCP3
Per Capita Demand (L/person/day)												
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	BAS
Integrated Scenario 3	430.12	428.45	426.83	425.24	423.70	422.19	420.71	419.27	417.85	416.47	415.12	SET
Waste Water Flows (ML/day)												
Daily Average	13.61	13.72	13.84	13.95	14.07	14.18	14.30	14.43	14.55	14.67	14.80	BAS
Integrated Scenario 3	13.05	13.15	13.25	13.35	13.46	13.57	13.68	13.79	13.91	14.02	14.14	BCP3
Design Wet Weather Baseline	35.46	35.78	36.12	36.45	36.79	37.13	37.48	37.83	38.19	38.55	38.91	BAS
Integrated Scenario 3	34.89	35.21	35.53	35.85	36.18	36.52	36.86	37.20	37.55	37.90	38.25	BCP3

Demand Management Least Cost Planning – Decision Support System

Scenario 4

Demand Measures:

Existing	Community Education
	System Water Loss Management
	Evaporative Cooling Unit and Cooling Tower Audit
	Non-Residential Water Audits BASIX – Fixture Efficiency with Rainwater Use BASIX – Fixture Efficiency with Dual Reticulation
New	Permanent Low Level Restrictions on Water Use
	Conservation Pricing for Residential Users
	Rainwater Tanks for all New Residential Development
	Dual Reticulation for all New Residential Development

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Demand Measures Water Savings (ML/year)											
Total Water Savings Scenario 3	0.0	118.4	169.0	219.5	269.0	308.9	347.1	387.2	426.6	465.4	503.7
Permanent Low Level Restrictions on Water Use	0.0	135.7	138.9	142.1	145.1	148.0	150.9	153.6	156.3	158.9	161.5
Conservation Pricing for Residential Users	173.5	176.3	296.2	301.5	346.4	351.4	356.3	361.1	365.9	370.6	375.3
Rainwater Tanks for all New Residential Development	0.0	11.4	22.9	34.6	46.3	58.2	70.2	82.3	94.5	106.9	119.3
Dual Reticulation for all New Residential Development	0.0	13.7	27.7	41.9	56.3	70.8	85.6	100.4	115.5	130.7	146.0
Calculated Total Savings	173.47	455.46	654.83	739.52	863.12	937.34	1010.04	1084.67	1158.77	1232.40	1305.66
Total Water Savings Scenario 4 (Modelled)	**173.47**	**429.89**	**599.70**	**671.65**	**779.02**	**838.62**	**895.99**	**954.49**	**1011.74**	**1067.83**	**1122.87**
Annual Average Water Consumption (ML/year)											
Baseline Forecast	5834.5	5887.0	5940.0	5993.5	6047.4	6101.8	6156.7	6212.2	6268.1	6324.5	6381.4
Integrated Scenario 4	5661.0	5457.1	5340.3	5321.8	5268.4	5263.2	5260.8	5257.7	5256.3	5256.6	5258.5
Total Water Savings	173.5	429.9	599.7	671.7	779.0	838.6	896.0	954.5	1011.7	1067.8	1122.9
Peak Day Demand (ML)											
Baseline Forecast	33.61	34.22	34.81	35.39	35.95	36.49	37.03	37.56	38.08	38.58	39.09
Integrated Scenario 4	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83
Per Capita Demand (L/person/day)											
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 4	474.30	453.14	439.48	434.06	425.87	421.65	417.70	413.73	409.93	406.30	402.82
Waste Water Flows (ML/day)											
Daily Average	11.96	12.01	12.06	12.12	12.18	12.24	12.32	12.39	12.47	12.55	12.63
Integrated Scenario 4	11.78	11.72	11.71	11.72	11.63	11.68	11.72	11.77	11.82	11.88	11.95
Design Wet Weather Baseline	29.89	30.12	30.35	30.59	30.83	31.09	31.34	31.61	31.87	32.15	32.42
Integrated Scenario 4	29.71	29.83	30.00	30.19	30.29	30.52	30.75	30.99	31.23	31.48	31.74

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Demand Management Least Cost Planning – Decision Support System

Scenario 4

Demand Measures:

Existing
- Community Education
- System Water Loss Management
- Evaporative Cooling Unit and Cooling Tower Audit
- Non-Residential Water Audits
- BASIX – Fixture Efficiency with Rainwater Use BASIX – Fixture Efficiency with Dual Reticulation

New
- Permanent Low Level Restrictions on Water Use
- Conservation Pricing for Residential Users
- Rainwater Tanks for all New Residential Development
- Dual Reticulation for all New Residential Development

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Demand Measures Water Savings (ML/year)											
Total Water Savings Scenario 3	541.5	579.0	612.4	645.5	678.2	710.7	742.9	774.9	806.7	838.4	869.9
Permanent Low Level Restrictions on Water Use	164.0	166.4	168.8	171.2	173.5	175.8	178.0	180.3	182.5	184.7	186.9
Conservation Pricing for Residential Users	379.9	384.4	388.9	393.4	397.9	402.4	406.8	411.2	415.6	420.0	424.5
Rainwater Tanks for all New Residential Development	131.8	144.5	157.2	170.1	183.0	196.1	209.2	222.5	235.9	249.4	263.0
Dual Reticulation for all New Residential Development	161.5	177.1	192.8	208.7	224.7	240.8	257.1	273.5	290.0	306.6	323.4
Calculated Total Savings	1378.61	1451.31	1520.14	1588.78	1657.28	1725.68	1794.03	1862.37	1930.74	1999.16	2067.69
Total Water Savings Scenario 4 (Modelled)	**1176.94**	**1230.12**	**1278.79**	**1326.65**	**1373.77**	**1420.19**	**1465.97**	**1511.17**	**1555.82**	**1599.98**	**1643.68**
Annual Average Water Consumption (ML/year)											
Baseline Forecast	6438.8	6496.8	6555.3	6614.3	6673.8	6733.8	6794.4	6855.6	6917.3	6979.6	7042.4
Integrated Scenario 4	5261.9	5266.7	5276.5	5287.6	5300.0	5313.7	5328.5	5344.4	5361.5	5379.6	5398.7
Total Water Savings	1176.9	1230.1	1278.8	1326.7	1373.8	1420.2	1466.0	1511.2	1555.8	1600.0	1643.7
Peak Day Demand (ML)											
Baseline Forecast	39.58	40.07	40.56	41.04	41.51	41.99	42.46	42.93	43.40	43.87	44.33
Integrated Scenario 4	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83
Per Capita Demand (L/person/day)											
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50
Integrated Scenario 4	399.48	396.28	393.47	390.79	388.21	385.74	383.37	381.08	378.89	376.78	374.74
Waste Water Flows (ML/day)											
Daily Average	12.72	12.81	12.90	13.00	13.09	13.19	13.29	13.40	13.50	13.61	13.72
Integrated Scenario 4	12.01	12.08	12.16	12.24	12.32	12.40	12.49	12.58	12.67	12.77	12.87
Design Wet Weather Baseline	32.71	32.99	33.29	33.58	33.89	34.19	34.50	34.82	35.13	35.46	35.78
Integrated Scenario 4	32.00	32.27	32.55	32.83	33.11	33.40	33.70	34.00	34.30	34.61	34.93

Cont'd over page

Demand Management Least Cost Planning – Decision Support System
Scenario 4

Demand Measures:

Existing
- Community Education
- System Water Loss Management
- Evaporative Cooling Unit and Cooling Tower Audit
- Non-Residential Water Audits
- BASIX – Fixture Efficiency with Rainwater Use BASIX – Fixture Efficiency with Dual Reticulation

New
- Permanent Low Level Restrictions on Water Use
- Conservation Pricing for Residential Users
- Rainwater Tanks for all New Residential Development
- Dual Reticulation for all New Residential Development

Year	2030	2031	2032	2033	2034	2035	2036	2037	2038	
Demand Measures Water Savings (ML/year)										
Total Water Savings Scenario 3	901.3	932.7	964.0	995.2	1026.4	1057.6	1088.8	1120.0	1151.3	BCP4
Permanent Low Level Restrictions on Water Use	189.1	191.2	193.4	195.5	197.6	199.8	201.9	204.0	206.2	PERM
Conservation Pricing for Residential Users	428.9	433.3	437.7	442.1	446.6	451.0	455.5	460.0	464.5	PRI
Rainwater Tanks for all New Residential Development	276.7	290.5	304.5	318.5	332.7	347.0	361.4	375.9	390.5	RAIN
Dual Reticulation for all New Residential Development	340.3	357.4	374.6	391.9	409.4	427.0	444.7	462.6	480.7	DUAL
Calculated Total Savings	2136.33	2205.13	2274.12	2343.30	2412.72	2482.39	2552.33	2622.57	2693.11	calc
Total Water Savings Scenario 4 (Modelled)	**1686.96**	**1729.86**	**1772.41**	**1814.64**	**1856.57**	**1898.24**	**1939.67**	**1980.89**	**2021.91**	BCP4
Annual Average Water Consumption (ML/year)										
Baseline Forecast	7105.8	7169.7	7234.2	7299.3	7365.0	7431.3	7498.2	7565.7	7633.8	BAS
Integrated Scenario 4	5418.8	5439.8	5461.8	5484.7	5508.5	5533.1	5558.5	5584.8	5611.9	BCP4
Total Water Savings	1687.0	1729.9	1772.4	1814.6	1856.6	1898.2	1939.7	1980.9	2021.9	BCP4
Peak Day Demand (ML)										
Baseline Forecast	44.80	45.26	45.73	46.19	46.66	47.13	47.60	48.07	48.54	BAS
Integrated Scenario 4	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	31.83	BCP4
Per Capita Demand (L/person/day)										
Baseline Forecast	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	488.50	BAS
Integrated Scenario 4	372.78	370.89	369.07	367.31	365.61	363.97	362.38	360.85	359.36	SET
Waste Water Flows (ML/day)										
Daily Average	13.84	13.95	14.07	14.18	14.30	14.43	14.55	14.67	14.80	BAS
Integrated Scenario 4	12.97	13.07	13.17	13.28	13.39	13.50	13.61	13.73	13.84	BCP4
Design Wet Weather Baseline	36.12	36.45	36.79	37.13	37.48	37.83	38.19	38.55	38.91	BAS
Integrated Scenario 4	35.25	35.57	35.90	36.23	36.57	36.91	37.25	37.60	37.96	BCP4

APPENDIX B: 30 Year Forward Capital Works Programs & OMA

(Source: BRC, Integrated Water Cycle Management Strategy, MWH, 2009)

IWCM 2

Water Supply

Capital Works Program

2009 Financial Year of Program Commencement
2009 Financial Year of Capital Estimates - All Estimates in $000

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Chifley Dam											
BCC Capital Works Strategic Plan*	BCD	17	Management Plan Works		30	30	30	30	30	30	30	30	30	30
BCC Capital Works Strategic Plan*		20	Pipeline Dam to Town							10,000	10,000	5,000		
BRC 08/09 - 11/12 Draft Management Plan		14	Recreation/env/catchment		150	150	150	150	150	150	150	150	150	150
BRC 08/09 - 11/12 Draft Management Plan		18	Roads		68	68								
BRC 08/09 - 11/12 Draft Management Plan		14	Caravan Park											
BRC 08/09 - 11/12 Draft Management Plan		20	Pipeline Feasibility		150								250	
			Winburndale Dam											
BCC Capital Works Strategic Plan*	Win Dam	31	Dam Safety			1,000	4,000	4,000						
BCC Capital Works Strategic Plan*		17	Pipeline		100	100	100	100	100	100	100	100	100	100
BRC 08/09 - 11/12 Draft Management Plan		17	Scour Valve refurb											
			Water Filtration Plant											
BCC Capital Works Strategic Plan*	WFP	29	Capacity augmentation											
BCC Capital Works Strategic Plan*		29	Capacity augmentation											
BCC Capital Works Strategic Plan*		29	Install GAC filters							0	0	0	0	
BCC Capital Works Strategic Plan*		29	Electrical refurbishment		150	150	150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Mechanical refurbishment		150	150	150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Raw water pumping station							0	0	0	0	0
BCC Capital Works Strategic Plan*		29	Clear water pumping station							0	0	0	0	0
BCC Capital Works Strategic Plan*		29	Model review					150		0	0	0	150	
BCC Capital Works Strategic Plan*		29	Model implementation						150					150

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
			Chifley Dam											
BCC Capital Works Strategic Plan*	BCD	17	Management Plan Works		30	30	30	30	30	30	30	30	30	30
BCC Capital Works Strategic Plan*		20	Pipeline Dam to Town											
BRC 08/09 - 11/12 Draft Management Plan		14	Recreation/env/catchment		150	150	150	150	150	150	150	150	150	150
BRC 08/09 - 11/12 Draft Management Plan		18	Roads											
BRC 08/09 - 11/12 Draft Management Plan		14	Caravan Park											
BRC 08/09 - 11/12 Draft Management Plan		20	Pipeline Feasibility										250	
			Winburndale Dam											
BCC Capital Works Strategic Plan*	Win Dam	31	Dam Safety											
BCC Capital Works Strategic Plan*		17	Pipeline		100	100	100							
BRC 08/09 - 11/12 Draft Management Plan		17	Scour Valve refurb											
			Water Filtration Plant											
BCC Capital Works Strategic Plan*	WFP	29	Capacity augmentation						9,450					
BCC Capital Works Strategic Plan*		29	Capacity augmentation											
BCC Capital Works Strategic Plan*		29	Install GAC filters											
BCC Capital Works Strategic Plan*		29	Electrical refurbishment		150	150	150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Mechanical refurbishment		150	150	150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Raw water pumping station						250					
BCC Capital Works Strategic Plan*		29	Clear water pumping station						500					
BCC Capital Works Strategic Plan*		29	Model review					150					150	
BCC Capital Works Strategic Plan*		29	Model implementation						150					150

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2029	2030	2031	2032	2033	2034	2035	2036
			Chifley Dam									
BCC Capital Works Strategic Plan*	BCD	17	Management Plan Works		30	30	30	30	30	30	30	30
BCC Capital Works Strategic Plan*		20	Pipeline Dam to Town									
BRC 08/09 - 11/12 Draft Management Plan		14	Recreation/env/catchment		150	150	150	150	150	150	150	150
BRC 08/09 - 11/12 Draft Management Plan		18	Roads									
BRC 08/09 - 11/12 Draft Management Plan		14	Caravan Park									
BRC 08/09 - 11/12 Draft Management Plan		20	Pipeline Feasibility									
			Winburndale Dam									
BCC Capital Works Strategic Plan*	Win Dam	31	Dam Safety									
BCC Capital Works Strategic Plan*		17	Pipeline									
BRC 08/09 - 11/12 Draft Management Plan		17	Scour Valve refurb									
			Water Filtration Plant									
BCC Capital Works Strategic Plan*	WFP	29	Capacity augmentation									
BCC Capital Works Strategic Plan*		29	Capacity augmentation									
BCC Capital Works Strategic Plan*		29	Install GAC filters									
BCC Capital Works Strategic Plan*		29	Electrical refurbishment		150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Mechanical refurbishment		150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Raw water pumping station									
BCC Capital Works Strategic Plan*		29	Clear water pumping station									
BCC Capital Works Strategic Plan*		29	Model review					150				
BCC Capital Works Strategic Plan*		29	Model implementation						150			

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
			Infrastructure Distribution											
Pers Comms (R. Deans BRC July 08)	Network	29	Mechanical refurbishment		150	150	150	150	150	150	150	150	150	150
Pers Comms (R. Deans BRC July 08)		29	Electrical refurbishment		150	150	150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Additional No.6 Res Cap ML											
Pers Comms (R. Deans BRC July 08)		29	New meter installation		50	50	50	50	50	50	50	50	50	50
BRC IWCM		29	Leak Detection + Repair	11	40	13	13	0	0	0	0	0	0	0
BRC IWCM		29	Mains flushing	31	30									
			New works/renewals											
BCC Capital Works Strategic Plan*	All	18	Minor new works		100	100	100	100	100	100	100	100	100	100
BCC Capital Works Strategic Plan*		18	Unmetered properties		20	20	20	20						
BCC Capital Works Strategic Plan*		18	CBD renewal program		250	250	250	250	250	250	250	250	250	250
Pers Comms (R. Deans BRC July 08)		18	New Water Services		200	200	200	200	200	200	200	200	200	200
		17	Demand Management											
BRC/IWCM	All	17	WELS	6	0	0	0	0	0	0	0	0	0	0
BRC/IWCM	All	17	IWCM Education	1	23	2	2	2	2	2	2	2	2	2
BRC/IWCM	All	17	RWT Rebate	2	0	0	0	0	0	0	0	0	0	0
BRC/IWCM	All	17	Greywater Recyc Retrofit	13	25	6	6	6	6	7	7	7	2	2
BRC/IWCM	All	17	W Machine Rebate	12	62	53	53	0	0					
BRC/IWCM		17	Commercial Toilet Retrofit	30	61	23	23	20	20	0	0	0	0	0
			Planning											
Pers Comms (R. Deans BRC July 08)	All	17	IWCM Review						75				125	
Pers Comms (R. Deans BRC July 08)		25	Strategic Business Plan		75					75				
					4,043	**4,675**	**7,608**	**7,690**	**3,746**	**13,578**	**13,504**	**8,505**	**4,026**	**3,652**
					2,034	**2,665**	**5,597**	**5,678**	**1,733**	**11,564**	**11,489**	**6,489**	**2,009**	**1,634**
					686	446	447	528	583	413	389	339	609	484
					500	1,350	4,350	4,350	350	10,350	10,350	5,350	600	350
					868	800	800	800	800	800	800	800	800	800
					196	76	78	22	22	2	2	2	2	2

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2019	2020	2021	2022	2023	2024	2025	2026
			Infrastructure Distribution									
Pers Comms (R. Deans BRC July 08)	Network	29	Mechanical refurbishment		150	150	150	150	150	150	150	150
Pers Comms (R. Deans BRC July 08)		29	Electrical refurbishment		150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Additional No.6 Res Cap ML		1,350							
Pers Comms (R. Deans BRC July 08)		29	New meter installation		50	50	50	50	50	50	50	50
BRC IWCM		29	Leak Detection + Repair	11	0	0	0	0	0	0	0	0
BRC IWCM		29	Mains flushing	31								
			New works/renewals									
BCC Capital Works Strategic Plan*	All	18	Minor new works		100	100	100	100	100	100	100	100
BCC Capital Works Strategic Plan*		18	Unmetered properties									
BCC Capital Works Strategic Plan*		18	CBD renewal program									
Pers Comms (R. Deans BRC July 08)		18	New Water Services		200	200	200	200	200	200	200	200
		17	Demand Management									
BRC/IWCM	All	17	WELS	6	0	0	0	0	0	0	0	0
BRC/IWCM	All	17	IWCM Education	1	2	2	2	2	2	2	2	2
BRC/IWCM	All	17	RWT Rebate	2	0	0	0	0	0	0	0	0
BRC/IWCM	All	17	Greywater Recyc Retrofit	13	2	2	2	2	2	2	2	2
BRC/IWCM	All	17	W Machine Rebate	12								
BRC/IWCM		17	Commercial Toilet Retrofit	30	0	0	0	0	0	0	0	0
			Planning									
Pers Comms (R. Deans BRC July 08)	All	17	IWCM Review					75				125
Pers Comms (R. Deans BRC July 08)		25	Strategic Business Plan		75					75		
					4,678	**3,254**	**3,255**	**3,381**	**13,507**	**3,233**	**3,159**	**3,285**
					2,659	**1,234**	**1,234**	**1,359**	**11,484**	**1,209**	**1,134**	**1,259**
					409	334	334	559	1,234	409	334	459
					1,700	350	350	350	9,800	350	350	350
					550	550	550	450	450	450	450	450
					2	2	2	2	2	2	2	2

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2026	2027	2028	2029	2030	2031	2032	2033
			Infrastructure Distribution									
Pers Comms (R. Deans BRC July 08)	Network	29	Mechanical refurbishment		150	150	150	150	150	150	150	150
Pers Comms (R. Deans BRC July 08)		29	Electrical refurbishment		150	150	150	150	150	150	150	150
BCC Capital Works Strategic Plan*		29	Additional No.6 Res Cap ML									
Pers Comms (R. Deans BRC July 08)		29	New meter installation		50	50	50	50	50	50	50	50
BRC IWCM		29	Leak Detection + Repair	11	0	0	0	0	0	0	0	0
BRC IWCM		29	Mains flushing	31								
			New works/renewals									
BCC Capital Works Strategic Plan*	All	18	Minor new works		100	100	100	100	100	100	100	100
BCC Capital Works Strategic Plan*		18	Unmetered properties									
BCC Capital Works Strategic Plan*		18	CBD renewal program									
Pers Comms (R. Deans BRC July 08)		18	New Water Services		200	200	200	200	200	200	200	200
		17	Demand Management									
BRC/IWCM	All	17	WELS	6	0	0	0	0	0	0	0	0
BRC/IWCM	All	17	IWCM Education	1	2	2	2	2	2	2	2	2
BRC/IWCM	All	17	RWT Rebate	2	0	0	0	0	0	0	0	0
BRC/IWCM	All	17	Greywater Recyc Retrofit	13	2	2	2	2	2	2	2	2
BRC/IWCM	All	17	W Machine Rebate	12								
BRC/IWCM		17	Commercial Toilet Retrofit	30	0	0	0	0	0	0	0	0
			Planning									
Pers Comms (R. Deans BRC July 08)	All	17	IWCM Review		125					75		
Pers Comms (R. Deans BRC July 08)		25	Strategic Business Plan					75				
					3,285	**3,561**	**3,312**	**3,238**	**3,164**	**3,240**	**3,316**	**3,317**
					1,259	**1,534**	**1,284**	**1,209**	**1,134**	**1,209**	**1,284**	**1,284**
					459	484	484	409	334	409	484	484
					350	600	350	350	350	350	350	350
					450	450	450	450	450	450	450	450
					2	2	2	2	2	2	2	2

Data Sources	Area	Issue	Capital Element	IWCM Opt#	2034	2035	2036
			Infrastructure Distribution				
Pers Comms (R. Deans BRC July 08)	Network	29	Mechanical refurbishment		150	150	150
Pers Comms (R. Deans BRC July 08)		29	Electrical refurbishment		150	150	150
BCC Capital Works Strategic Plan*		29	Additional No.6 Res Cap ML				
Pers Comms (R. Deans BRC July 08)		29	New meter installation		50	50	50
BRC IWCM		29	Leak Detection + Repair	11	0	0	0
BRC IWCM		29	Mains flushing	31			
			New works/renewals				
BCC Capital Works Strategic Plan*	All	18	Minor new works		100	100	100
BCC Capital Works Strategic Plan*		18	Unmetered properties				
BCC Capital Works Strategic Plan*		18	CBD renewal program				
Pers Comms (R. Deans BRC July 08)		18	New Water Services		200	200	200
		17	Demand Management				
BRC/IWCM	All	17	WELS	6	0	0	0
BRC/IWCM	All	17	IWCM Education	1	2	2	2
BRC/IWCM	All	17	RWT Rebate	2	0	0	0
BRC/IWCM	All	17	Greywater Recyc Retrofit	13	2	2	2
BRC/IWCM	All	17	W Machine Rebate	12			
BRC/IWCM		17	Commercial Toilet Retrofit	30	0	0	0
			Planning				
Pers Comms (R. Deans BRC July 08)	All	17	IWCM Review			125	
Pers Comms (R. Deans BRC July 08)		25	Strategic Business Plan		75		
					3,243	**3,294**	**3,170**
					1,209	**1,259**	**1,134**
					409	459	334
					350	350	350
					450	450	450
					2	2	2

Bathurst Regional Council

Water **OMA** **IWCM2**

2009 Financial Year of Schedule Commencement

2009 Financial Year of OMA Estimates - All Estimates in $000

% Multiplier	% Var	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
			0	0	0	0	0	0	0	0	0	0	0	0	0
	Historical Administration (M)	1,475	1,475	1,490	1,505	1,520	1,535	1,550	1,565	1,580	1,595	1,610	1,625	1,640	1,655
0	Scenario Administration	1,475	1,475	1,490	1,505	1,520	1,535	1,550	1,565	1,580	1,595	1,610	1,625	1,640	1,655
	Historical Engineering & Supervision (M)	698	698	705	712	719	728	733	740	747	754	761	768	775	782
0	Scenario Engineering & Supervision	698	698	705	712	719	728	733	740	747	754	761	768	775	782
	Historical Expenses (M)	1,585	1,585	1,601	1,617	1,633	1,849	1,685	1,681	1,697	1,713	1,729	1,745	1,781	1,777
0	Scenario Operation Expenses	1,585	1,585	1,601	1,617	1,633	1,849	1,685	1,681	1,697	1,713	1,729	1,745	1,781	1,777
	Scenario Operation Expenses	1,862	1,912	2,355	2,483	2,428	2,377	2,398	2,325	2,345	2,365	2,381	2,401	2,422	2,443
	Historical Maintenance Expenses (M)	1,548	1,548	1,584	1,580	1,596	1,612	1,628	1,644	1,660	1,675	1,690	1,705	1,721	1,736
0	Scenario Maintenance Expenses	1,548	1,548	1,584	1,580	1,596	1,612	1,628	1,644	1,660	1,675	1,690	1,705	1,721	1,736
	Historical Energy Costs (M)	89	89	90	91	92	93	94	95	98	97	98	99	100	101
0	Scenario Energy Costs	89	89	89	86	86	86	85	86	87	88	89	90	91	91
	Historical Chemical Costs (M)	550	550	556	562	568	574	580	586	592	598	604	609	615	621
1	Scenario Chemical Costs	550	550	552	532	529	528	527	532	537	542	547	551	557	563
	Historical Purchase of Water (M)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	Scenario Purchase of Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Historical Other Expenses (M)	238	236	238	240	242	244	246	248	250	252	254	256	258	260
0	Scenario Other Expenses	238	236	238	240	242	244	246	248	250	252	254	256	258	260
	SCENARIO TOTAL	**6,458**	**6,508**	**6,994**	**7,138**	**7,119**	**7,100**	**7,188**	**7,141**	**7,206**	**7,272**	**7,332**	**7,397**	**7,464**	**7,530**
	Historical TOTAL	6,181	6,181	6,244	6,307	6,370	6,433	6,496	6,559	6,622	6,684	6,746	6,807	6,870	6,932

		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
% Multiplier	**% Var**	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Historical Administration (M)	1,670	1,685	1,700	1,715	1,730	1,745	1,759	1,773	1,787	1,801	1,815	1,829	1,844	1,854
0	Scenario Administration	1,670	1,685	1,700	1,715	1,730	1,745	1,759	1,773	1,787	1,801	1,815	1,829	1,844	1,854
	Historical Engineering & Supervision (M)	789	796	803	810	817	824	831	838	845	852	859	866	873	886
0	Scenario Engineering & Supervision	789	796	803	810	817	824	831	838	845	852	859	866	873	886
	Historical Expenses (M)	1,793	1,809	1,825	1,841	1,857	1,873	1,889	1,904	1,919	1,934	1,949	1,964	1,980	1,996
0	Scenario Operation Expenses	1,793	1,809	1,825	1,841	1,857	1,873	1,889	1,904	1,919	1,934	1,949	1,964	1,980	1,996
	Scenario Operation Expenses	2,464	2,485	2,506	2,527	2,548	2,569	2,590	2,610	2,630	2,650	2,669	2,689	2,710	2,731
	Historical Maintenance Expenses (M)	1,751	1,766	1,782	1,798	1,814	1,830	1,845	1,860	1,875	1,890	1,905	1,920	1,935	1,950
0	Scenario Maintenance Expenses	1,751	1,766	1,782	1,798	1,814	1,830	1,845	1,860	1,875	1,890	1,905	1,920	1,935	1,950
	Historical Energy Costs (M)	102	103	104	105	106	107	108	109	110	111	112	113	114	115
0	Scenario Energy Costs	92	93	94	95	96	97	98	98	99	100	101	102	103	104
	Historical Chemical Costs (M)	627	633	639	645	651	657	662	667	672	677	682	687	692	698
1	Scenario Chemical Costs	568	573	578	583	588	594	598	602	608	611	615	619	624	629
	Historical Purchase of Water (M)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	Scenario Purchase of Water	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Historical Other Expenses (M)	262	264	266	268	270	272	274	276	278	280	282	284	286	288
0	Scenario Other Expenses	262	264	266	268	270	272	274	276	278	280	262	284	286	288
	SCENARIO TOTAL	**7,596**	**7,882**	**7,729**	**7,796**	**7,863**	**7,930**	**7,994**	**8,057**	**8,120**	**8,183**	**8,246**	**8,310**	**8,375**	**8,441**
	Historical TOTAL	6,994	7,056	7,119	7,182	7,245	7,308	7,368	7,427	7,486	7,545	7,604	7,683	7,724	7,786

Bathurst Regional Council

IWCM2 Sewerage **Capital Works Program**

2009 Financial Year of Program Commencement

2009 Financial Year of Capital Estimates - All Estimates in $000

Issue	Capital Element	IWCM Opt#	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
12	Major Headworks STP Capacity																
12	Model Review					150					150					150	
12	Mechanical Refurbishment		250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
12	Electrical Refurbishment		250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
12	Model Implementation						150					150					150
	Gilmour St PS																
12	Sewage pumping stations																
12	Dry weather flows PS upgrade		200	1,200													
	Pump Stations																
31	Pump Station odour control		105														
	Sewerage Reticulation System																
12	General Sewerage System Rehab		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
12	Minor New Works		50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
12	Seymour St main upgrade		155														
12	Rankin St main upgrade		481														
12	Stanley St main upgrade				634												
12	Durham St main upgrade				213												
12	Northern Gilmour St main upgrade					473											
12	Southern Gilmour St main upgrade					992											
12	Remove constructed overflows						36										
12	Year 5 Performance assessment						58										
12	Mechanical Refurbishment		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
12	Electrical Refurbishment		150	150	150	150	150	150	150	150	150	150	150	150	150	150	150
12	New Wastewater Services		180	180	180	180	180	180	180	180	180	180	180	180	180	180	180
	Smart Sewers	18	324	39	39	39	39	39	39	39	39	39	39	39	39	39	39
12	Infiltration/Inflow assessment	8	87	301	303	306	309	312	314	317	320	323	326	329	332	335	338

Issue	Capital Element	IWCM Opt#	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
	Major Headworks STP														
12	Capacity														
12	Model Review					150					150				
12	Mechanical Refurbishment		250	250	250	250	250	250	250	250	250	250	250	250	250
12	Electrical Refurbishment		250	250	250	250	250	250	250	250	250	250	250	250	250
12	Model Implementation						150					150			
	Gilmour St PS														
12	Sewage pumping stations														
12	Dry weather flows PS upgrade														
	Pump Stations														
31	Pump Station odour control														
	Sewerage Reticulation System														
12	General Sewerage System Rehab		150	150	150	150	150	150	150	150	150	150	150	150	150
12	Minor New Works		50	50	50	50	50	50	50	50	50	50	50	50	50
12	Seymour St main upgrade														
12	Rankin St main upgrade														
12	Stanley St main upgrade														
12	Durham St main upgrade														
12	Northern Gilmour St main upgrade														
12	Southern Gilmour St main upgrade														
12	Remove constructed overflows														
12	Year 5 Performance assessment														
12	Mechanical Refurbishment		150	150	150	150	150	150	150	150	150	150	150	150	150
12	Electrical Refurbishment		150	150	150	150	150	150	150	150	150	150	150	150	150
12	New Wastewater Services		180	180	180	180	180	180	180	180	180	180	180	180	180
	Smart Sewers	18	39	39	39	39	39	39	39	39	39	39	39	39	39
12	Infiltration/Inflow assessment	8	341	344	347	350	353	365	358	361	364	367	370	374	377

Issue	Capital Element	IWCM Opt#	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
	Monitoring																
	Septic Monitoring Program	32	30	24	24	24	24	24	24	24	24	24	24	24	24	24	24
	Planning																
12	IWCM Review						75				125					75	
26	Strategic Business Plan		75					75					75				
12	Development Servicing Plan		75					75					75				
			4,721	**4,754**	**4,404**	**5,176**	**3,884**	**3,719**	**3,572**	**3,576**	**3,855**	**3,734**	**3,738**	**3,592**	**3,596**	**3,825**	**3,754**
			2,009	2,010	2,011	2,012	2,013	2,014	2,015	2,016	2,017	2,018	2,019	2,020	2,021	2,022	2,023
			2,712	**2,744**	**2,393**	**3,164**	**1,871**	**1,705**	**1,557**	**1,560**	**1,838**	**1,716**	**1,719**	**1,572**	**1,575**	**1,803**	**1,731**
			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			602	555	558	710	882	716	569	571	849	727	730	583	586	814	742
			1,159	1,239	886	1,504	39	39	39	39	39	39	39	39	39	39	39
			950	950	950	950	950	950	950	950	950	950	950	950	950	950	950

Issue	Capital Element	IWCM Opt#	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
	Monitoring														
	Septic Monitoring Program	32	24	24	24	24	24	24	24	24	24	24	24	24	24
	Planning														
12	IWCM Review				125					75				125	
26	Strategic Business Plan		75					75					75		
12	Development Servicing Plan		75					75					75		
			3,758	**3,612**	**3,741**	**3,770**	**3,774**	**3,787**	**3,631**	**3,710**	**3,789**	**3,793**	**3,797**	**3,777**	**3,656**
			2,024	2,025	2,026	2,027	2,028	2,029	2,030	2,031	2,032	2,033	2,034	2,035	2,036
			1,734	**1,587**	**1,715**	**1,743**	**1,746**	**1,758**	**1,601**	**1,679**	**1,757**	**1,760**	**1,763**	**1,742**	**1,620**
			0	0	0	0	0	0	0	0	0	0	0	0	0
			745	598	726	754	757	760	613	691	769	772	775	753	631
			39	39	39	39	39	39	39	39	39	39	39	39	30
			950	950	950	950	950	950	950	950	950	950	950	950	950

Bathurst Regional Council

Sewerage **OMA** **IWCM2 Scenario**

2009 Financial Year of Schedule Commencement

2009 Financial Year of OMA Estimates - All Estimates in $000

% Multiplier	% Var DSS	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
			0.0%	- 0.9%	-3.4%	- 4.1%	- 4.3%	- 4.5%	- 4.6%	- 4.7%	- 4.9%	- 5.0%	- 5.2%	- 5.2%	- 5.2%	-5.3%
	Historical Administration (M)	1,326	1,346	1,361	1,378	1,391	1,406	1,421	1,435	1,449	1,463	1,477	1,491	1,505	1,519	1,533
0	Scenario Administration	1,326	1,346	1,361	1,378	1,391	1,406	1,421	1,435	1,449	1,463	1,477	1,491	1,505	1,519	1,533
	Historical Engineering & Supervision (M)	734	745	753	761	769	777	785	793	801	809	817	825	833	841	849
0	Scenario Engineering & Supervision	734	745	753	761	769	777	785	793	801	809	817	825	833	841	849
	Historical Expenses (M)	993	1,008	1,019	1,030	1,041	1,052	1,063	1,074	1,085	1,096	1,107	1,118	1,129	1,140	1,151
0	Scenario Operation Expenses	993	1,008	1,019	1,030	1,041	1,052	1,063	1,074	1,085	1,096	1,107	1,118	1,129	1,140	1,151
	Historical Maintenance Expenses (M)	1,208	1,226	1,240	1,254	1,287	1,280	1,293	1,306	1,319	1,332	1,345	1,358	1,371	1,384	1,397
0	Scenario Maintenance Expenses	1,208	1,226	1,240	1,254	1,287	1,280	1,293	1,306	1,319	1,332	1,345	1,358	1,371	1,384	1,397
	Historical Energy Costs (M)	322	327	331	335	339	343	347	351	355	359	363	367	371	375	379
0.6	Scenario Energy Costs	322	327	329	328	331	334	338	341	345	349	352	356	359	363	367
	Historical Chemical Costs (M)	129	131	132	133	134	135	136	137	138	139	140	141	142	143	144
0.6	Scenario Chemical Costs	129	131	132	130	131	132	132	133	134	135	136	137	138	139	139
	Historical Other Expenses (M)	172	175	177	179	181	183	185	187	189	191	193	195	197	199	201
0	Scenario Other Expenses	172	175	177	179	181	183	185	187	189	191	193	195	197	199	201
	SCENARIO TOTAL	**4,884**	**4,958**	**5,011**	**5,058**	**5,110**	**5,164**	**5,217**	**5,269**	**5,322**	**5,374**	**5,427**	**5,479**	**5,532**	**5,585**	**5,638**
	Historical TOTAL	4,884	4,958	5,013	5,068	5,122	5,176	5,230	5,283	5,336	5,389	5,442	5,495	5,548	5,601	5,654

% Multiplier	% Var DSS	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
		-	-	-	-	-	-	-	-	-	-	-	-	-
		5.4%	5.5%	5.6%	5.7%	5.9%	6.0%	6.1%	6.2%	6.2%	6.3%	6.3%	6.3%	6.4%
	Historical Administration (M)													
0	Scenario Administration	1,547	1,568	1,576	1,591	1,606	1,620	1,634	1,648	1,662	1,676	1,690	1,704	1,718
		1,547	1,561	1,576	1,591	1,608	1,620	1,634	1,648	1,662	1,676	1,690	1,704	1,718
	Historical Engineering & Supervision (M)													
0	Scenario Engineering & Supervision	857	865	873	881	889	897	905	913	921	929	937	945	953
		857	865	873	881	889	897	905	913	921	929	937	945	953
	Historical Expenses (M)													
0	Scenario Operation Expenses	1,162	1,173	1,184	1,195	1,206	1,217	1,227	1,237	1,247	1,257	1,268	1,279	1,290
		1,162	1,173	1,184	1,195	1,206	1,217	1,227	1,237	1,247	1,257	1,268	1,279	1,290
	Historical Maintenance Expenses (M)													
0	Scenario Maintenance Expenses	1,410	1,423	1,436	1,449	1,462	1,475	1,488	1,500	1,513	1,526	1,539	1,552	1,565
		1,410	1,423	1,436	1,449	1,462	1,475	1,488	1,500	1,513	1,526	1,539	1,552	1,565
	Historical Energy Costs (M)													
0.6	Scenario Energy Costs	383	387	391	395	399	403	406	409	412	415	419	423	427
		371	374	378	381	385	389	391	394	397	399	403	407	411
	Historical Chemical Costs (M)													157
0.6	Scenario Chemical Costs	145	146	147	148	149	150	151	152	153	154	155	156	157
		140	141	142	143	144	145	146	146	147	148	149	150	151
	Historical Other Expenses (M)													
0	Scenario Other Expenses	203	205	207	209	211	213	215	217	219	221	223	225	227
	SCENARIO TOTAL	203	205	207	209	211	213	215	217	219	221	223	225	227
	Historical TOTAL	**5,690**	**5,742**	**5,796**	**5,849**	**5,903**	**5,955**	**6,006**	**6,055**	**6,106**	**6,157**	**6,209**	**6,262**	**6,315**
		5,707	5,760	5,814	5,868	5,922	5,975	6,026	6,076	6,127	6,178	6,231	6,284	6,337