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Alice Springs Water Efficiency Study

Stages I & II - Final Report

Volume I

Prepared by

Institute for Sustainable Futures

For

PW/DIPE

University of Technology, Sydney

KBR

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Volume II of this Report contains confidential material related to transcripts of interviews undertaken as part of the Study.

ABBREVIATIONS

ABS	Australian Bureau of Statistics
ALEC	Arid Lands Environment Centre (Alice Springs)
ASTC	Alice Springs Town Council
ASUWMS	Alice Springs Urban Water Management Strategy
ASUWMSRG	Alice Springs Urban Water Management Strategy Reference Group
AWA	Australian Water Association
BOM	Bureau of Meteorology
CARL	Current annual real losses
C/I	Commercial/Industrial
CIS	Customer Information System
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
DIPE	Department of Infrastructure Planning and Environment
DPWS	Department of Public Works and Services
GHG	Greenhouse gas
ha	Hectares
I	Institutional
ISF	Institute for Sustainable Futures
KBR	Kellogg Brown & Root Pty Ltd
kL/c/a	Kilolitres per capita per annum
kL/hh/a	Kilolitres per household per annum
km	Kilometers
kWh/ML	Kilowatt hours per megalitre
L/conn/day	Litres per connection per day
LCD	Litre per capita per day
LCP	Least Cost Planning
LGA	Local Government Area
L/p/d	Litres per person per day
LPE	Land Planning & Environment
m	Meter
M	Million
MCA	Multi criteria analysis
mg/L	Milligrammes per litre
ML/a	Megalitres per annum

ML/d	Megalitres per day
MR	Multi residential
MWh	Megawatt hours
NatHERS	Nationwide House Energy Rating Software
NCP	National Competition Policy
NT	Northern Territory
OR	Other residential
p.a.	Per annum
PH	Public Housing
PW	Power & Water
Q	Quarter
SKM	Sinclair Knight Mertz
SLA	Statistical Local Area
SR	Single residential
SWC	Sydney Water Corporation
t	tonne
UARL	Unavoidable annual real losses
UFW	Unaccounted for water
US	United States
WWTP	Waste Water Treatment Plant

EXECUTIVE SUMMARY

Potable water demand in Alice Springs, in a business as usual scenario, is expected to rise from the current 10,000 ML/a to approximately 12,500 ML/a by 2021 due to the projected rise in population. This Study has developed two demand management program scenarios, which could reduce water demand by at least 1,050 ML/a and 3,400 ML/a by 2021 at an estimated cost of $3.8M and $10.2M respectively. The costs of implementing either of these program scenarios would be recouped by the energy savings obtained from reduced water pumping requirements alone. In addition to reducing the demand for potable water both programs would: reduce wastewater production with subsequent environmental and social benefits in relation to Ilparpa swamp overflows; reduce and/or defer capital investment required to augment the potable water and wastewater systems; reduce greenhouse gas emissions; and provide significant additional social and environmental benefits.

Background

The Northern Territory Government, Power and Water Corporation (PW) and the Department of Infrastructure Planning and Environment (DIPE), have recognised the need to use a coordinated approach to managing water resources in Alice Springs. Hence they have set up the Alice Springs Urban Water Management Strategy (ASUWMS), which aims to use a combination of approaches including demand management, alternative sources and effluent reuse to reduce potable water demand and wastewater production in Alice Springs.

The Alice Springs Water Efficiency Study (the Study), which is the subject of this report, looks specifically at demand management opportunities and thus forms a part of the ASUWMS. The aim of the Study is to identify options for reducing both water demand and the production of wastewater effluent in Alice Springs principally in order to:

- reduce the need for augmentation of the Roe Creek Borefield;
- reduce the need for augmentation of the reticulation system because of future population growth; and
- reduce the volume of effluent overflow from the wastewater treatment plant (WWTP) passing to Ilparpa swamp and subsequently reduce mosquito breeding and other issues.

This report provides details on the work undertaken for Stages I and II of the Study:

- production of models that reflect historical patterns and project future water demand and wastewater production; and
- development of demand management options that aim to reach specific targets to reduce potable water demand, peak demand and wastewater production.

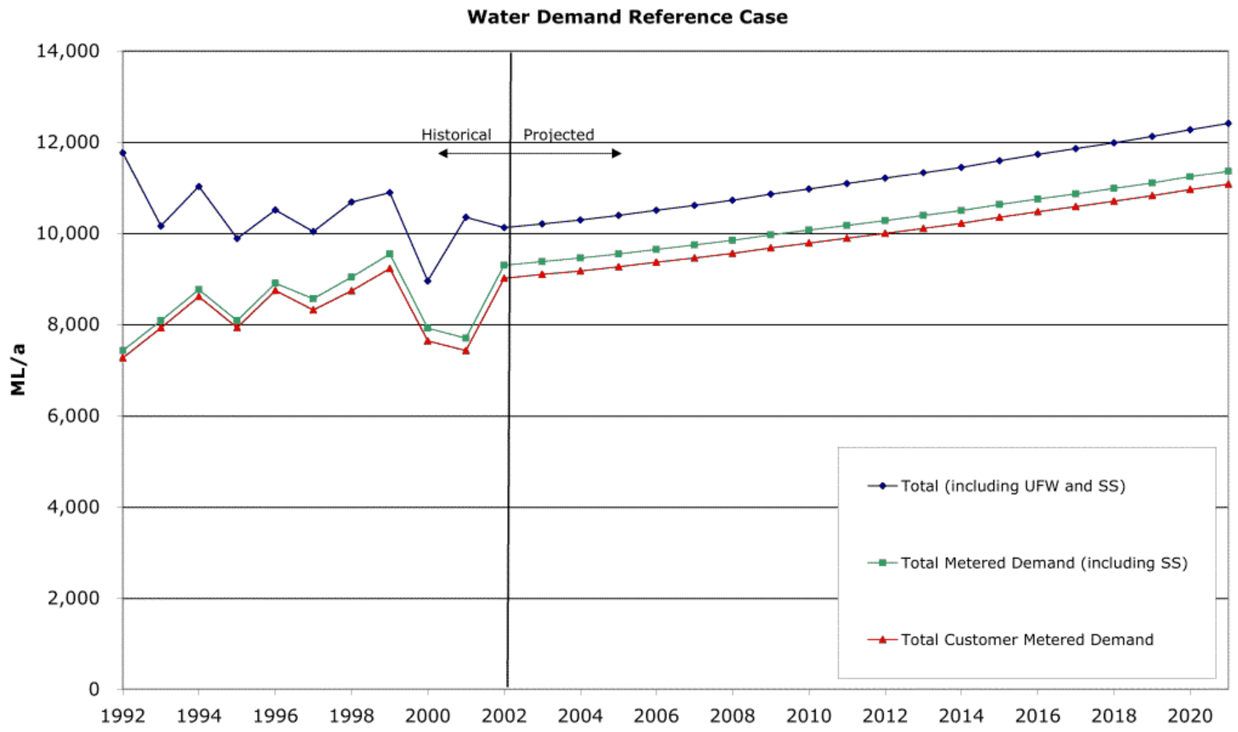
The report also sets out a number of recommendations that should be considered by PW/DIPE and justification for moving to Stage III of the Study, the implementation plan for the proposed demand management program.

The Demand for Water

The population of Alice Springs is expected to grow by more than 5,500 people in the next 20 years from 27,000 (2001) to 32,500 (2021) which represents an increase of 20%. Without investment in demand management, source substitution or reuse alternatives, per capita demand for potable water is likely to remain at or near current levels. Hence the demand for potable water in Alice Springs is likely to increase in the future, from the historical average over the last 10 years of approximately 10,000 ML/a to around 12,500 ML/a by 2021.

Figure 1 shows the historical and projected customer metered demand, metered demand including source substitution (non potable supply from the Town Basin) and the total water supplied by PW including unaccounted for water (UFW), metered potable water and metered source substitution. This water demand projection represents the reference case or business as usual case and has been used to assess the effectiveness of demand management options in achieving identified demand reduction targets. The reference case incorporates anticipated improvements in water use efficiency, which will occur without PW intervention (e.g. stock turnover of 12 L single flush toilets with water efficient 6/3 L dual flush toilets).

Figure 1 Water Demand Reference Case (ML/a)



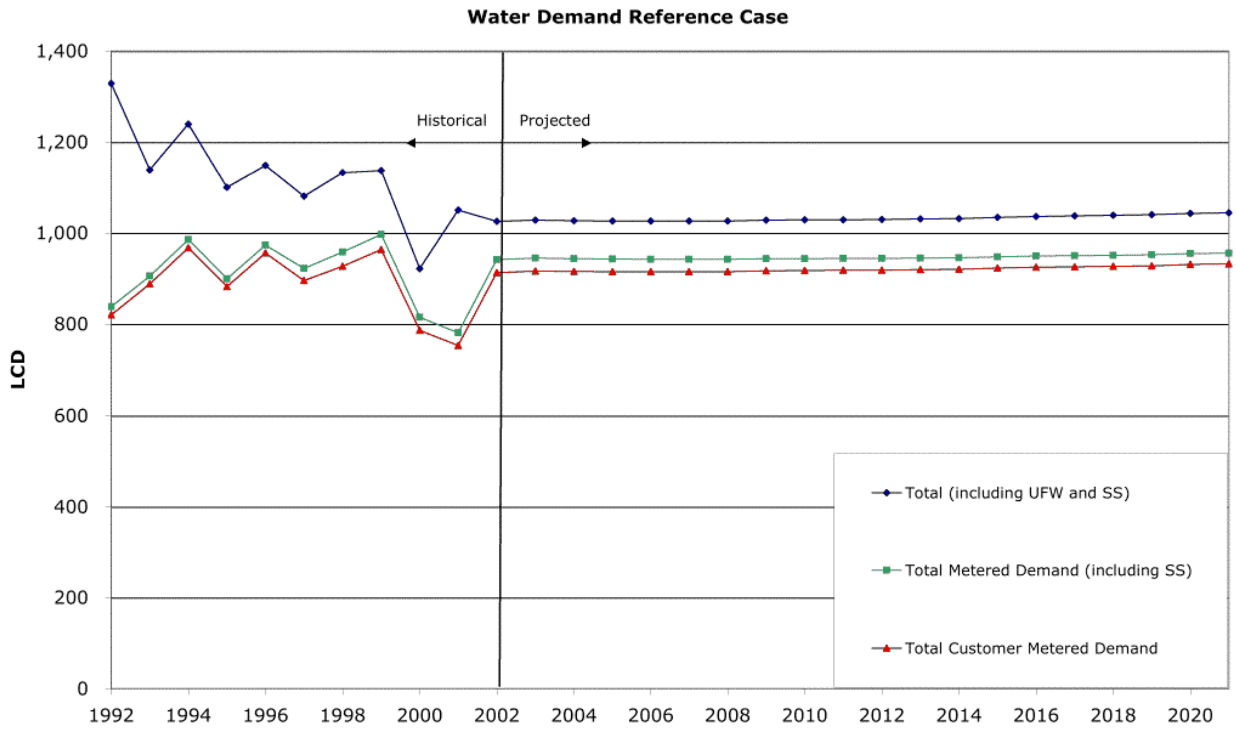
Note – SS represents Town Basin source substitution and UFW represents unaccounted for water.

Figure 1 indicates that there has been a downward trend in total water supplied over the last ten years. However, upon closer inspection of the data the recent reduction in demand can mainly be attributed to two main factors:

- a gradual reduction in system losses or UFW from 21% to 12%, except for 2001 when a major leak contributed to UFW increasing to 27%; and
- a reduction in customer metered demand in 2000 and 2001 due to above average rainfall, which significantly reduced demand in both the residential and non residential sectors.

Hence although water demand has reduced over the last ten years, per capita metered demand has remained fairly constant and is expected to remain so unless a demand management program is implemented. The historical and projected per capita demand is illustrated in litres per capita per day (LCD) in Figure 2.

Figure 2 Water Demand Reference Case (LCD)



Hence overall water demand is expected to increase, as the population grows, as shown in the projection in Figure 1.

Water Supply Constraints

The implications of this increase in water demand are that aquifer levels will continue to fall, as the current annual extraction already exceeds the recharge rate of the primary potable water supply aquifer. The water level of this aquifer is currently at more than 145 m below ground level and is falling at a rate of between 1 to 2 m per year with the current level of water demand. This means that additional capital expenditure will be required to drill new bores or rehabilitate existing bores just to reach the lowering aquifer levels to meet current demand. With greater demand from the additional population the aquifer level will drop more quickly resulting in additional capital costs being required for new bores and to deepen existing bores and earlier in terms of capital expenditure planning. In addition as the aquifer levels fall energy costs associated with pumping will increase as water is extracted from greater depths. Even with no increase in annual demand, extraction depths will increase from the current 145 m to around 190 m by 2021. If demand increases to around 12,500 ML/a, as projected by this Study (the reference case), the extraction depths of the bores could potentially increase to 240 m by 2021. It should be noted that these are estimates.

The energy usage and costs associated with extracting/pumping water in Alice Springs, currently approximately 1,100 kWh/ML and $150/ML respectively, are amongst the highest in the Australian water industry. These will increase as the aquifer level falls further. Hence, if water demand is reduced, significant benefits can be obtained such as avoided or deferred capital and operating costs for water supply and wastewater treatment and disposal, reduced capital and operating costs for the electricity supply system and reduced greenhouse gas (GHG) emissions.

The results of this Study show that a demand management program of the type developed under this Study, could reduce water supply operating costs sufficiently, so that this cost reduction alone would pay for the cost of the demand management program. This does not include the additional benefits of deferred capital expenditure associated with the water supply system and other environmental benefits such as reduction in effluent discharge volumes and reduction in energy usage and GHG emissions. These factors are discussed in more detail in the following sections together with the associated costs of the demand management program scenarios.

Sewage Overflows

The average annual volume of wastewater passing to the WWTP is currently estimated to be between 2,500 and 3,000 ML/a. This is expected to rise as the population grows. The existing WWTP is nearing both hydraulic and treatment capacity and wastewater effluent overflows from the WWTP (estimated to be approximately 600 ML/a) currently discharge to Ilparpa swamp causing ecological and mosquito breeding issues. These overflows are generally at their peak during winter months when evaporation rates are at their lowest and visitor numbers are at their highest. It is expected that these issues will continue as the population grows unless significant intervention is adopted (e.g. demand management or effluent reuse).

An investment of up to $10M for storage and effluent reuse is planned by PW over the next five years to reduce overflows by establishing an effluent transmission system to supply a horticultural district near the Arid Zone Research Centre. A demand management program that targets indoor water demand and the tourist sector will provide not only water demand reduction but also a reduction in terms of wastewater production, thus reducing the flows passing to the WWTP and overflows to Ilparpa swamp. Hence a demand management program could assist in reducing the capital expenditure required for the planned reuse scheme, reduce or defer the capital costs associated with the future planned WWTP hydraulic and treatment upgrade and general operational costs associated with the wastewater system.

The Study Approach

The main aim of this study has been to develop a suite of options (the demand management program), which together reduce annual and peak potable water demand as well as wastewater production. The demand management options have been developed using the principles of least cost planning (LCP) where LCP involves the development and analysis of a range of options to determine the least cost means ($/ML supplied or saved) of providing customers with the water related services they require rather than the water itself. This process recognises that customers do not necessarily want more water, rather they want the services that water provides (e.g. aesthetically pleasing landscapes, sanitation and clean clothes) and that every litre of water saved is the equivalent of a litre supplied. The demand management options developed target a broad range of customers in all sectors (e.g. residential, commercial/industrial and institutional) and individual end uses such as indoor (e.g. toilets, taps, showers) and outdoor (e.g. pools, air conditioners, gardens). They also use a wide range of approaches to increase indoor and outdoor water efficiency including the use of a measure (e.g. increased water efficiency through the fitting of a AAA-rated showerhead) and an instrument (e.g. economic incentive where PW pays for the showerhead and labour and communicative where PW provides a brochure on water efficient tips around the home).

The Options

The options developed, which are described in detail in Section 8.0 of the report, have been grouped as follows:

- residential indoor;
- residential outdoor;
- other residential;
- commercial/industrial;
- institutional;

- new developments; and
- other options.

The options include a combination of measures and instruments such as: retrofitting appliances and fittings (e.g. toilets, showerheads and taps); specialist visits to targeted properties to investigate outdoor water use; provision of give-aways such as tap timers; rebates for the purchase of AAAA-rated washing machines; audits and associated retrofitting and management advice for hotels; and development controls for new residential and commercial buildings. Targeting of new developments has been included to ensure that water efficiency is locked in to new residential and non residential developments as far as possible. This is in order to reduce future investment in demand management measures and to take advantage of the fact that generally the inclusion of water and energy efficiency in new buildings has only a marginal effect on the overall cost of the building. In addition such buildings can relatively easily incorporate options such as demand management, source substitution and reuse.

Savings in terms of total water, peak day water, sewage effluent, energy and GHG have been modelled together with total implementation costs for each option based on assumptions around take-up rates and savings levels.

These options have been developed into three water saving scenarios (1 – low, 2 – medium and 3 – high) to determine the level of investment required to achieve the Alice Springs Urban Water Management Strategy Reference Group (ASUWMSRG) preliminary goals of:

- a 25% reduction in total annual water demand over the first three years, with a further 10% reduction in the following two years;
- a 10% reduction in peak day demand over the first three years, with a further 5% reduction in the following two years; and
- a reduction in inflows to the WWTP from 8 ML/d to 7 ML/d.

Each of the scenarios uses the options developed with varying levels of implementation. Scenario 1, with the lowest costs, shows the baseline savings achievable and represents a standard efficiency options program. In this scenario the participants in a retrofit program might be assumed to be 50% of all available households. Scenario 2, the mid-range scenario, has involved consideration of which of the model's assumptions may reasonably be increased (for example take-up rates) and at what cost. In this scenario the participants in a retrofit program might be assumed to be considerably more at 75% of all available households, which could potentially require additional incentives and thus cost more to attract the level of participants needed. By changing the take-up rate of those options with the lowest cost first ($/kL), it has been possible to develop Scenario 2 at the lowest cost. The high scenario (Scenario 3) has not been fully developed, as it is considered that Scenario 2 pushes the demand management options considered to the limit of their application (in terms of their uptake) and that a more holistic approach combining demand management, leakage control, source substitution and reuse would provide the overall savings required at a lower average unit cost.

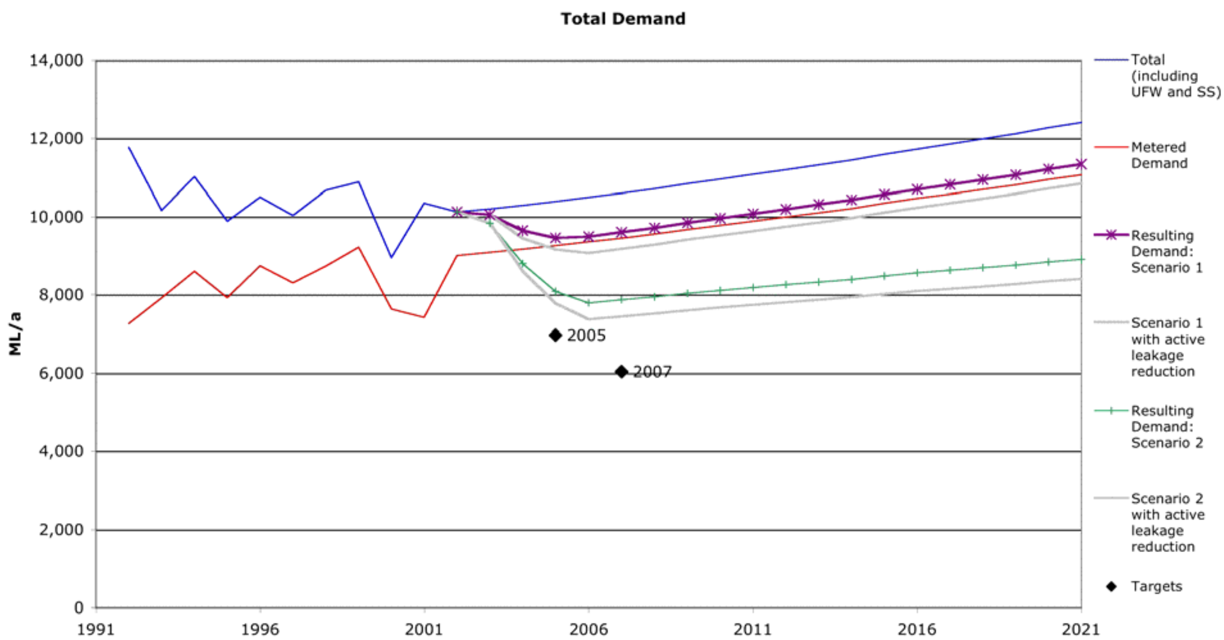
Table 1 shows the results of this process and the scenarios compared with the reference case. These are also illustrated in Figure 3.

Table 1 Demand Management Program Scenarios

Scenario	Resulting Demand (ML/a in 2008)	Demand Reduction Achieved (ML/a in 2008)	Resulting Demand (ML/a in 2021)	Demand Reduction Achieved (ML/a in 2021)	Present Value of Total Cost ($M)
Reference Case	10,715	N/A	12,405	N/A	N/A
1	9,714	1,001	11,339	1,066	3.8
2	8,020	2,695	8,979	3,426	10.2
3*	N/A	N/A	N/A	N/A	N/A

* - Scenario 3 not developed

Figure 3 Demand Management Program (Scenarios 1 and 2)



The demand management programs developed as Scenarios 1 and 2 are estimated to cost approximately $3.8M and $10.2M respectively in present value terms (using a discount rate of 7%). Whilst neither of these scenarios actually meet the preliminary ASUWMSRG targets, it is important to recognise that neither of the scenarios incorporate the full range of opportunities available for inclusion of options relating to leakage control, source substitution or reuse. In Scenario 1, options related to new developments have assumed the use of source substitution/reuse to a limited extent. In Scenario 2, such options have assumed a higher level of source substitution/reuse and in the case of targeted options, such as Pine Gap, some level of source substitution/reuse has be assumed to attain low potable water demand per household.

Although not part of the brief for this Study, Figure 3 provides an indication of how leakage reduction in the PW maintained system could assist in reducing overall demand. The leakage reduction identified is an estimate and indicates the savings available if PW leakage was brought in line with other Australian water service providers at the lower end of current Australian leakage practice. Further leakage reduction could potentially be achieved if PW leakage was brought in line with current international best practice. The estimated savings and costs identified in Table 1 for Scenarios 1 and 2 do not include these potential leakage savings or costs as these will need to be investigated by PW.

As indicated in Table 1, Scenario 3 has not been developed as it is considered that Scenario 2 pushes demand management of the options developed to the limits. Hence, it is recommended that a more holistic strategy is developed in parallel to Stage III of this Study to enable leakage, source substitution and reuse options to be investigated whilst the demand management implementation plan is being developed. It is understood that such options have already been developed to an extent as part of the ASUWMS, however, assessment of all these options together using an LCP approach has not been carried out to date. The evaluation of all options (the reference case, demand management, leakage reduction, source substitution and reuse) should be reviewed using an LCP approach and using the same population and per capita demand assumptions (developed as part of this Study). This will enable PW/DIPE to determine the least cost strategy to take forward for implementation and to ensure that all cross benefits are identified and evaluated. In addition the targets should be reviewed by the ASUWMSRG in the light of the findings of this Study and further assessment of alternative options should be evaluated considering the level of investment required to achieve the preliminary targets.

As a minimum PW should invest in the baseline savings demand management scenario (Scenario 1) at $3.8M. Water efficiency through a demand management program is essential for other options (e.g. supply from additional bores, source substitution and reuse) to provide services effectively and to reduce their unit cost ($/ML) in terms of meeting required demand. For example, if the existing potable water supplied is used more efficiently through demand management then more customers can be supplied with the water saved at no extra cost. In addition, if water required for the watering of ovals from Town Basin supplies is used more efficiently then the water saved can be used for other customers such as hotels for outdoor water use at no extra cost and reduces the demand for potable water demand by these customers. Hence a demand management program is effectively a foundation upon which to build alternative supply options. Without a demand management program investment in alternative options will not be optimised as the water being provided will still be wasted.

Investment in Demand Management

As previously identified Scenarios 1 and 2 are estimated to cost $3.8M and $10.2M respectively. These are the full costs of each program and assume that PW will (in a similar way to investment in borehole augmentation) pay for all required costs, thus, maximising the potential take-up rates by participants of the options and incentives developed.

As mentioned previously this investment will effectively be recouped in the form of deferred or avoided capital and operating costs in the water and wastewater (and potentially energy) infrastructure. Table 2 shows the capital and operating expenditure and savings for potable water for the reference case and Scenarios 1 and 2.

Table 2 Capital & Operating Water Expenditure & Savings

Scenario	Reference Case Borehole Expenditure Present Value $M	Scenario 1 Borehole Expenditure Present Value $M	Scenario 1 Borehole Expenditure Savings Present Value $M	Scenario 2 Borehole Expenditure Present Value $M	Scenario 2 Borehole Expenditure Savings Present Value $M
Water					
- capital	5.1*	4.7	Savings proportion unknown	3.9	Savings proportion unknown
- operating	23.7	20	3.8	14.1	9.7

* It should be noted that the present value capital cost for the reference case in this table extracting 12,500 ML/a is virtually the same as the present value cost ($5M) identified by PW in their Asset Management Plan for the borefield extracting only 10,000 ML/a. This can be attributed to the fact that the reference case in this table uses a linear assumption for capital expenditure over the 20 years considered unlike the reference case calculated by PW which assumes distinct times when bores will be replaced. In addition the reference case in the table uses a 7% discount rate and the reference case identified by PW uses a discount rate of 9%.

The table shows that the present value savings in operating costs for Scenarios 1 and 2 are $3.8M and $9.7M respectively. This indicates that for Scenario 1 the present value savings in operating costs for water alone actually pay for the Scenario 1 demand management program ($3.8M) and are only $0.5M short for Scenario 2 ($10.2M). Hence if the savings attributable to deferred capital expenditure for the water system and deferred capital and operating expenditure for the wastewater and electricity system were also included the demand management costs for both scenarios could easily be paid for.

The cost savings attributable to the water, wastewater and energy infrastructure should be reviewed further by PW as full details were not available for this Study. Detail should be available for Stage III of the Study and the assessment of the other alternative options to assist in understanding the full costs and benefits of all options developed.

Recommendations

During this Study a number of recommendations have become apparent. These are summarised below. Full details of the recommendations are provided in individual sections.

PW/DIPE should commit to Stage III of the Study and the implementation of a Demand Management Program by:

- committing required funds for at least Program Scenario 1 ($3.8M);
- investigating Program Team personnel to be involved in Stage III;
- investigating capital and operating costs of running the water, wastewater and electricity systems to assist in clarifying assumptions and costs/benefits identified;
- committing to pilot studies and surveys to assist in Stage III development; and
- investigating other initiatives/projects related to water and energy issues (e.g. CRC, Desert Knowledge) to liaise and coordinate funding and research gaps/synergies to assist in Stage III and long term research.

In parallel to Stage III PW/DIPE should consider:

- restructuring their current pricing structure on water by moving away from an NT uniform tariff policy to a locally based inclining block tariff and a volume based charging system on sewage related to winter water demand similar to the Trade Waste tariffs;
- updating their borefield augmentation model to ensure assumptions are consistent with this Study and to allow fair reference case comparison with other options;
- investigation of leakage reduction, source substitution and reuse options using an LCP framework to determine which other least cost options should be implemented together with the demand management program to form the ASUWMS;
- review of the current preliminary targets together with the ASUWMSRG;
- the implications of the benefits of the demand management program on the investment requirements for other options; and
- evaluate existing initiatives where possible (e.g. Cut the Lawn, audits) to assist in Stage III design and using the climate correction model to check UFW in 2001/02.

PW/DIPE should also consider/investigate:

- using the climate correction model for future evaluation of demand management and other initiatives;

- draft a system management implementation plan/schedule to reduce UFW and move towards best practice management including accurate UFW calculation, the substantial auditing and upgrading of the CIS to allow for ongoing evaluation of customers, use of flow meters at the WWTP, use of outdoor meters to identify outdoor demand, use of meters on individual units of occupancy and use of SIC for individual customers;

- use of demand management on other sources such as the Town Basin and reactivation of additional sources such as the hospital borehole and gaol reuse system;

- obtain more accurate data on the indigenous populations and Pine Gap residents to improve the accuracy of the model and when available incorporate the Trade Waste results and WWTP flow records to assist in calibration of the end use models; and

- steps to advocate appliance water efficiency nationally and ensure local building codes incorporate the synergies of water and energy efficiency as far as possible in both new and modified buildings to minimise the need to demand management investment in future development.

1 INTRODUCTION

1.1 Background

In July 2002 the Power & Water Corporation (PW) together with the Department of Infrastructure Planning and Environment (DIPE) commissioned Kellogg Brown & Root Pty Ltd (KBR) and the Institute for Sustainable Futures (ISF) to carry out the '*Alice Springs Water Efficiency Study*' (the Study), which forms part of the Alice Springs Urban Water Management Strategy (ASUWMS). The main aim of the Study is to identify the most cost effective, and socially and environmentally appropriate options for reducing both water demand and the production of wastewater effluent in Alice Springs. This is principally to:

- reduce the need for augmentation of the Roe Creek Borefield, which will be required if the groundwater level continues to fall at the current rate of approximately 1.5 m per year (90 m below surface level in 1964 and more than 145 m below in 2000 (SKM, 2000c, p9));
- reduce the need for augmentation of the reticulation system because of future population growth; and
- reduce the volume of effluent overflow from the wastewater treatment plant (WWTP) passing to Ilparpa swamp during winter months of low evaporation and subsequently reduce mosquito breeding issues and assist in returning the swamp to its original ecological state.

The Study is being carried out in three stages:

- Stage I – Review of existing data, reports and information associated with historical water use and wastewater production, and development of models that satisfactorily reflect historical patterns and project future demand.
- Stage II – Evaluation of water efficiency options appropriate to Alice Springs to achieve nominated target levels for reduction of annual and peak day water demand and wastewater production.
- Stage III – Development of a water efficiency implementation plan to successfully achieve agreed water use reduction within agreed sectors, timeframes and budgets.

1.2 This Report

This Report provides details of Stages I & II of the Study and additional information, which may assist in Stage III. It has been written to enable a broad spectrum of readers to understand the wide variety of complex issues involved. Additional details for those interested in particular aspects of the Study are provided as Appendices.

The structure of this Report is as follows:

- Introduction.
- Approach & Methodology.
- The System Networks.
- Factors Affecting Water Demand in Alice Springs.
- The Demand for Water.
- Customer Metered Demand.

- The End Use Model.
- The Demand Management Program.
- Recommendations.
- References.

Where relevant, recommendations are provided at the end of each section for PW/DIPE consideration. These recommendations have been summarised in Section 9.0.

The appendices give details on:

- Wastewater Treatment Plant Layout.
- Tariffs & Historical PW/DIPE Demand Management/System Management Initiatives.
- Climate Correction Model.
- Customer Type Interviews for Various Sectors (details contained in Volume II).
- Summary of DPWS Audits.
- End Use Model.
- Specialist Interviews & the Alice Springs Show Survey (some of detail contained in Volume II).
- Option Assumptions.
- ASUWMSRG Workshop – 20 March 2003.
- Collated Recommendations.

A number of interviews have been undertaken as part of this Study. To maintain confidentiality transcripts of these interviews have not been included in this Report but collated and included in a separate volume (Volume II).

2 APPROACH & METHODOLOGY

2.1 Introduction

Before going into the details of Alice Springs, it is essential that the basic principles, approach and methodology of the Study are identified. These are described in the following sections.

2.2 Basic Principles

This Study is underpinned by the principles of Least Cost Planning, demand management, end use analysis and cost benefit analysis. These basic principles are detailed below:

2.2.1 Least Cost Planning

Least Cost Planning (LCP) is a process whereby, for example, a water service provider determines a range of options that at lowest cost provide their customers with the water related services they require rather than the water itself. This process recognises that customers do not necessarily want more water, rather they want the services that water provides (e.g. aesthetically pleasing landscapes, sanitation and clean clothes). LCP options can range from traditional supply (e.g. dams, groundwater aquifers), source substitution (e.g. rainwater tanks, greywater reuse) to demand management (e.g. leakage control, installation of water efficient fixtures and fittings), where demand management or water efficiency is often found to be the cheapest option because it allows deferral of capital works and reduces operating costs.

2.2.2 Demand Management

Demand Management (DM) should often be considered first, prior to expansion of a potable supply system or use of source substitution as it ensures that the existing water provided is used most efficiently. Demand management options include (White, 1998):

- cost reflective pricing and universal customer metering (e.g. user pays principles);
- operational measures (e.g. leakage detection, pressure reduction);
- communication and education;
- use of water efficient appliances (e.g. 6/3 litre dual flush toilets, AAA-rated showerheads and AAAA-rated washing machines);
- regulation of the efficiency of water using equipment and processes; and
- temporary or permanent water use restrictions (e.g. sprinkler times).

These demand management options may be implemented for any combination of reasons (White, 1998):

- defer augmentation of water supply and wastewater treatment infrastructure;
- reduce operating costs of water supply and wastewater treatment;
- meet operating requirements;
- achieve environmental goals;
- enhance the level of customer service; and/or
- encourage the development of a water efficient industry.

2.2.3 End Use Analysis

End Use Analysis (EUA) is an essential tool in the development of demand management options. End use analysis involves the disaggregation of water demand by customer sector and ultimately by end use within each sector. Basic sectors within a typical urban community would normally be disaggregated into residential, commercial/industrial and institutional customers. The residential sector could be further disaggregated into single and multi residential customers and into end uses such as toilets, showers, baths and washing machines for the indoor component (going to sewer) and garden irrigation and pools for the outdoor component. By disaggregating water usage in this way a detailed understanding of water demand can be obtained for each sector, which can be modelled to project future water demand and effluent discharge more accurately.

This model can be used to determine potential water savings available from a demand management option. For example, replacement of a 12 litre toilet with a 6/3 litre dual flush toilet provides the same service but can reduce the water demand associated with this end use by 60%. By using the model to combine options such as toilet or shower replacement and by calculating the associated costs, the least cost options can be determined.

2.2.4 Cost Benefit Analysis

Cost Benefit Analysis (CBA) is used to determine the cost effectiveness of different options. The net present value of the cost of implementing each option is calculated over a set period using an appropriate discount rate (in this Study over 20 years using a 7% discount rate). The present value of the cost of the option is divided by the present value of the water savings over the same timescale to provide a unit cost in dollars per kilolitre ($/kL). This unit cost represents the monetary costs only of a demand management measure (financial benefits are not included). This provides an indicator of the 'best buy' to achieve the objective of reducing demand at the least cost, and can be used to rank the cost-effectiveness of different options.

CBA can be expanded to include a wider range of costs and benefits. For example, the Total Resource Cost test, in which quantifiable costs and benefits to the utility and customers (both participants and non participants in any program) are considered. This includes benefits such as the reduced cost of water supply and treatment, energy bill savings to customers from reduced hot water use, and reduced water and sewerage bills. This provides a better indication of the least cost to the 'community' of reducing demand. It is also possible to introduce some quantifiable environmental benefits, such as reduction in greenhouse gas emissions. This Study has used the simple unit cost approach to rank cost effectiveness but has identified other economic, environmental and social benefits in order to assist more detailed ranking of the options developed.

2.3 Approach

In order to determine how and where water can be saved and wastewater effluent reduced, it is essential to understand where water is currently being used and lost and what key factors are likely to affect water demand in the future.

To understand how water is used and lost this Study has considered the water supply, customer use and transfer and treatment of wastewater as one system. A simplified view of the Alice Springs system, where water is currently sourced and how it is transferred to the typical water demand sectors (e.g. residential and commercial) and end uses (e.g. toilets and showers), is shown in Figures 2.1 and 2.2. By using this approach, individual elements that make up the system can be investigated to determine how much water they use, how they should be modelled, what potential savings can be made and how much it would cost to obtain those savings.

Figure 2-1 The System

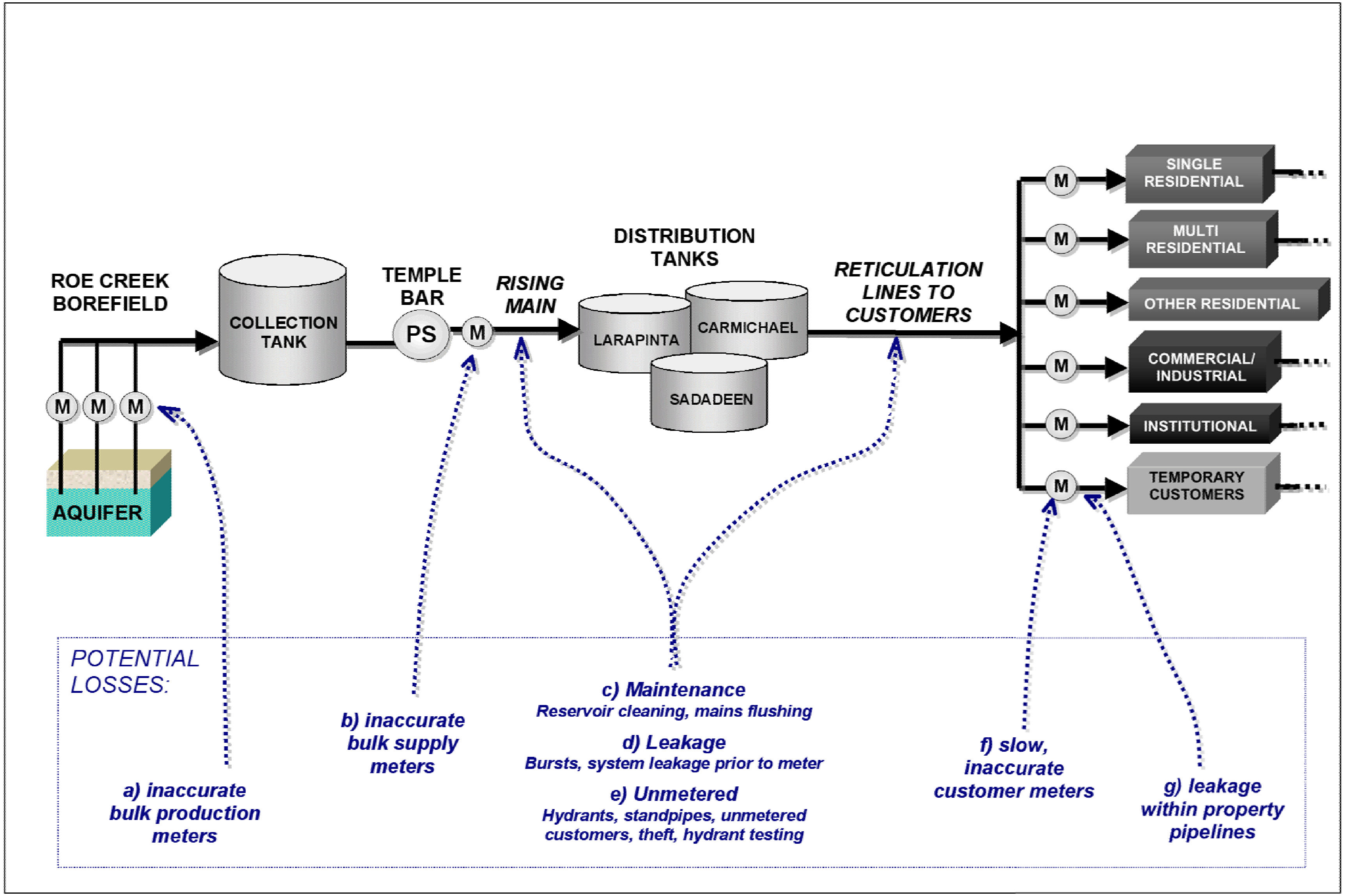
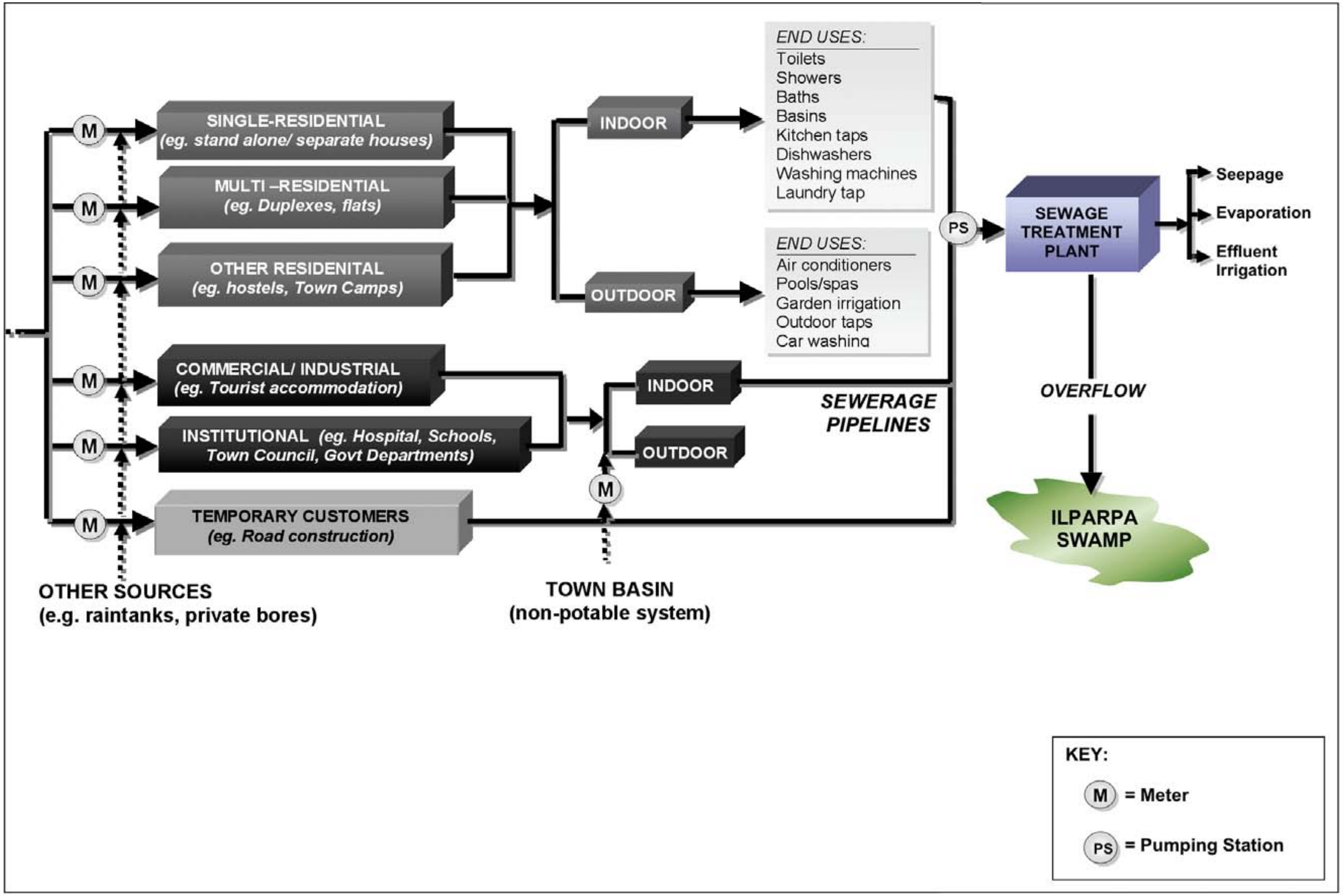


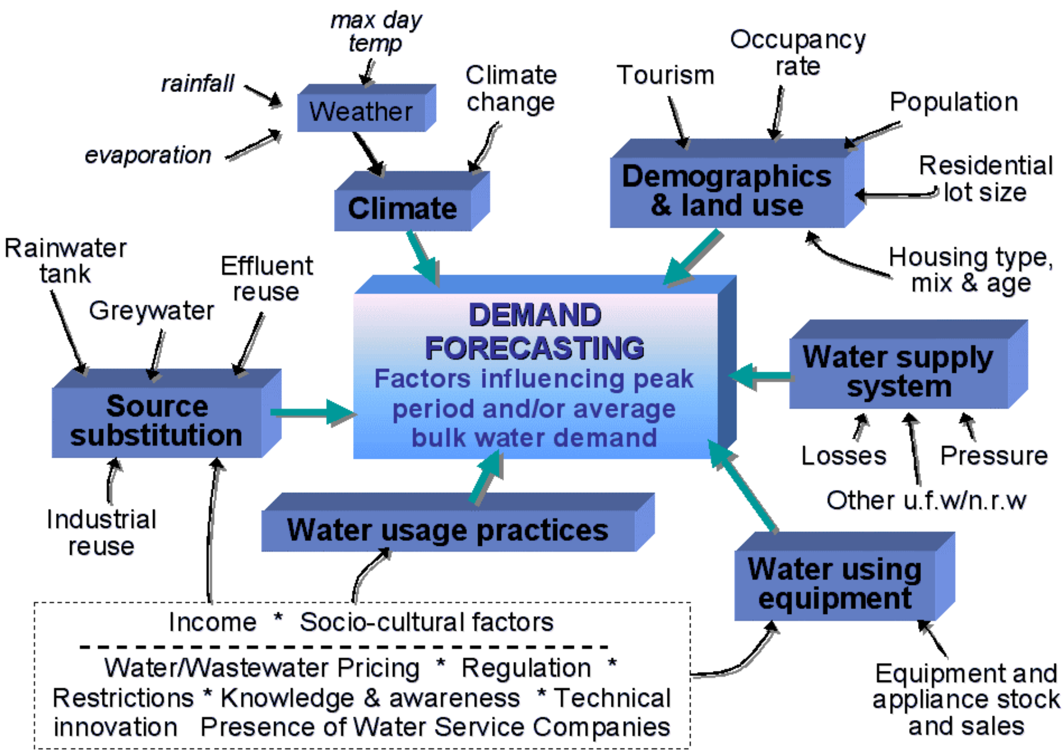
Figure 2-2 The System (continued)



Some of the key factors affecting historical, current and future water demand that have been considered by the Study and which are illustrated in Figure 2.3 include:

- Demographics and land use – Historical and projected population size, tourist population, dwelling type/mix/age/lot size, planned development and occupancy ratio (i.e. people per household).
- Climate – Temperature, evaporation and rainfall patterns which vary both seasonally and from year to year and which often significantly influence outdoor water demand in arid climates such as Alice Springs.
- Water Using Equipment – Equipment within dwellings (e.g. dual flush toilets, evaporative air conditioners), their age and the penetration of more efficient equipment into the market (e.g. percentage of annual sales).
- Water Usage Patterns – Affected by income, socio-cultural factors and demand management (e.g. pricing, regulation, restrictions, knowledge or awareness).
- System Management – Changes in the management of the system such as pressure reduction, leakage control and meter replacement/calibration.
- Source Substitution – Use of rainwater tanks, non potable water supplies (e.g. Town Basin supply, greywater reuse, effluent reuse).

Figure 2-3 Key Factors Affecting Water Demand

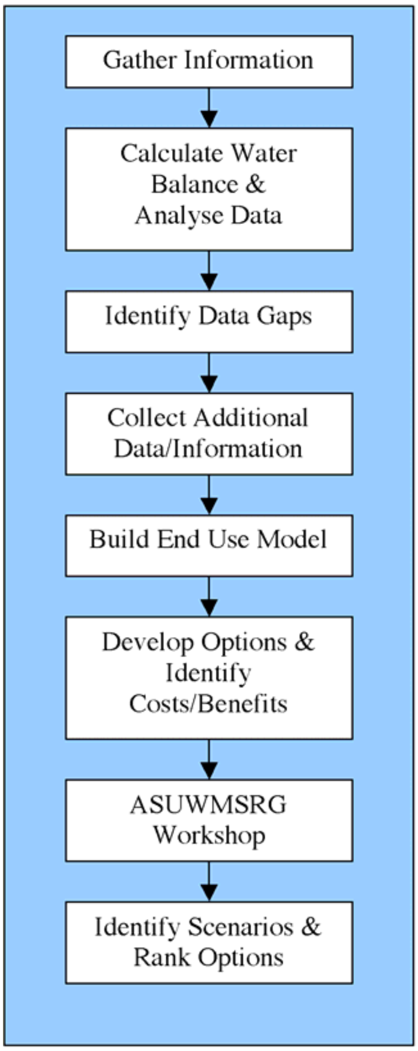


Source – ISF, 2003

2.4 Methodology

The approach identified in Section 2.3, that is, considering water and wastewater as a system and considering the way in which key factors affect demand, has influenced the methodology used for this Study. A simplified flow diagram illustrating the process is shown in Figure 2.4 and discussed below.

Figure 2-4 Methodology



Gather information – Information was collected and assessed on various issues including demographics and land use, the water and wastewater systems, bulk and customer metered data, sewage flows, details on water using equipment/stock and usage practices and climate data. Local information and data was collected where possible but territory, national and international data and information was collected where local data was unavailable.

Calculate water balance and analyse data – The customer metered data collected was analysed and disaggregated into sectors and customer types to clarify where water has historically been used. This total customer annual demand was compared with bulk water supply records to identify losses from the system. The customer metered data was further analysed to determine which sectors/customers/end uses have above average demand (locally/nationally/internationally) to assist in identifying potential areas to save water.

Identify data gaps – From the data and information collected, data gaps were identified and additional information sought where possible or assumptions identified where information gaps existed.

Collect additional data/information – Having identified the data gaps and understood which customer/end uses could be targeted to save water, specific additional information was gathered on:

- The residential sector – by carrying out the Alice Springs Show survey which tested information on indoor and outdoor water use such as the proportion of dual flush toilets in Alice Springs, the proportion of evaporative air conditioners and the number of swimming pools.

- Specific customers – to find out further details of the appliances within households through interviews with the Pine Gap, public housing and individual Aboriginal community housing managers.

- Specific end uses – to find out more about high water demand outdoor end uses through interviews with specialists on subjects such as plumbing, air conditioners, swimming pools and gardens.

- Evaporative air conditioners – to understand average evaporation and bleed off rates in an arid environment through experiments on typical units in Alice Springs.

The Alice Springs Show survey was carried out at the commencement of the Study before data gaps were known, to take advantage of the opportunity the Show gave of reaching a large proportion of Alice Springs residents at a relatively low cost. The information gathered from the Show survey and interviews proved invaluable in verifying assumptions in the local context from other sources and provided an opportunity to gather information on costs and implementation issues of potential demand management options.

Build the end use model – Using the data and information collected, an end use model was developed which represents the historical demand for water in each sector and projects the demand for water taking into consideration factors such as population increase, change in housing occupancy and change in stock of particular end uses such as toilets. The output of the model was a reference case for water demand calibrated using metered data. Other outputs of the end use model were a peak day model and a sewage model calibrated against limited available data on sewage flows entering the WWTP. A climate correction model was developed to assess how bulk demand has changed over the assessed period, taking into consideration population and climate variables. This climate correction model will be used by PW in future to evaluate demand management options implemented as part of this Study.

Develop options and identify costs/benefits – Having obtained the reference case, a series of options were identified, targeting indoor and outdoor water demand for various customer types in the residential, commercial/industrial and institutional sectors. For each of these options the water savings and costs (capital and operational) were derived in present value terms ($/kL). The savings were accumulated where possible and compared with the PW/DIPE preliminary target savings. As well as identifying the total cost of each option, benefits were also identified, such as the reduction in energy required (e.g. for pumping to extract the water from the borefield and the associated reduction in greenhouse gas emissions. In addition the costs of augmenting the water system (the reference case) were identified to assist in understanding how water savings obtained through the demand management options developed could defer augmentation requirements, although this was difficult due to lack of available data.

Alice Springs Urban Water Management Strategy Reference Group (ASUWMSRG) Workshop – On 20 March 2003 the options developed were presented to the ASUWMSRG for comment and discussion in a workshop. The concerns and opportunities of various options were discussed together with additional options that could be considered and implementation issues that should be taken into consideration during Stage III of the Study. These comments were used to refine the options developed.

Identify scenarios and rank options – The options were grouped into scenarios (low, medium and high), which represented varying levels of water savings attainable through different levels of uptake of the demand management options developed. For example, higher levels of water savings associated with an indoor retrofitting program (e.g. replacement of inefficient showerheads with AAA-rated showerheads and fitting of tap aerators) could be obtained if more households participated in a retrofit program. However, this would require higher levels of investment in the retrofit program to interest additional participants. These higher levels of investment could take the form of additional advertisements/free giveaways/advice. Hence the scenarios were developed by considering the level of water saved and the amount of investment required thus providing the unit cost ($/kL in present value terms) of each program scenario.

A number of criteria specifically important to Alice Springs were also identified (e.g. reduction on water demand, peak demand, sewage discharge, energy demand and greenhouse gas emissions). For each option these additional benefits, which cannot generally be costed, were quantified. The options were then ranked in terms of unit cost per kilolitre of water saved ($/kL) but the other benefits such as reduction in sewage discharge and greenhouse gas emissions were clearly identified.

The identification of other important benefits will assist when more detailed ranking of the options are undertaken, using a process such as multi criteria analysis (MCA). MCA allows the importance of a benefit such as reduction in sewage flows and equity issues to be taken into consideration when ranking by weighting that importance, thus allowing the ranking process to move away from relying primarily on choosing the lowest cost options first.

***Stage III* -** The scenarios and ranked options identified under this Study and summarised in this Report will be submitted to PW/DIPE for review to determine whether to proceed to Stage III of the Study (the implementation plan).

3 THE SYSTEM NETWORKS

3.1 Introduction

PW is responsible for the provision of water and wastewater services as well as electricity services. A brief description of the water and wastewater networks are provided in the following sections for those not familiar with the systems managed by PW.

Where available, details of planned augmentation of individual networks associated with population increases or environmental issues are provided. This is to clarify what work and costs are required to enable PW to cater for its existing and future customers based on current demand levels per capita. This represents the reference case which does not rely on demand management, source substitution or reuse options. These costs will ultimately be compared to the demand management options developed under this Study, which will aim to reduce water demand and wastewater production to such an extent that augmentation of the existing system can be deferred. The resulting reduced capital and operating cost to PW and reduced water and energy costs to the customers can be used to offset the costs of the preferred demand management options (the program) developed. Details of the demand management options together with their costs and comparison with the reference case costs are described in Section 8.0.

3.2 Roe Creek Borefield Potable Water Supply

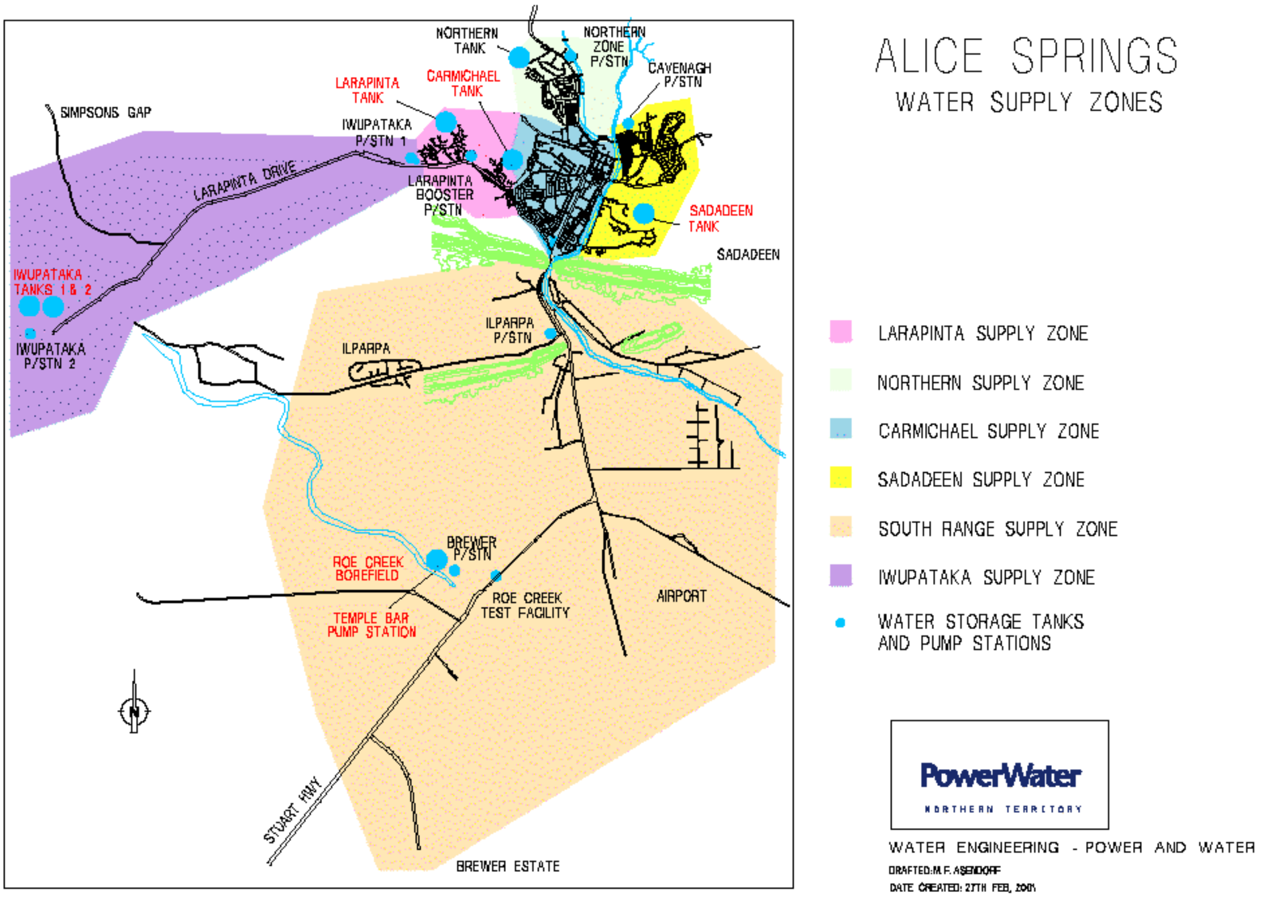
Approximately 10,000 ML/a of potable water, for drinking and general use, is drawn from 17 production bores. These are located approximately 13 km south of Alice Springs, in a 4 km stretch in close proximity to Roe Creek. This water is pumped to an 8 ML collection tank at the Temple Bar pumping station where chlorine gas is injected (0.5 mg/L) just before the tank to provide residual disinfection. Water is pumped over a distance of 15 km to the main storage reservoirs of Sadadeen, Carmichael and Larapinta. These reservoirs, which have a combined effective storage of 60 ML, supply distinct zones with separate reticulation systems. The reservoirs float on the reticulation system with the Temple Bar pumping station pressurizing the entire system when the pumps are operating. Water pressure in Alice Springs is high with average pressures ranging from 30 to 50 metres although these pressures reduce significantly in summer during peak demand (SKM, 2000c). Figure 3.1 shows the general layout of the potable supply areas.

Larapinta tank, which supplies areas west of Bradshaw Drive has a large reserve capacity to cater for future development in the area. However, ongoing development in the Mount Johns Valley, Emily Hills and Farms Area will eventually require additional storage capacity which is likely to be located to the south of Heavitree Gap.

The water drawn from the Roe Creek Borefield is pumped from four individual aquifers located in three geological formations. The Mereenie Sandstone formation currently provides the majority (75%) of the required water and is likely to continue to do so. However, since commencement of pumping from this formation in the 1960s, the water level has dropped from 90 m to over 145 m below ground level with an average fall of approximately 1.5 m per annum (SKM, 2000c) associated with a very low recharge of only approximately 5%.

Consequently, energy use to operate the water supply system in Alice Springs, which is dominated by borehole pumping, is high in comparison with similar non-major urban water utilities, using about 1,080 kWh/ML in 2001/02 (pers comm. N DeCastro). This was the third highest consumption listed by the Australian Water Association (AWA) survey of 65 similar systems (AWA, 2002), exceeded only by Kalgoorlie, which has an extreme level of energy use due to the pumping distance involved, and Toowoomba. At the current energy price, energy costs associated with the water supply system are approximately $150/ML (pers comm. N DeCastro). Both operational pumping costs and capital costs for bore rehabilitation and augmentation will increase even if consumption remains constant due to the falling water level of the aquifer.

Figure 3-1 Potable Water Supply Network



Source - PW

The gradual increase in population and the falling water level in the Mereenie Sandstone formation will require existing bores to be deepened to enable extraction to continue. Such rehabilitation of bores costs approximately $0.3M per bore and results in increased operational costs associated with drawing the water from greater depths. Increased demand and/or the inability to deepen specific bores may require new bores to be constructed, which cost approximately $0.75M to drill, test and equip (SKM, 2000c).

According to PW Asset Management Plans, PW currently plan to spend approximately $9M ($5M in present value terms assuming a 9% discount rate) over the next 20 years on borefield rehabilitation and augmentation just to maintain the current level of supply of approximately 10,000 ML/a (PW, 2003a). The PW borefield augmentation model used to determine future and capital operating expenditure assumes that although the population will increase, the water demand per person will decrease, ultimately meaning that demand will effectively remain around 10,000 ML/a. From the results of this Study however, it is anticipated that total demand in 2021 will be closer to 12,500 ML/a if there is no additional investment in demand management, source substitution or effluent reuse programs. It is therefore anticipated that borehole rehabilitation and augmentation expenditure will actually be considerably more than $9M and the associated operational costs will be higher than predicted by the PW model. Details of the projected water demand are provided in Section 7.6 and further details on the projected capital and operational costs associated with the higher levels of demand predicted by this Study are provided in Section 8.7.

The demand management options developed under this Study will assist in reducing future water demand associated with the rising population and defer augmentation requirements related to extracting water from deeper depths within the aquifers. Demand management measures that also target peaking factors, which together with total volume extraction determine the design of the water supply networks (e.g. pipelines, pumping stations, storage tanks) will assist in deferring augmentation of the network. In addition by reducing overall demand they will assist in reducing the high operating expenditure associated with pumping water from the aquifers.

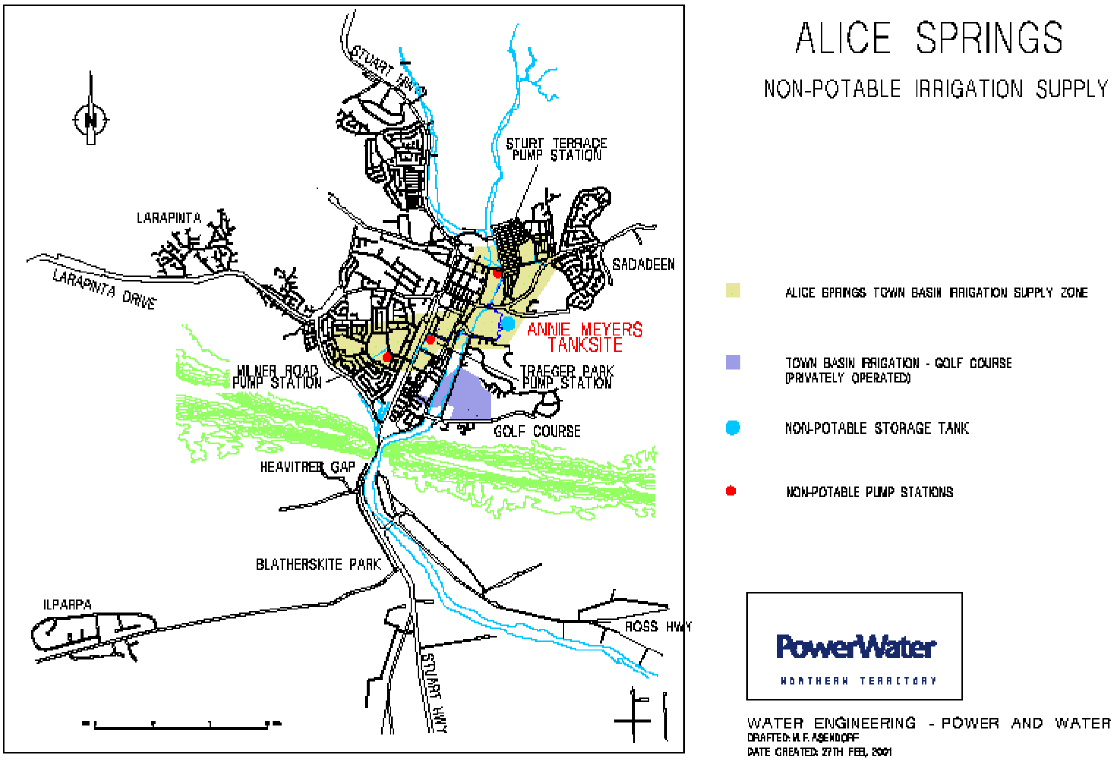
3.3 Town Basin Non Potable Water Supply

Non potable water is supplied to a limited number of customers from the Town Basin aquifer underlying the Todd River. This aquifer was once used to supply much of the town's potable demand until the population increased to such an extent that the Roe Creek Borefield was established. Alice Springs Town Council used the Town Basin supply for irrigation of a number of parks and ovals until it was decided that PW should take over the management of the system and augment it as part of a strategy to reduce demand on the Roe Creek Borefield in addition to reducing Town Basin water levels, which have caused salinity issues at various times in the past. PW took over the system in 1996. Alice Springs Town Council has continued to use the system and a number of additional customers (mainly schools) have been connected since 1996.

Town Basin non potable supplies are distributed through the PW managed network which is supplied by six individual bores which feed into the 4 ML Annie Myers Tank. In addition, six private bores, which are not linked to the PW network are located around town.

Figure 3.2 shows the layout of the PW Town Basin supply network and the area currently supplied.

Figure 3-2 PW Non Potable Water Supply Network



Source - PW

Details of the individual bores are provided in Table 3.1 together with capacity and recent extraction details.

Table 3-1 Non Potable Supply

Ownership	Current Equipped Capacity L/s	Current Effective Capacity L/s	Groundwater Extraction Volume ML/a	
			1999	2000
PW – Traegar	8.4	7	63	48
PW – Hockey	10	10	139	105
PW – Sturt	4	3	25	15
PW – CAFL	10	10	119	102
PW – Pacific	2.8	2.8	32	2
PW – Baseball	7.8	7	54	72
Private – Golf Course	15	9	78	29
Private – Golf Course	15	9	285	197
Private – Golf Course	15	9	74	36
Private – St Philips School	3	1.8	23	19
Private – Det 421	2	1.2	7	5
Private – Casino	1.5	0.9	37	15
Totals	**94.6**	**70.7**	**936**	**642**

Source – SKM, 2001

Notes - Effective capacity allows for effects associated with drawdown.
Bores located at the Memo Club and Alice Springs Resort are no longer operated.
A bore at the hospital was provided by PW and was planned to be connected to the PW network. However, the hospital bore is not currently being operated and is not connected to the PW network.
Roe Creek Borefield is used to top up the Annie Myers Tank during high demand (contribution approximately 4.5% of 1996 to 2000 non potable demand)

As indicated, 936 and 642 ML/a were used in 1999 and 2000 respectively with the drop in demand in 2000 being associated with higher than average rainfall in that particular year.

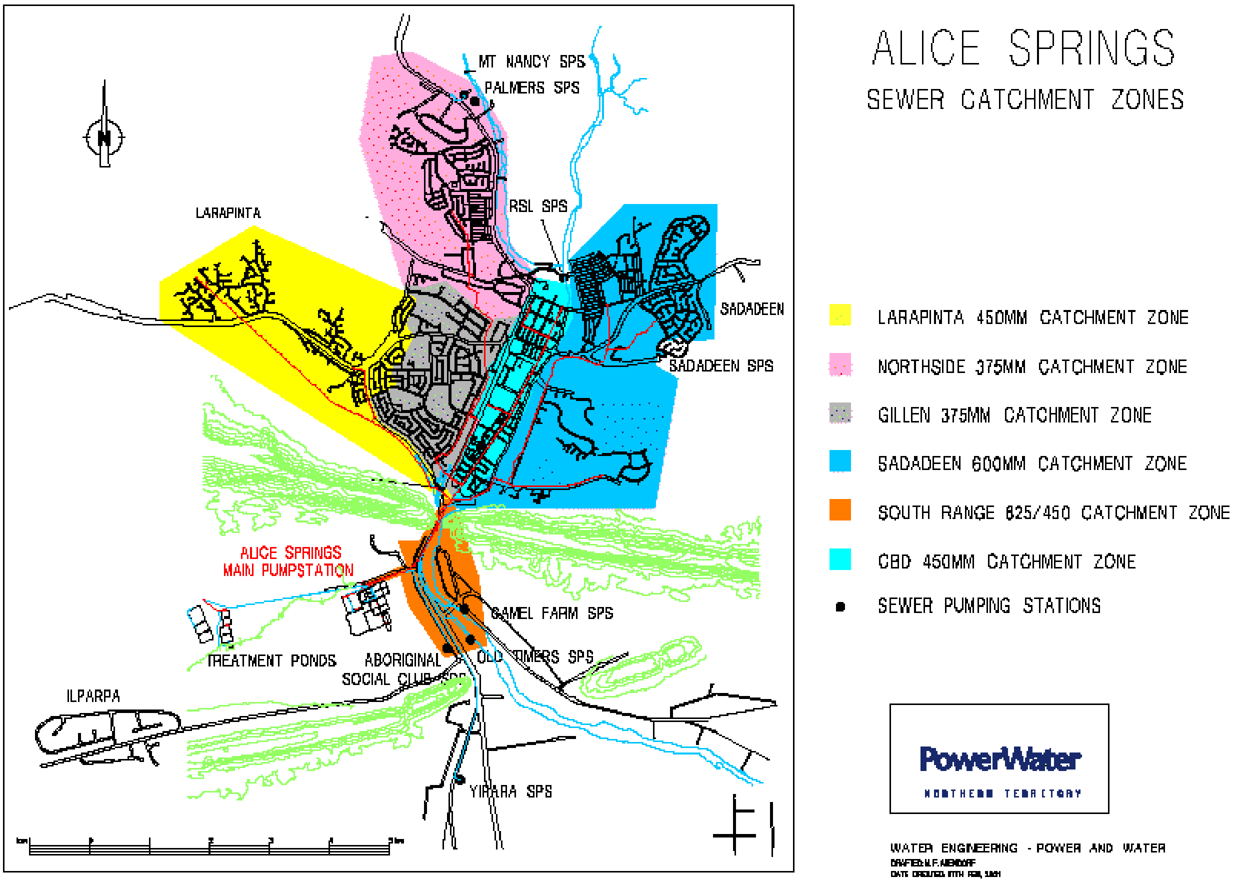
From an assessment carried out (SKM, 2001), it was found that if the demand on the aquifer was increased to 1,140 ML/a (the sustainable recharge) the Town Basin could be used to supply additional customers and assist in alleviating infiltration problems associated with the sewerage system. Hence, there is scope to increase the use of non potable water to assist in the reduction of demand on the Roe Creek supply. There is also scope to use the non potable supply more efficiently through demand management options to allow this limited resource to be used more effectively by more customers.

No details are available on the planned augmentation of this system.

3.4 Wastewater Treatment

Currently approximately 2,500 to 3,000 ML/a of wastewater generated in Alice Springs is transferred to the wastewater treatment plant (WWTP) to the south west of town (approximately 7 to 9 ML/day). The majority of Alice Springs customers are connected to the wastewater system. Those that are not include the Ilparpa area, Iwupataka Land Trust and properties to the south of town such as those properties to the east along Ragonesi Road and Ross Highway (e.g. Amoonguna) and directly south such as the airport, Brewers Estate and the gaol. The sewered areas are shown in Figure 3.3.

Figure 3-3 Wastewater System



Source - PW

The Alice Springs WWTP, which is classified as a secondary treatment process according to the National Water Quality Management Strategy, has a series of ponds (facultative, oxidation and maturation) that treat the effluent. This effluent is then passed to evaporation ponds where the effluent either evaporates, is lost through seepage, used for irrigation or overflows to Ilparpa swamp. The WWTP has been augmented gradually over time to cater for the growing population and comprises of:

- the original set of ponds (Ponds A) in the Commonage Road area adjacent to Blatherskite Park which were built in the 1960s;
- additional ponds (Ponds B) built in the 1970s, 3km further west of Ponds A;
- a 25 ha forestry plot adjacent to Ponds B and an irrigation system (20 ha) constructed in Blatherskite Park established in the 1980s to reduce overflows to Ilparpa swamp;
- additional ponds (Ponds C) adjacent to Ponds B built in the late 1980s; and
- an effluent pond constructed adjacent to Ponds A, built in 1995, to collect all effluent from treatment ponds for disposal by evaporation to minimise effluent passing to Ilparpa swamp.

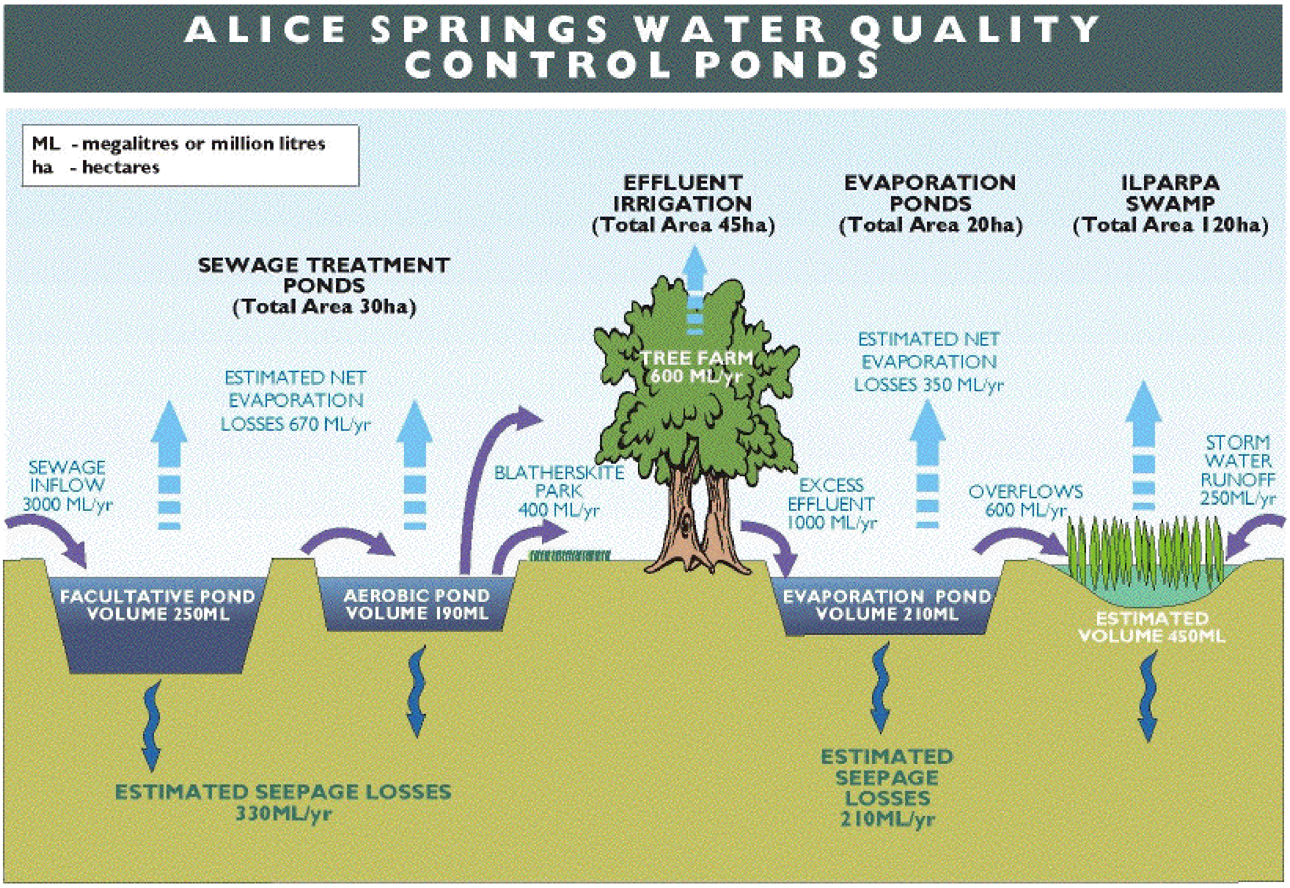
The layout of the WWTP is provided in Appendix A.

Even with the gradual augmentation of the WWTP, overflows to Ilparpa swamp, which have changed the ecology of the swamp and caused associated mosquito breeding problems, have been an ongoing issue since the 1960s. From a simulation model developed (SKM, 2000d) it is currently estimated that of a total of 3,000 ML/a inflows to the WWTP:

- one third is reused for irrigation on the Tree Farm and the Blatherskite Park;
- one third is lost in evaporation; and
- the remaining third enters the environment with half lost in seepage and the other half lost in overflows to Ilparpa swamp (600 ML/a).

This is illustrated in Figure 3.4.

Figure 3-4 Wastewater Treatment System Water Balance



Source - PW

The simulation model (SKM, 2000d) takes into consideration seasonal fluctuations in irrigation needs, evaporation pond levels and overflows to the swamp. From the simulation model, effluent overflows generally occur from April to December with the maximum overflows occurring in June, July and August.

In addition to overflow issues associated with the WWTP reaching hydraulic capacity, the WWTP is also reaching biological treatment capacity. A number of options have been considered by PW to alleviate the effluent overflow problems and the WWTP hydraulic and treatment capacity issues including:

- extension or modification of the existing WWTP;
- increase of effluent reuse; and
- reduction of sewage flows through demand management options.

A decision on which option, or combination of options, to take forward has not been made although it is expected that considerable capital expenditure will be required to alleviate the long standing overflow and treatment capacity issues.

According to the PW Asset Management Plans (PW, 2003b), over the next five years there will not be a need to augment the existing collection network and although reaching capacity, operational efficiencies can be utilised at the WWTP prior to new capital investment being required for the treatment process. However, an investment of up to $10M has been identified in the PW Plan (PW, 2003b), to improve the present level of effluent disposal of the WWTP due to hydraulic overload. This investment caters for existing flows but does not make allowances for population growth. This investment will be put towards effluent reuse within an overall effluent disposal strategy. The $10M will be used to establish a new effluent transmission system to support the development of a horticultural district near the Arid Zone Research Centre. This investment will augment the market for effluent reuse as irrigation water but also assist in establishing a longer term solution to address existing limitations on effluent disposal from the ponds and assist in more sustainable use of the local water resources. This $10M investment will be over and above the funds required for repairs and maintenance of the existing wastewater system.

Concerning the operational aspects of the wastewater system, the energy cost of operating this part of the system is relatively low, due to the prevalence of gravity trunk sewers and the low technology nature of the WWTP. In 2001/02 energy consumption was 210 kWh/ML, which equates to approximately $32/ML (pers comm. N DeCastro). This energy level is at the low end of the 65 utilities surveyed by AWA (AWA, 2002).

The demand management options developed under this Study will provide valuable input to the investment decisions required for the wastewater system. A reduction in wastewater generation through demand management is likely to downsize and/or defer any system augmentation required due to population increase, overflow issues and WWTP hydraulic/treatment constraints. In addition, it will reduce operational costs, reduce energy consumption, greenhouse gas emissions and benefit the natural environment.

3.5 Recommendation

3a – PW should consider updating their borefield augmentation model to ensure the assumptions associated with population growth and water demand are consistent with those developed as part of this Study. Thus allowing fair comparison of demand management, source substitution and reuse options with augmentation requirements associated with the reference case.

3b – PW should take advantage of the significant opportunities a demand management program would have in reducing/deferring capital costs associated with planned water and wastewater system augmentation and the high energy operational costs associated with potable water extraction.

3c – PW should take advantage of the Town Basin supply and consider increasing extraction to that of the sustainable recharge (1,140 ML/a). PW should ensure that where Town Basin supplies are used that water efficient practices are adopted to maximise the effective use of this limited resource. Maximising extraction, ensuring efficient use of the resource and increasing the number of customers connected to the

Town Basin supply will provide significant benefits such as reduced potable demand and reduced infiltration to the WWTP.

3d – PW should consider the proposed investment in the effluent reuse scheme with other available options. The demand management program developed under this study will reduce the volume of effluent passing to the WWTP. Hence any investment or design decisions associated with the reuse project should take into consideration the effects of the demand management program.

4 FACTORS AFFECTING WATER DEMAND IN ALICE SPRINGS

The factors affecting water demand in Alice Springs are discussed below and are based on those key factors identified in Section 2.3 and illustrated in Figure 2.3.

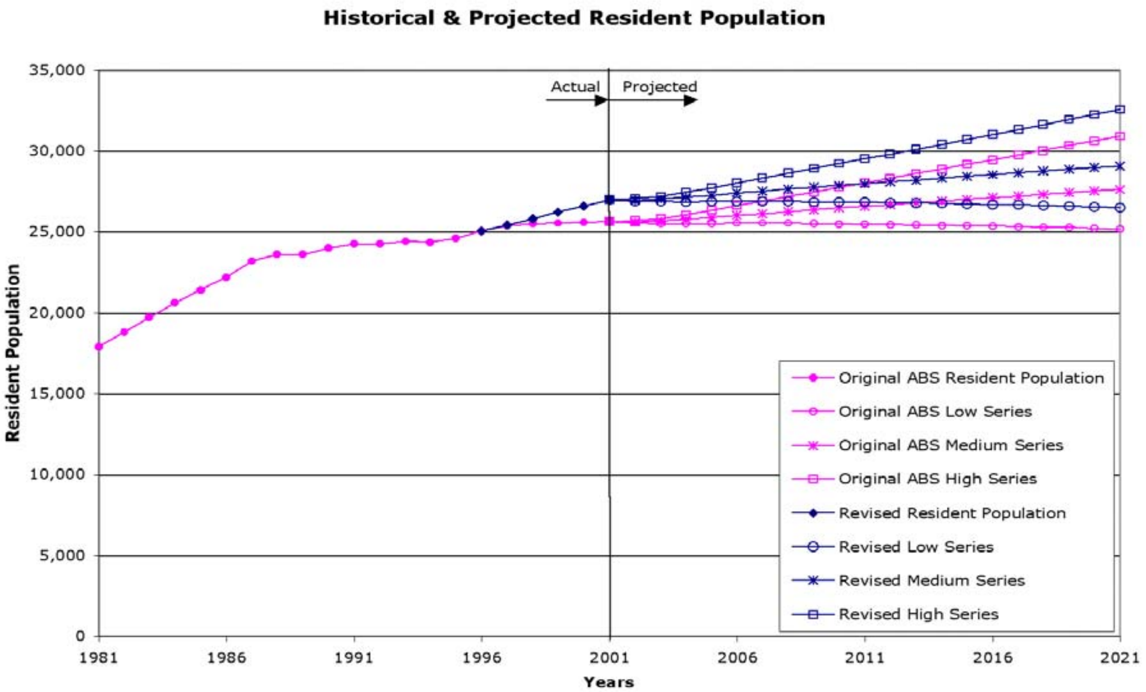
4.1 Demographics and Land Use

4.1.1 Population

Resident Population

Figure 4.1 shows the historical and projected resident population for Alice Springs. This figure includes groups such as the indigenous population and US Pine Gap residents who live within the Alice Springs Statistical Local Areas (SLA) of Charles, Heavitree, Larapinta, Ross and Stuart, but does not include estimates of annual visitors to Alice Springs, which are considered separately.

Figure 4-1 Historical and Projected Resident Population



(Source – Original ABS Series (ABS, 2001e, p25-26). Revised series from ISF modelling incorporating ABS (ABS, 2002e p52).

The historical resident population has risen by over 9,000 over the last 20 years, from 17,900 in 1981 to 26,990 in 2001. There have been significant variations in the average annual growth rates between these years. In the 6 years between 1981 and 1987, the average annual growth rate was 4.4% p.a. and in the 9 years between 1987 and 1996, it was only 0.85% p.a. The growth rate between 1996 and 2001 increased again to 1.5%. As indicated in Figure 4.1, the resident population for the period 1996 to 2001 has been revised for this Study, 'Revised Resident Population', according to the latest published Australian Bureau of Statistics (ABS) data[1].

A number of population projections are identified in Figure 4.1. In 2001, the ABS published three population projections: high, medium and low (ABS, 2001e). The 2001 census has revealed higher than expected 2001 resident population figure of 26,990. In the absence of revised ABS projection figures the same high, medium and low growth rates have been applied to the revised 2001 resident population figure of 26,990. DIPE are currently in discussions with ABS to resolve projection figures in the light of the 2001 census figures (pers comm. P Somerville). Given the population growth over the last 20 years, the 'Revised High Series' shown in Figure 4.1 is being used as the projected population for the Study. This has an average annual growth rate of 0.94% and projects a population of over 32,500 by 2021.

Special Groups within the Resident Population Figures

Two special groups that are contained within the resident population figures are the residents employed by the US Pine Gap and the indigenous residents of Alice Springs.

The number of residents employed at the US Pine Gap facility has not risen substantially over the last 15 years, ranging from over 800 in the mid 1980s to the current 937. Approximately half of these 937 employees are American. A further 300 employees are employed by Boeing Contractors. No details are available on the exact number of US residents associated with the Pine Gap facility and ABS figures appear to be inconsistent. All Pine Gap residents reside within town in a mixture of single residential, duplex and multi residential dwellings and children attend local schools (pers comm. J McManus). Hence, the Pine Gap residents have been considered as part of the main residential sector for analysis purposes.

The exact number of indigenous residents living in the Alice Springs area is difficult to determine. According to 2001 ABS figures the indigenous population residing within the five SLAs of Larapinta, Charles, Stuart, Ross and Heavitree was 3,043 with another 964 residents living in the 18 Town Camps at various locations around town and a further 246 residents living in the Aboriginal community of Amoonguna to the south east of town (ABS, 2001a, p59). This combined population represents over 15% of the total resident population. All these residents are supplied by the Roe Creek town water supplies. Approximately a further 400 indigenous residents (although this figure needs to be confirmed) are supplied with potable town water. These residents live on the Iwupataka Land Trust situated west of town, extending over approximately 18 km from Simpsons Gap.

According to recent discussions with Tangentyere Council (MEC, 5/2/03), the ABS figures quoted for the Town Camps only represent the stable adult population and do not include children. Neither do they include the considerable itinerant population of the Town Camps, which includes approximately another 1,100 people. Trends in population growth for the Town Camps were not available. However, the growth in houses on the Town Camps is known to have grown from approximately 160 in 1991 to 180 in 2001, with five to six houses now planned each year. From discussions with the Amoonguna housing manager (MEC, 5/3/03), there are currently 300 permanent residents (including children) at Amoonguna. This figure has doubled from 150 over the last two years, due to improvements in the housing stock. This figure is likely to stabilise

[1] Estimated resident population (ERP) figures released in February 2002 (ABS, 2002d) indicate that the resident population has risen from 25,040 in 1996 to 25,636 in 2001. However, a more recent publication released in July 2002 (ABS, 2002e) indicates the ERP has actually risen from 25,040 in 1996 to 26,990 in 2001. The ABS has not yet released a revised set of ERP figures between 1996 and 2001 nor any updated projection of population. Hence, to ensure more representative population figures are used in the Study the population figures have been interpolated between the 1996 and the higher, more recently released 2001 ERP figure of 26,990.

now as no new dwellings are currently planned. It is understood that the population at Amoonguna and around town can double due to major sporting or cultural events throughout the year. Unfortunately, due to time constraints, no details were obtained from the Iwupataka community but from discussions with PW staff (pers comm. S Satour), it was identified that there are 18 individual customer meters which service individual family groups with approximately five houses per family group.

It is understood that in the Town Camps new houses typically have four bedrooms. Generally, in Town Camps, there are approximately 2.6 people per bedroom (ultimate aim is to have 1.7), with itinerants increasing house occupancy to as much as 30 in some cases. At Amoonguna, approximately six people live in each house with some houses having as many as twelve permanent residents.

Therefore, from further investigation carried out under this Study, it appears that the indigenous population is considerably more than 15% of the total resident population of Alice Springs and can vary significantly throughout the year. Due to these anomalies, the indigenous population associated with the Town Camps, Amoonguna and Iwupataka has been considered separately from the main residential population during the analysis undertaken as part of this Study.

Tourists

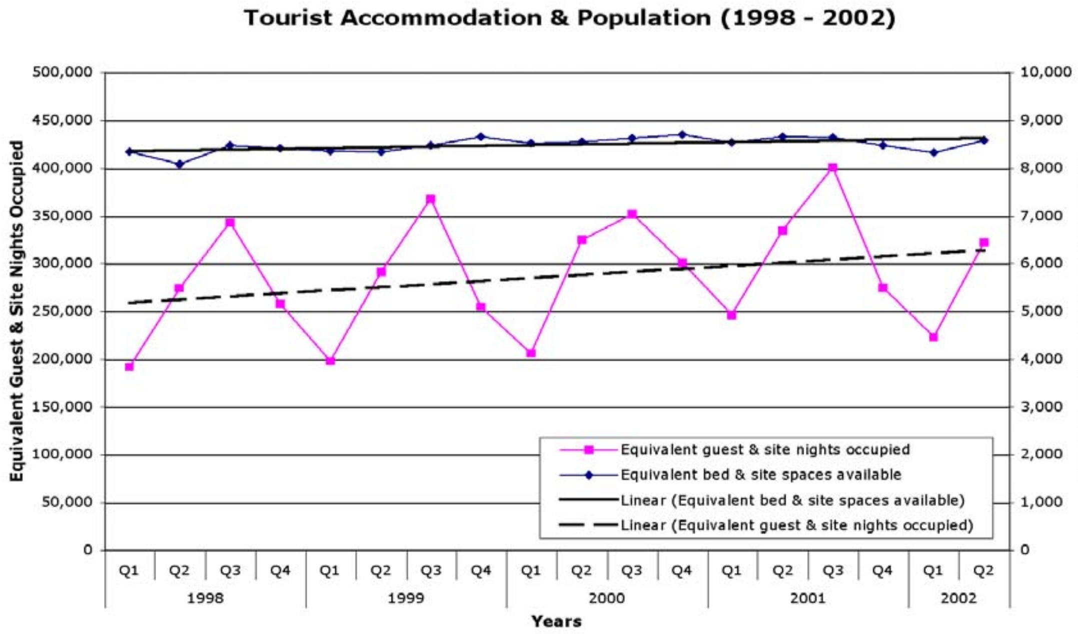
Tourist population figures are not classified as part of the resident population figures and have therefore been considered separately.

The tourist industry in Alice Springs has grown significantly over the last 20 years and is recognised as one of the most important generators of employment and economic activity in the town. As such, development of this sector is being encouraged.

Consistent ABS statistics on tourist figures are only available from January 1998 to June 2002. To determine the growth in the tourist population and seasonal variation over this period ABS statistics for hotels, guesthouses, serviced apartments, visitor hostels and caravan parks have been assessed including the total bed spaces available and the guest nights stayed. For caravan parks the total capacity (i.e. no. of sites available and site nights occupied) have been used.

Figure 4.2 illustrates how the number of bed spaces/site nights available has grown over the past five years and the guest nights/site nights occupied indicates how the number of people being catered for by the tourist accommodation each quarter has gradually grown over the same period. Figure 4.2 shows that the peak tourist quarter is Q3 (July, August, September) during the winter season and the low tourist quarter is Q1 (January, February, March) during the summer season. This high tourist season during the winter months when evaporation is low is likely to be one of the factors exacerbating the overflow from the WWTP to Ilparpa swamp.

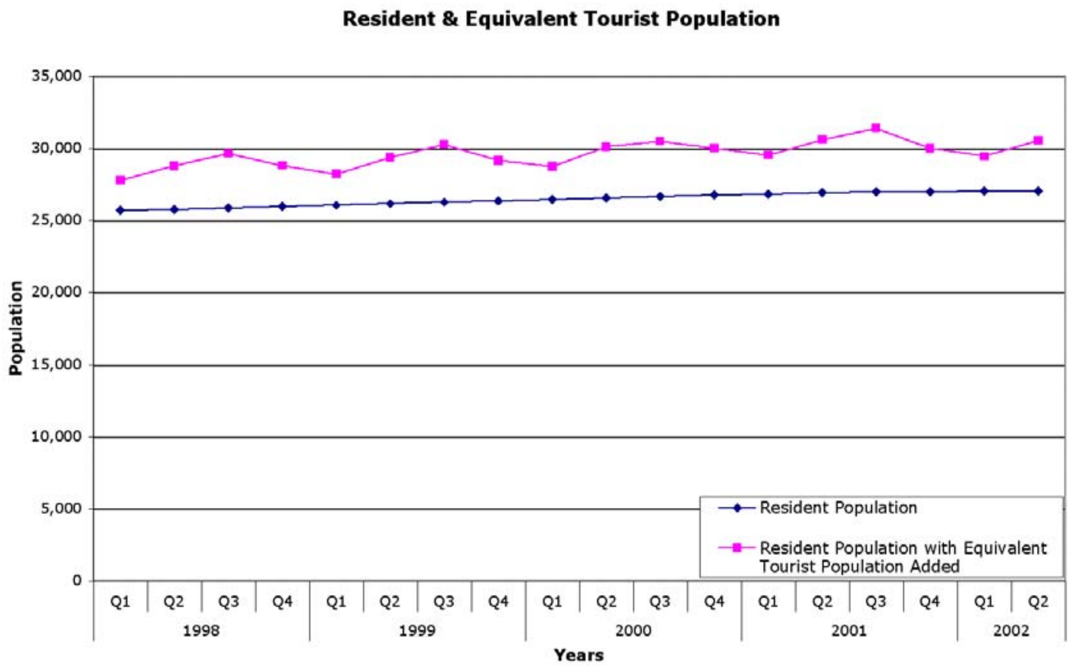
Figure 4-2 Tourist Accommodation and Population Growth (1998 - 2002)



(Source – ABS, 2002b)
Note - Site spaces and site nights multiplied by two to equate to approximately two bed spaces and two persons per site.

Figure 4.3 shows how the equivalent annual tourist population has affected the total Alice Springs population each season between 1998 and 2002. As indicated the proportion of tourists is high ranging from 8% to as much as 14% in Q1/Q3 (summer/winter) respectively. Hence the hotel sector has been considered in the options developed (refer to Section 8.0) in terms of reducing both water demand and wastewater production.

Figure 4-3 Resident & Equivalent Tourist Population Trends (1998 – 2002)



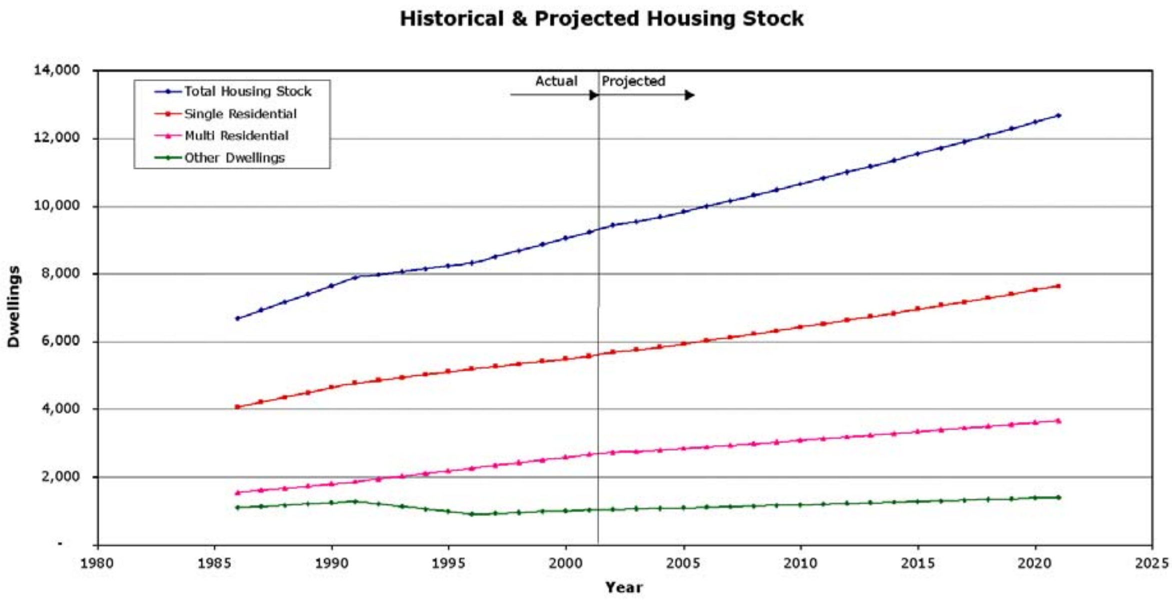
Source – ABS 2001e and 2002b
Note - Guest/site nights occupied equated to population by dividing by days per quarter

4.1.2 Dwellings & Planned Development

Figure 4.4 illustrates the historical and projected housing stock in Alice Springs.

Single residential dwellings, with typical lot sizes of approximately 800 m^2, currently dominate the housing stock. In 2001, there were 5,550 single residential dwellings, which represented 60% of housing stock. Multi residential dwellings (duplexes, terraced/town houses, flats, units and apartments), with typical density ratios of 1,200 m^2 for three units of occupancy (400 m^2 per unit) represented 29% of housing stock in 2001 with 2,656 units of occupancy. Alice Springs has a high proportion of other dwellings such as caravans, cabins, improvised homes and houses attached to shops/offices. In 2001, other dwellings represented 11% of housing stock with 1,011 dwellings (ABS 2002f). Hence, the current single residential/multi residential/other residential housing ratio is 60:29:11.

Figure 4-4 Historical and Projected Housing Stock



Source – ABS, 2002f

Although the lot size of single residential dwellings is currently approximately 800 m^2 and is anticipated to stay around this figure, lot sizes have changed over time. This change is likely to have affected the average water consumption per household due to the significance of outdoor water demand in Alice Springs associated with end uses such as garden watering. In the older subdivisions of Old East Side, which were built in the 1950s, some lot sizes range from 1,300 to 1,600 m^2. However, in some of the newer areas built since the early 1990s such as Clara Court and Ochre Court, single residential dwelling lot sizes are as low as 400 m^2 and 300 m^2 respectively. Areas such as Cromwell Drive near the golf course have been developed in stages since the 1980s and show the gradual change in lot sizes from the older 1,000 m^2 to the more recent 400 m^2 (pers comm. P Sommerville).

It should be noted that between 1991 and 2001 there was a 17% increase in the total number of dwellings from 7,874 to 9,217. This large increase in new dwellings is likely to have reduced water demand per household due to several factors including lot size and associated garden size. However, it should be noted that larger rural lots have been developed in the area south of the Gap. In the 10 years assessed, the number of rural lots has doubled.

There are currently only 100 available undeveloped lots in Alice Springs, although it is anticipated that additional land will become available from early 2004 (pers comm. P Somerville). It is therefore likely that initial development will be met through infill of existing areas (pers comm. P Somerville) although new subdivision areas such as Larapinta to the west of town and Mt Johns Valley to the east and rural residential areas such as Emily Hills to the south east will be developed when land becomes available (LPE 1999 p2).

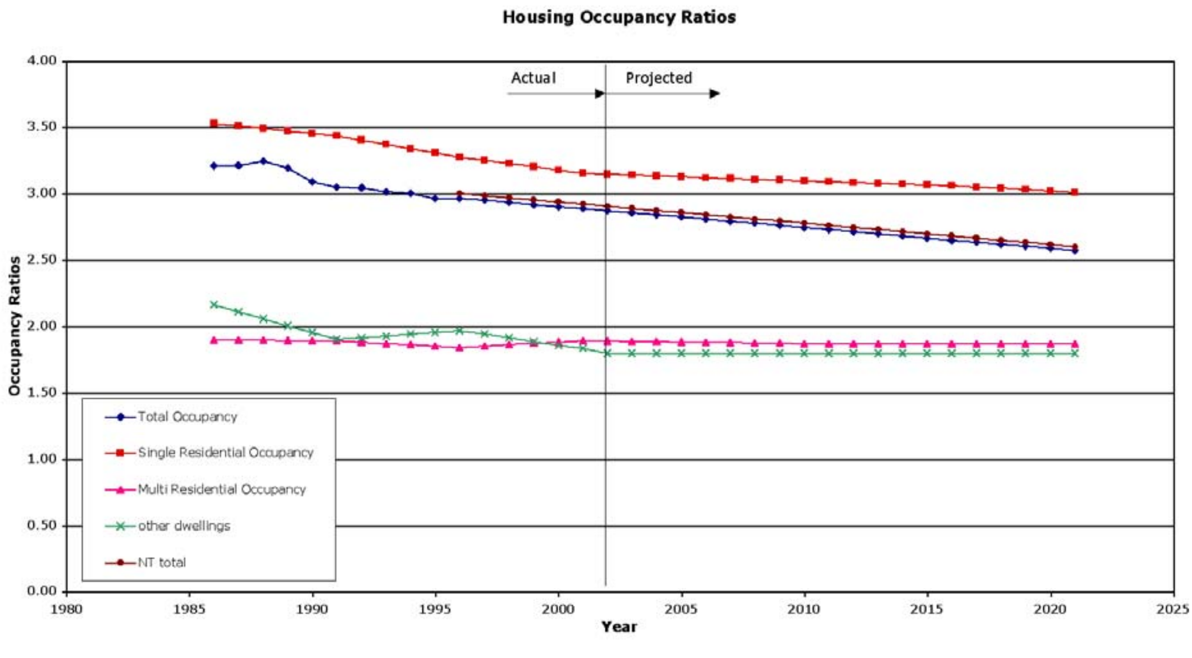
The local land use plan proposes that development within Alice Springs should be sympathetic to the existing areas and indicates a preference that the low-density character of the existing residential areas is maintained (LPE 1999). Existing multi residential developments are currently no higher than three storeys and all future multi residential developments will be capped at two storeys (pers comm. P Somerville). Hence, Alice Springs is likely to maintain its fairly low-density character and predominance of single residential dwellings unlike many of the larger Australian cities.

4.1.3 Occupancy Ratio

The ABS projects that overall NT household size will decrease from 3.0 in 1996 to 2.6 in 2021 as indicated in Figure 4.5 (ABS, 2001g, p31). Since there is good agreement (on average +/- 0.03%) between the NT and Alice Springs historic annual percentage change in occupancy, this projected rate of decline (ranging from 0.55% to 0.61% p.a.) has been used. This rate of decline results in overall occupancy in Alice Springs decreasing from 2.89 in 2001 to 2.57 in 2021. Using the population projection (see Section 4.1.1), this overall occupancy can be used to derive the total number of properties and their growth over the next twenty years (as noted in Section 4.1.2).

Given the overall occupancy and housing stock numbers, what remains to be determined is the mix of housing type and occupancy rate in each. Section 4.1.2 explains that the housing mix has been assumed to remain constant. The occupancy for each housing type was determined as a dependent value. It is determined based on historic patterns and the projected overall occupancy. The projections shown in Figure 4.5 indicate a stable occupancy in multi residential properties with occupancy remaining at between 1.87 and 1.89 through to 2021. Single residential occupancy is seen to decrease from 3.15 in 2001 to 3.01 in 2021 in line with the overall change in occupancy.

Figure 4-5 Housing Occupancy Ratios

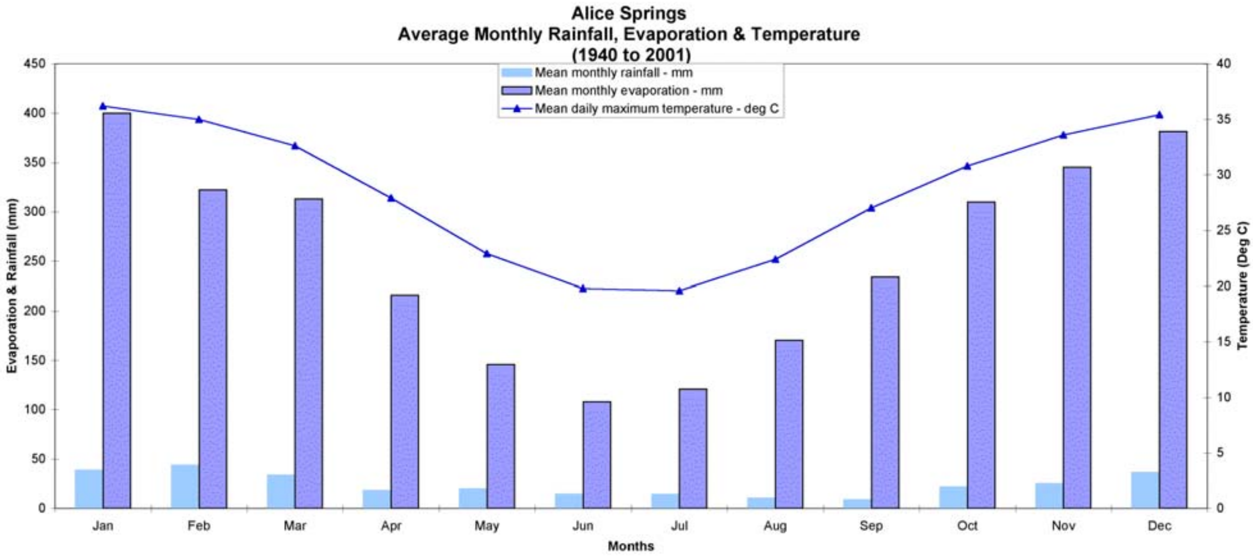


Source – ABS, 2001g

4.2 Climate

Water demand is significantly affected by climatic variables. Alice Springs is classified as an arid climate with low rainfall and high temperature and evaporation. Figure 4.6 shows the average monthly rainfall, temperature (average maximum) and evaporation for available data (1940 to 2001), indicating significant seasonal variation with the hottest months generally being in December and January and coolest months being in June and July.

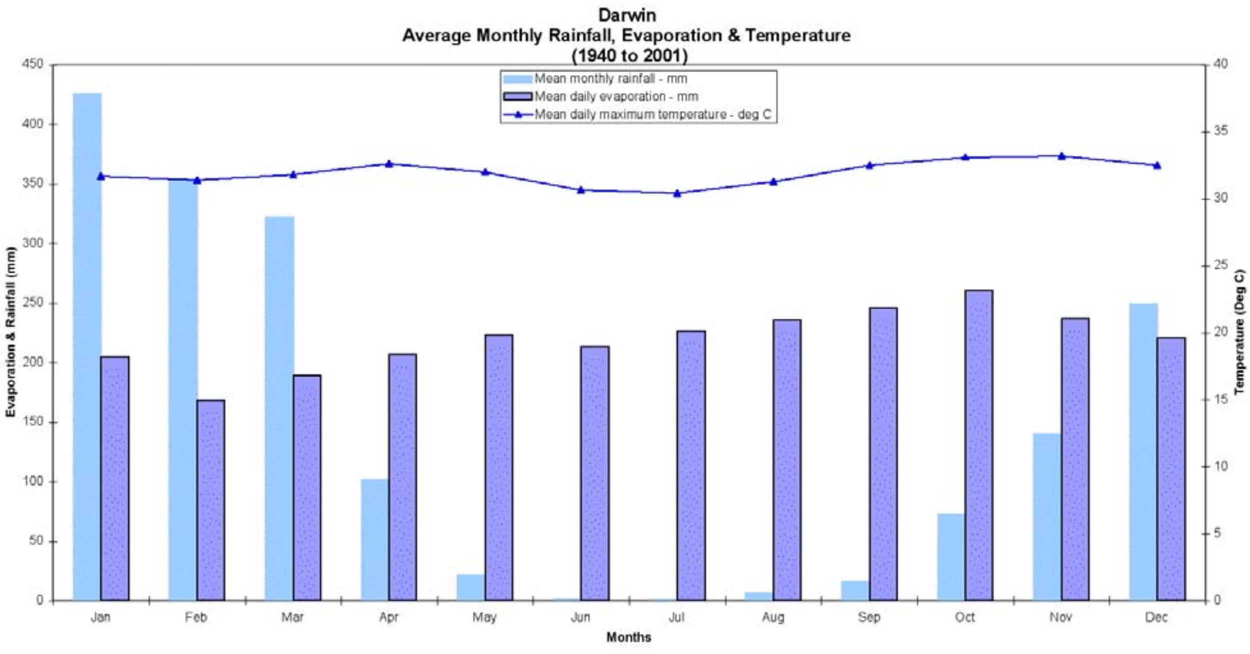
Figure 4-6 Alice Springs Average Monthly Rainfall, Temperature and Evaporation (1940 to 2001)



Source – BOM, 2003

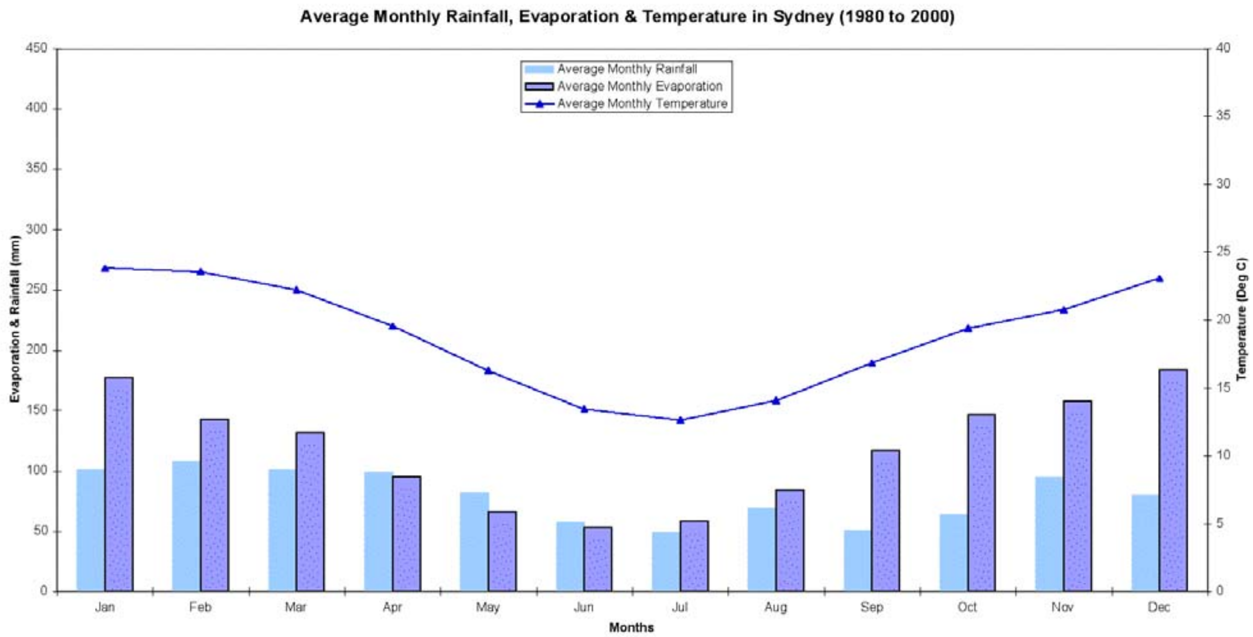
To illustrate the extreme seasonal variation of Alice Springs relative to other regions, similar charts of Darwin and Sydney are provided in Figures 4.7 and 4.8 using the same scales.

Figure 4-7 Darwin Average Monthly Rainfall, Temperature and Evaporation (1940 to 2001)



Source – BOM, 2003

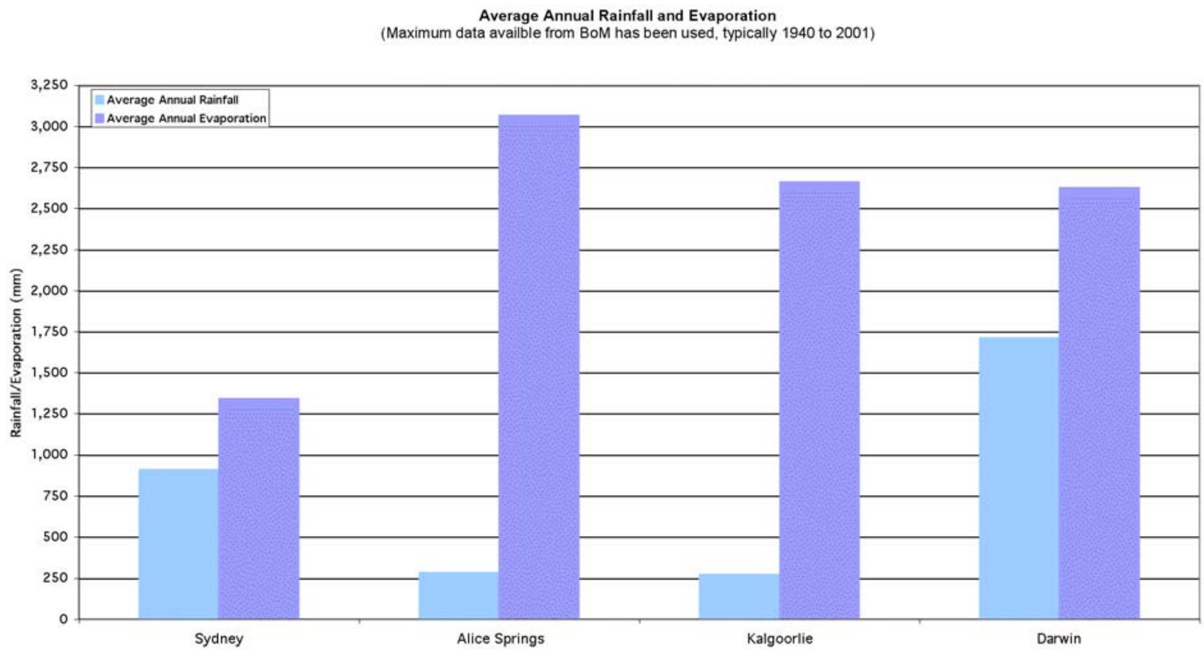
Figure 4-8 Sydney Average Monthly Rainfall, Temperature and Evaporation (1980 to 2000)



Source – BOM, 2003

This comparison can be seen more clearly in Figure 4.9, which shows the difference in total average annual rainfall and evaporation for Alice Springs as well as for Kalgoorlie Boulder (similar arid climate), Sydney and Darwin. As indicated on average each year Alice Springs experiences extremely high evaporation and very little rainfall. In order to make up for the deficit in rainfall, potable water supplies are likely to be used for outdoor end uses such as swimming pools and gardens. For swimming pools alone, nearly 3 m of substitute rainfall per 1 m^2 of surface area would be required annually to replace evaporation losses alone. Low rainfall and high evaporation would significantly affect soil moisture, thus influencing garden watering.

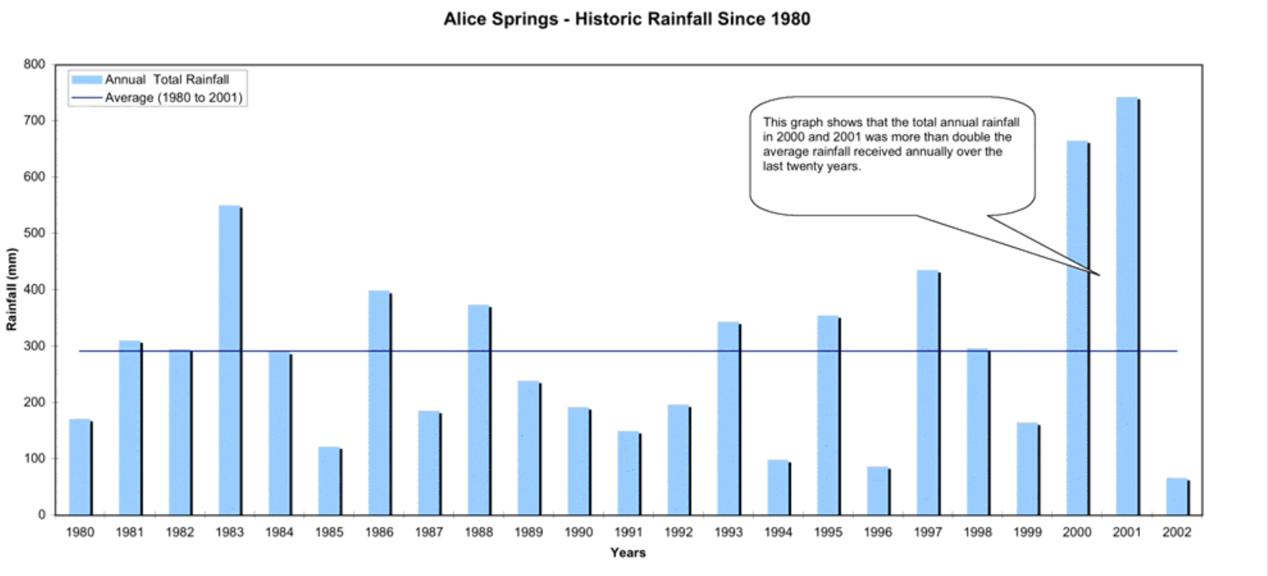
Figure 4-9 Average Annual Rainfall and Evaporation for Alice Springs & Other Urban Centres



Source – BOM, 2003

Figure 4.10 shows the annual rainfall for Alice Springs since 1980. Both 2000 and 2001 appear to have had significantly higher rainfall than any other year in the 20 year period considered and thus are likely to affect the outdoor water demand and ultimately the overall water demand of Alice Springs in these two years.

Figure 4-10 Annual Rainfall (1980 to 2002)



Source – BOM, 2003

4.3 Water Using Equipment & Usage Patterns

Equipment

As far as water use indoors is concerned, Alice Springs is unlikely to be vastly different from other major towns and cities around Australia. For modelling purposes, indoor end uses are defined as those end uses that ultimately discharge to sewer. As indicated in Figure 2.1 & 2.2, typical household end uses are:

- toilets;
- showers;
- baths;
- basins;
- kitchen taps;
- dishwashers; and
- washing machines and laundry taps.

These end uses and the stock of appliances (e.g. proportion of efficient 6/3 litre dual flush toilets compared to 12 litre single flush toilets) have been considered in the end use model developed for Alice Springs. Specific details of the stock and usage patterns input to the end use model are provided in Section 7.0. Where necessary the details in the end use model have been modified specifically for Alice Springs (e.g. number of single flush toilets remaining in use and the likelihood of increased leaks associated with hard water problems).

Unlike indoor end uses, outdoor water demand is often predominantly climate dependent. Due to the arid climate in Alice Springs, it is necessary to consider this component of demand specifically for this location. Looking to Australian wide data is inappropriate because most of the population in Australia does not live in arid zones. Typical outdoor end uses in Alice Springs include:

- evaporative air conditioners[2];
- pools and spas;
- irrigation systems and garden watering with outdoor taps; and
- car washing and miscellaneous outdoor use with outdoor taps.

Although these end uses apply in other areas, the number of appliances and/or their usage patterns is likely to be vastly different in Alice Springs compared with other large urban centres in Australia. For example, evaporative air conditioners are used in other areas around Australia but they are particularly common in Alice Springs[3] due to their effectiveness in hot dry climates. Other areas such as coastal Queensland are more likely to use refrigerative air conditioners, which are better suited to wetter, more humid climates. Evaporative air conditioners use approximately 24 L/hr of water for evaporation on a hot day and 6 L/hr of water for bleed off[4] (e-mail 21/02/03, G Marshall)[5]. Refrigerative air conditioners do not use any water but are more energy intensive.

Pools are found in other areas of Australia. However, in areas such as coastal New South Wales topping up of a pool due to evaporation losses would be considerably less than in Alice Springs (3 m^3 required per 1 m^2 of fully exposed surface area of an Alice Springs pool).

As for pools, high evaporation and low rainfall is likely to significantly affect the soil moisture of gardens which will need more watering than other more temperate climates. In addition, Alice Springs appears to have a large proportion of drip and pop up sprinkler irrigation systems[6]. These systems can be very water efficient, however people often use them incorrectly by watering too often or for too long because they forget to turn the system off or adjust them as seasons change.

Hence, outdoor end uses such as those identified above have been considered in detail for Alice Springs because households in the area are more likely to use more water on these specific outdoor end uses than in other areas of Australia. Details of the indoor and outdoor end uses modelled together with their data sources are provided in Section 7.0.

Regulations

In some cases, regulations can affect end uses in specific areas. For example, mandatory dual flush toilets were regulated in the NT in 1993 (e-mail 6/9/02, J Childs). This regulation could have had a significant effect if imposed in the 1980s. However, due to the large number of buildings which have been built since 1993 and the fact that it was difficult to buy anything other than a dual flush toilet by the early 1990s this regulation appears to have had only a limited effect with respect to increasing the number of dual flush toilets in Alice Springs. Again, this is detailed in Section 7.0.

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[2] Although evaporative air conditioners are used indoors they are classified as outdoor for analysis purposes because they do not in general discharge to sewer. It is illegal to discharge an evaporative air conditioner to sewer or stormwater in Alice Springs.
[3] According to a survey and specialist interviews, approximately 80 to 90% of households have evaporative air conditioners.
[4] Bleed off is required for removal of salt build up. Investigations under this Study have found bleed off rates as high as 30 L/hr.
[5] These evaporation and bleed off rates are average readings, which were found during an experiment under taken by the Arid Lands Environment Centre in 2003.
[6] The Alice Springs Show survey results identified approximately 50% of single residential houses have automatic systems (e.g. drip or pop up).

If for example the use of water efficient showerheads and tap aerators was made mandatory in Alice Springs[7] and the principles of xeriscape[8] were used in garden designs, these forms of regulation could produce a significant effect on indoor and outdoor water demand in new developments. This is due to the large number of new buildings expected over the next 20 years and the fact that appliances such as AAA-rated showerheads/taps are not currently broadly used. The use of regulations and building controls on new and modified buildings can provide a very low cost water saving option. Hence, regulations have been considered as an option in Section 8.0.

On 1 January 2003, the NT adopted new energy efficiency regulations produced by the Australian Building Codes Board for new domestic dwellings. These set minimum standards for insulation, shading, window areas, sealing of doors/windows, natural ventilation and other minor features. The regulations anticipate that houses built according to the regulations will create houses that are the equivalent to three and a half stars under the Nationwide House Energy Rating Software (NatHERS). If regulations such as these could be modified to incorporate water efficiency measures such as those identified above and guidance on the positioning and design of evaporative air conditioning systems[9] considerable benefits could be obtained with respect to reducing water and energy demand and greenhouse gas emissions.

Pricing

As required by the National Competition Policy (NCP) and Council of Australian Government (COAG) water reforms, PW have a two-part tariff for water service charges. PW has used volume based charging for water in Alice Springs for many years and charges for wastewater on a per pedestal (per toilet) basis. The charge rates for both residential and commercial customers for both water and wastewater are provided in Appendix B. Water service charges in Alice Springs are currently a fixed daily charge of $0.2825/day ($103/a) plus $0.6765/kL for residential water with an additional charge of $314.20 for wastewater. These charges are relatively low compared to other cities around Australia (e.g. volumetric charge for water in Sydney is $1/kL) due to the NT Government having made a decision to subsidise charges where necessary to allow customers across the NT to pay similar charges (uniform tariff policy). With such a low charge for water, there is little financial incentive to reduce water demand or wastewater production. Hence, there is scope to consider raising the price of water including the use of an inclining block tariff for higher water usage[10] (refer to Section 8.0) as a demand management instrument. Modification of water service charges would require careful planning to increase public acceptance of the higher charges (e.g. combine increased charges with a demand management program and incentives to reduce water demand).

Non residential customers pay a fixed charge and volume based charge for water, related to the size of the meter (25 to >200 mm) and a fixed charge and per pedestal charge (over a minimum of two) for wastewater. As for the residential sector, charges are relatively low and do not provide an incentive for this sector to reduce water demand. Concerning the pedestal charge, this system is common but does not reflect the potential volume being produced by a non residential property. For example a commercial/industrial building such as a car washing facility may only have a limited number of toilets yet could produce a large volume of wastewater. Due to these anomalies and the requirement for PW to comply with NCP and COAG reforms concerning trade waste management, PW intends to introduce trade waste charges for commercial/industrial and institutional customers by July 2003. These charges will be primarily volume based considering the type of WWTP in Alice Springs. PW is currently in discussions with various commercial/industrial and

[7] This would be more effective if done nationally (through minimum performance standards) which would have the added advantage of protecting utility investment in demand management options. Local steps should be used to illustrate the effectiveness in broader advocacy and used to secure savings in the short term as they are likely to be easier to implement.
[8] Xeriscape water saving gardens use seven principles – planning and design, soil analysis, appropriate plant selection, practical turf areas, efficient irrigation, use of mulches and appropriate maintenance.
[9] During an ASUWMSRG Meeting on 20 March 2003 it was identified that the water efficiency of evaporative air conditioners can be improved and maintenance is likely to be more easily carried out if units are located in a shaded position and not on the roof.
[10] Inclining block tariffs are where water is charged at a higher rate the more water a customer uses. For example those customers using above a specific volume of water that is deemed to be the average for that area will be charged a higher $/kL rate for the water consumed above that threshold. Thus providing the customer with an incentive to reduce water usage above the threshold volume.

institutional customers to determine the volume of wastewater they discharge and thus what they will be required to pay after July 2003. Depending on the pricing scale, the introduction of the trade waste charging system may reduce water demand and wastewater production to some extent. It would be beneficial for PW to include a demand management option for such customers to assist them to reduce their wastewater discharge and thus prevent them incurring large costs when the charges are introduced. These customers have been considered in the demand management options developed in Section 8.0.

Restrictions

Restrictions on water use have not been implemented in Alice Springs. Restrictions are either voluntary or compulsory with the details of restrictions varying between different water service providers. Compulsory restrictions are normally implemented when the water level in a dam drops to a particular level. As the dam level drops, the severity of restrictions are increased, from for example watering with an irrigation system between certain times of the day (not within the peak hours) to watering only with a bucket within those times. Considering the seasonal climatic variations in Alice Springs and the effect this has on the pressure and storage within the system, it is likely that the use of restrictions during the peak summer months would be beneficial and should be considered as an option to reduce peak day demand. Water restrictions have been taken into consideration in the demand management options developed in Section 8.0.

Knowledge and Awareness

PW, DIPE and other interested parties have implemented a number of demand management initiatives since the early 1990s, which have been aimed at increasing people's awareness of the demand for water and the need to increase efficiency. These have included, for example:

- television advertisements and newspaper advertisements/articles;
- the ABC garden competition including best arid garden and best water harvesting garden;
- development of a number of gardening booklets;
- formation of the Alice Springs Water Action Group (formerly Water Committee) that included management of; pamphlets for hotels/Pine Gap/new department of housing residents, organisation of water efficiency competitions and workshops;
- 'Cut the Lawn' project run for various schools that involved reduction of lawn area and change of plant species;
- audits of schools, the hospital and public housing properties and subsequent workshops on water saving recommendations for participants;
- workshops for plumbers on water efficiency; and
- the PW show case garden.

The details of these and other initiatives are provided in Appendix B.

PW and DIPE have been extremely active in implementing demand management initiatives but have tended to concentrate predominantly on education and awareness and have carried out little evaluation of whether these initiatives have been effective. The relative success of these initiatives, discussed in Section 5.4, is likely to have been limited due to various factors such as the fact that education alone is rarely found to be effective. Demand management initiatives are generally more likely to succeed when a measure (e.g. increased water efficiency through the fitting of a AAA-rated showerhead) and an instrument (e.g. economic incentive where PW pay for the showerhead and labour and communicative where PW provide a brochure on water efficient tips for the garden) are combined.

Considering the transient nature of residents in Alice Springs and the fact that a large proportion of houses are rented[11] (residents are unlikely to know how much water they use as they are unlikely to pay their own bill), demand management relying on general education will have a limited effect. In addition, from a survey and a number of interviews carried out under this Study, along with previous local reports, it has been found that people in Alice Springs do consider water efficiency important. However, many new people to the area do not know how to use certain appliances such as evaporative air conditioners and irrigation systems, are unaware of how much water they use and are unable to find simple, cheap and concise forms of advice.

Hence, to increase the success of a demand management program in Alice Springs, an ongoing communication and awareness campaign will need to be combined with initiatives such as: trialling[12] and fitting of water efficient fixtures, hands on advice in the home on how to use and maintain equipment, simple leaflets providing advice, regular maintenance checks (due to hard water issues) and financial incentives.

This combination of measures and instruments has been used as the foundation for the demand management options identified in Section 8.0.

4.4 System Management & Source Substitution

System management and provision of source substitution by water service providers can have a significant effect on water demand. Best practice system management can achieve extremely low water losses, which can reduce capital and operating expenditure requirements and ensure that the water authority sends the correct message to the customer (i.e. that water is a valuable resource that should not be wasted).

System management can encompass activities such as:

- leakage detection and control;
- pressure reduction programs;
- pricing initiatives;
- maintenance activities; and/or
- customer metering, meter replacement and bulk water calibration scheduling.

Source substitution can include activities such as:

- encouragement in the use of alternative water supplies (e.g. subsidies for residents using rainwater tanks and on site greywater reuse);
- provision of a dual reticulation system (e.g. non potable supply for end uses that do not require high grade potable water such as outdoor water use or toilet flushing);
- sewer mining where wastewater is tapped from the sewer mains, treated and used for end uses such as irrigation that do not require high grade potable water; and/or

[11] 29% of single households and 77% of multi residential households in Alice Springs are rented (ABS, 2002f).
[12] Due to the hard water issues associated with the Alice Springs potable water supply it will be necessary to investigate/trial specific appliances in Alice Springs to ensure the appliances used within a retrofit program are appropriate. Specific appliances can be more appropriate in hard water areas with respect to robust design and/or ease of maintenance.

- treated wastewater effluent reuse for irrigation, which does not require high grade potable water.

A number of system management and source substitution initiatives have been undertaken in Alice Springs by PW. Details of these are provided in Appendix B together with the other more educational/ communicative type initiatives mentioned in Section 4.3. Although many of the key initiatives have been partially implemented in Alice Springs, they have not been implemented to their full extent (similar to the educational/communicative initiatives) and therefore reduction in potable demand has not been as effective as may have been expected. Further improvements in system management and taking advantage of the opportunities that remain in source substitution and reuse will provide additional savings in terms of potable water demand and effluent production and provide the benefits associated with reduced capital and operating costs.

4.4.1 System Management

With system management, it is essential that implementation plans are devised which allow for issues such as:

- clear lines of responsibility;
- systematic checking of equipment (e.g. water and sewage flow meters, their accuracy and calibration);
- accurate recording of data/modifications (e.g. trustworthy flow records and records of equipment replacement such as customer meters and hydrants); and
- evaluation of system modifications and records/data collected to assess effectiveness.

Although PW have actively undertaken system management activities, it has been difficult to obtain details for this Study. It has been found that many of these system management activities have not always been undertaken systematically, lines of responsibility have at times been unclear, records have not been kept up to date and little evaluation has been undertaken. PW has recently stepped up a number of initiatives such as customer meter replacement and leakage detection due to the overall objective of the ASUWMS to increase efficiency and due to an unexpected increase in losses over the period 2000/01. It is essential that these initiatives and others (e.g. accurate metering of wastewater entering the WWTP and overflowing to Ilparpa swamp) are put within an implementation plan, are recorded and evaluated to assess their effectiveness in reducing system water losses and that these initiatives are systematically repeated to minimise water losses and achieve best practice management.

4.4.2 Source Substitution

With respect to source substitution, again PW have a number of initiatives, which have been implemented and are under consideration. The most significant is the Town Basin system, which has the potential to supply approximately 10% of total current potable demand, by using the water for outdoor irrigation end uses (as indicated in Section 3.3). However, demand for this source is not currently being fully utilised and the customers (e.g. schools and Alice Springs Town Council) efficiency of irrigation application could be considerably improved. By improving the efficiency of demand the available Town Basin supply could be utilised by additional customers such as other schools, hotels and multi residential public housing properties, which are located in specific areas thus minimising the costs of extending the reticulation system. In addition, equipment such as the hospital borehole and cooling water discharge, which have been inoperable for some time, could further increase the volume of water available to the Town Basin system. By maximising the available sources of water for this system, increasing efficiency of demand and exploring additional customers, the Town Basin resource could significantly reduce demand on the potable supply system whilst providing environmental benefits associated with reducing the water level of the Town Basin (refer to Section 3.3).

Other opportunities such as greywater reuse have been investigated to some extent by PW/DIPE, However, as found by many water service providers utilisation of such resources are difficult to implement due to concerns such as health issues. Greywater reuse and other source substitution such as rainwater tanks and collection of evaporative air conditioner bleed off offers considerable opportunities for reducing both potable water demand and discharge to the wastewater system and thus should be further explored. The greatest opportunities are often available in new residential development areas and commercial buildings, which can apply water recycling or water quality cascade within the property or estate scale at little if any extra cost. Examples of source substitution/water quality cascade are: water from the shower being treated to the appropriate level and used for toilet flushing, rainwater being captured and combined with evaporative air conditioner bleed off and/or water discharged from the washing machine and used for outdoor irrigation. The greywater and source substitution options and the use of effluent reuse should be expanded further due to the potential benefits available.

4.5 Recommendations

4a – PW should obtain more accurate data on the indigenous population and Pine Gap residents and discuss the Alice Springs projection figures with ABS to assist in the accuracy of the End Use Model.

4b – PW/DIPE should take steps to advocate appliance water efficiency nationally and to ensure local building codes incorporate the synergies of water and energy efficiency as far as possible in both new and modified buildings including the location of evaporative air conditioning units.

4c – PW should consider restructuring their current pricing structure for water and reconsidering its decision to keep a uniform tariff structure across the NT.

4d – PW should consider restructuring their current pricing structure for sewage by moving away from pedestal charging and towards more volume based charging systems for wastewater effluent related to water demand (e.g. using winter demand to indicate discharge to sewer) similar to those properties being affected by Trade Waste Agreements.

4e – PW/DIPE should ensure that all demand management initiatives (e.g. Cut the Lawn) are monitored and evaluated in terms of achieving the objective of reducing water demand.

4f – PW should draft a system management implementation plan/schedule to ensure that unaccounted for water is minimised and best practice system management is achieved and maintained.

4g – PW/DIPE should ensure maximising the use of source substitution, greywater, effluent reuse and water quality cascade within new residential and commercial buildings due to both the potential benefits associated with reducing water demand and wastewater production.

Other recommendations have been incorporated into the options in Section 8.0.

5 THE DEMAND FOR WATER

5.1 Introduction

In order to understand the demand for water in the future and how we can obtain savings through demand management initiatives it is essential to understand how water demand has changed historically and how the key factors identified in Section 4.0 have influenced these changes.

For this Study, historical water demand has been obtained from two key sources:

- PW reservoir corrected bulk water supply for the last 20 years, which is the volume of potable water extracted each day from the Roe Creek Borefield and used by the system (refer to Figures 2.1 and 2.2); and

- PW customer metered demand for the last 10 years, which is the quantity of water used by individual customers.

The data has been analysed in calendar years rather than financial years. Hence, reference to quarter 1 (Q1) in 1992 refers to January, February and March within the first quarter of 1992 and Q3 in 1992 refers to July, August, September in the third quarter of 1992. As identified in Section 4.3, Q1 represents the summer months and Q3 the winter months for Alice Springs.

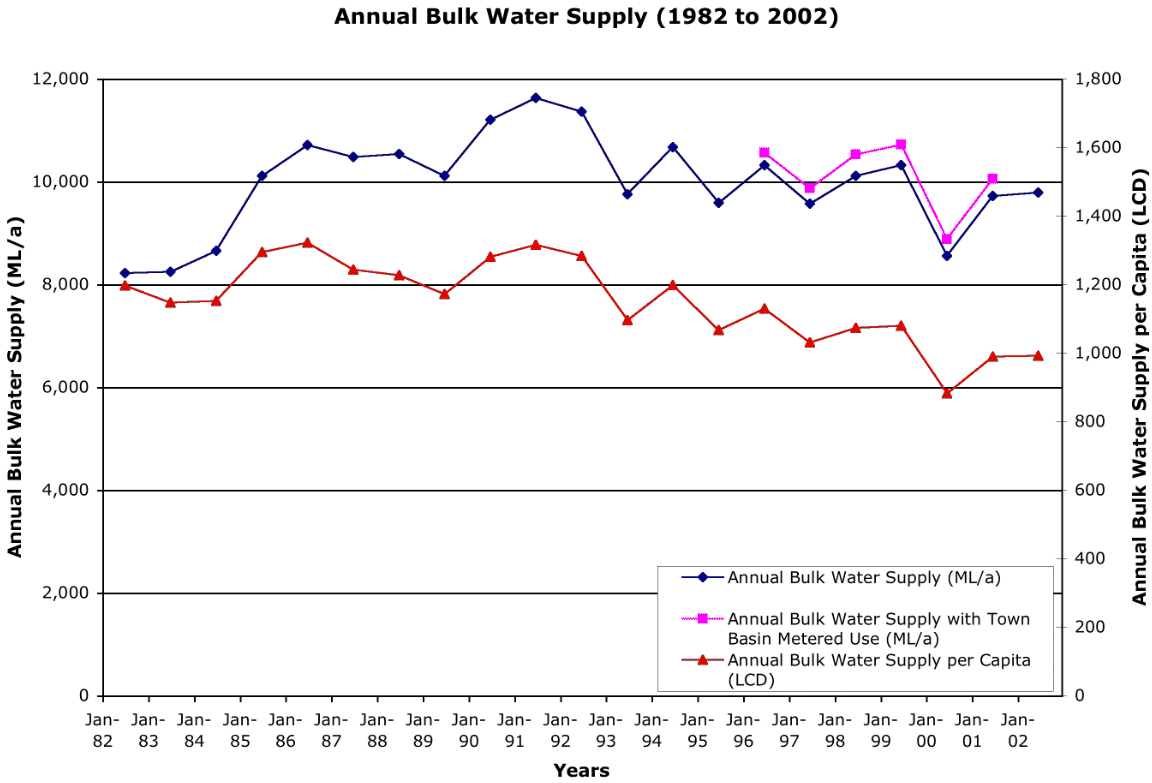
5.2 Bulk Water Supply

5.2.1 Annual Bulk Water Supply

Average annual bulk water supply from the Roe Creek Borefield has been 9,980 ML/a over the last 21 years as indicated in Figure 5.1. Annual bulk water supply from Roe Creek reached a peak of 11,623 ML/a in 1991 and a recent low of 8,549 ML/a in 2000, which is similar to early 1980 supply figures. This average has been reduced slightly since 1996 by source substitution with non potable water from the Town Basin supply network. According to non potable customer meter readings (mainly associated with schools and the Alice Springs Town Council) the Town Basin has supplied 335 ML/a on average over the last 6 years, which is shown on Figure 5.1. However, as indicated in Section 3.3, this figure does not include a number of private bores supplying the golf course, St Philips School and the Casino. According to recent studies, (SKM, 2001) the total non potable supply was closer to 936 and 642 ML/a for 1999 and 2000 respectively. Therefore total average demand for both bulk water supply and the Town Basin supply over the 20 year period is likely to be somewhere between 10,000 and 10,500 ML/a.

Figure 5.1 also shows the bulk water supply per capita over the same 20 year period. The average over this period has been 1,150 litres per capita per day (LCD), with highs of 1,320 and 1,315 LCD in 1986 and 1991 respectively and a low of 881 LCD in 2000. There appears to be a consistent downward trend of annual per capita consumption since 1991 enabling bulk water supply to fall slightly despite the growing population identified in Figure 4.1.

Figure 5-1 Annual Bulk Water Supply



5.2.2 Daily Bulk Water Supply

Augmentation requirements of bores, pumps, pipelines and storage facilities within water supply systems are generally dictated by peak day demand. Management of customer peak day demand through demand management or source substitution can often defer augmentation requirements, providing considerable economic benefits to the service provider.

The daily bulk water supply, which shows how peak day demand has changed between 1982 and 2002, is shown in Figure 5.2. Figure 5.3 shows how this demand has changed when the growth in population is taken into account by considering the daily bulk water supply per capita.

Figure 5-2 Daily Bulk Water Supply

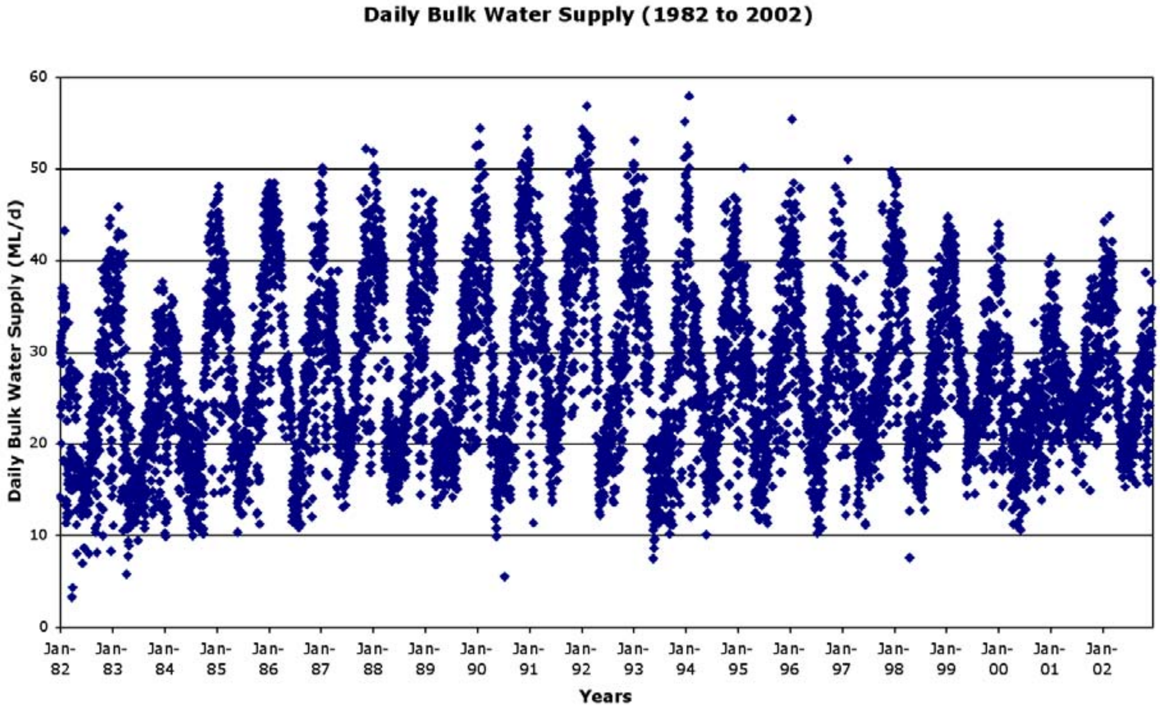
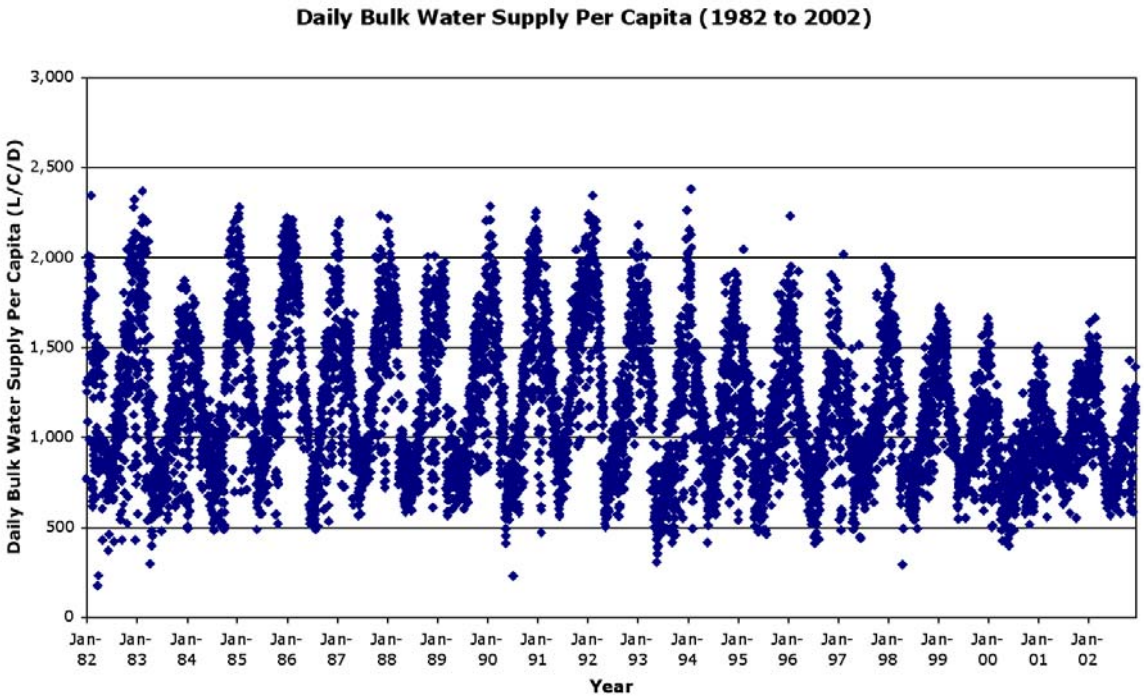


Figure 5-3 Daily Bulk Water Supply per Capita



As shown in Figure 5.2 the maximum annual peak day demand over the last 20 year period occurred in February 1994 with a value of 58 ML/d and the lowest annual peak day demand occurred in January 2001 with a value of 40 ML/d. The average annual peak day demand over the last 5 years has been 45 ML/d with individual peaks for each year generally occurring in January or February. The peak day demand figures per capita shown in Figure 5.3 indicate an even more marked downward trend in peak day demand from a peak of 2,375 LCD in February 1994 to 1,502 LCD in January 2001 and an average of 1,694 LCD over the last 5 years.

An average of the peak day bulk water production figures has been considered to ensure outliers do not influence the assessment of bulk water supply. Figure 5.4 shows the average annual bulk water supply against the top 5% of bulk water supply readings per annum and the lowest 5% of bulk water supply readings per annum.

Figure 5-4 Average Annual Daily Bulk Water Supply

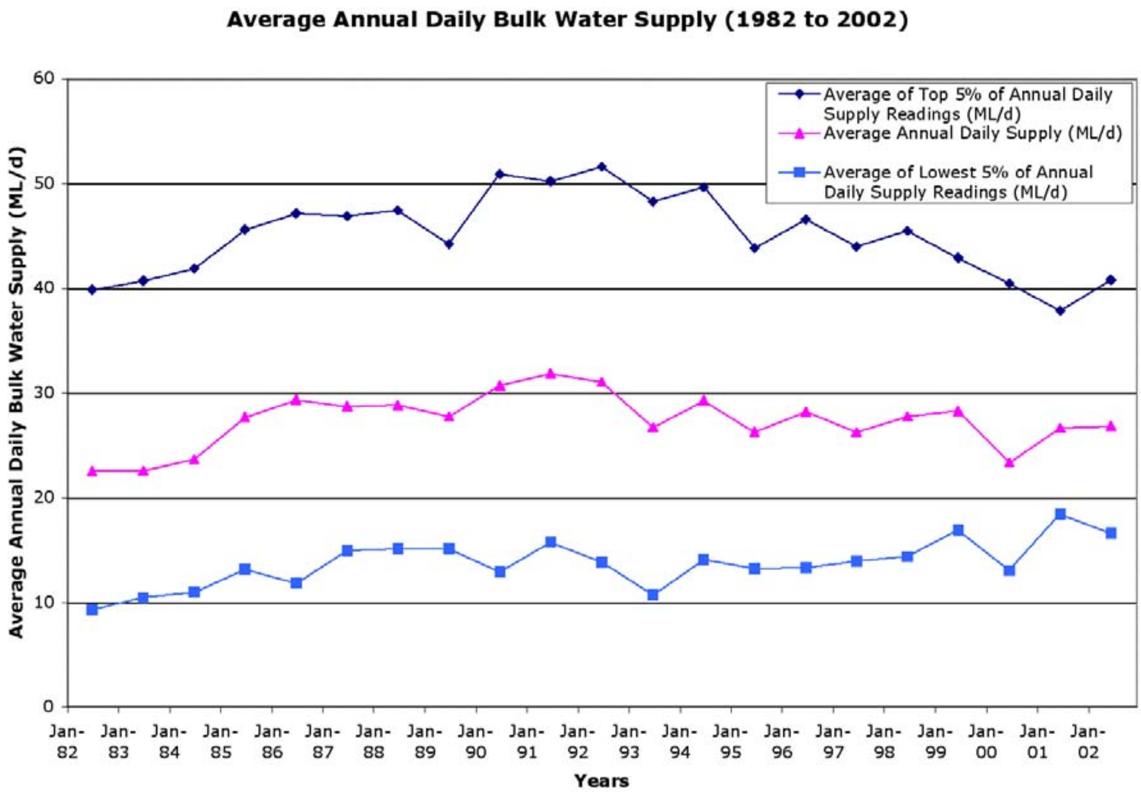
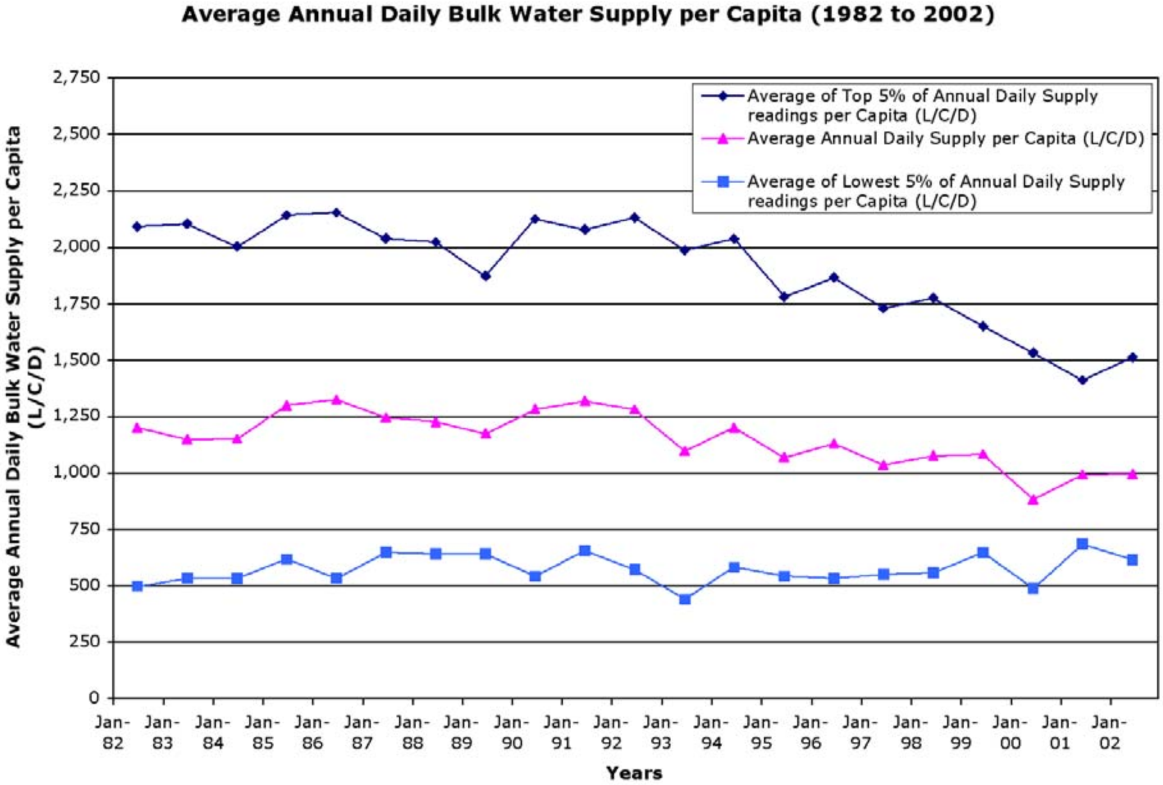


Figure 5.4 illustrates, as in Figure 5.1, that average bulk water supply has been declining since the peak of 1991. It shows that the average of the top 5% of bulk water supply readings has declined significantly from a high of 52 ML/d in 1992 to a low of 38 ML/d in 2001. The average of the lowest 5% of bulk water supply readings has increased from a low of 11 ML/d in 1993 (with the exception of the early 1980 figures which were similar) to a high of 18 ML/d in 2001. The recent trends in average high and low bulk water supply readings converge towards the downward trending average bulk water supply line. This indicates that the existing system is likely to be able to cater for the increasing population demand if these trends continue, although specific system constraints may still require augmentation. Figure 5.5 illustrates the same trends based on average annual bulk water supply per capita.

Figure 5-5 Average Annual Bulk Water Supply per Capita



5.2.3 Seasonal Bulk Water Supply

By looking at monthly and quarterly bulk water supply, seasonal trends can be observed illustrating issues such as climatic variation and tourist industry influences. Figures 5.6 and 5.7 show the average daily bulk water supply per quarter and per capita per quarter respectively.

Figure 5.6 shows that the peak bulk water supply per quarter for the last 20 years occurred in Q1 1992 and the lowest peak bulk water supply per quarter occurred in Q4 of 2002 (with the exception of the early 1980s) with values of 44 ML/d and 28 ML/d respectively. The quarters associated with 2000 and 2001, are markedly different from the peak seasonal variations experienced in previous years. This is most likely to be related to the fact that these two years experienced higher than average annual rainfall compared with previous years (refer to Figure 4.10).

Figure 5.7 shows the average daily bulk water supply per capita per quarter, which assists in removing specific trends associated with an increase in population. This figure illustrates that there has been a gradual decrease in the peak quarters since 1992 but with lower than expected figures in 1994 and 1996. Again, the very low peak quarters can be seen in 2000 and 2001. The majority of peak per capita quarters over the whole 20 year period occur in Q1 with only four peak quarters being experienced in the Q4 of the previous year, although on several occasions the Q1 and Q4 of the previous year are relatively close. This illustrates that the peak season can merge into the December period of Q4.

Figure 5-6 Average Daily Bulk Water Supply per Quarter

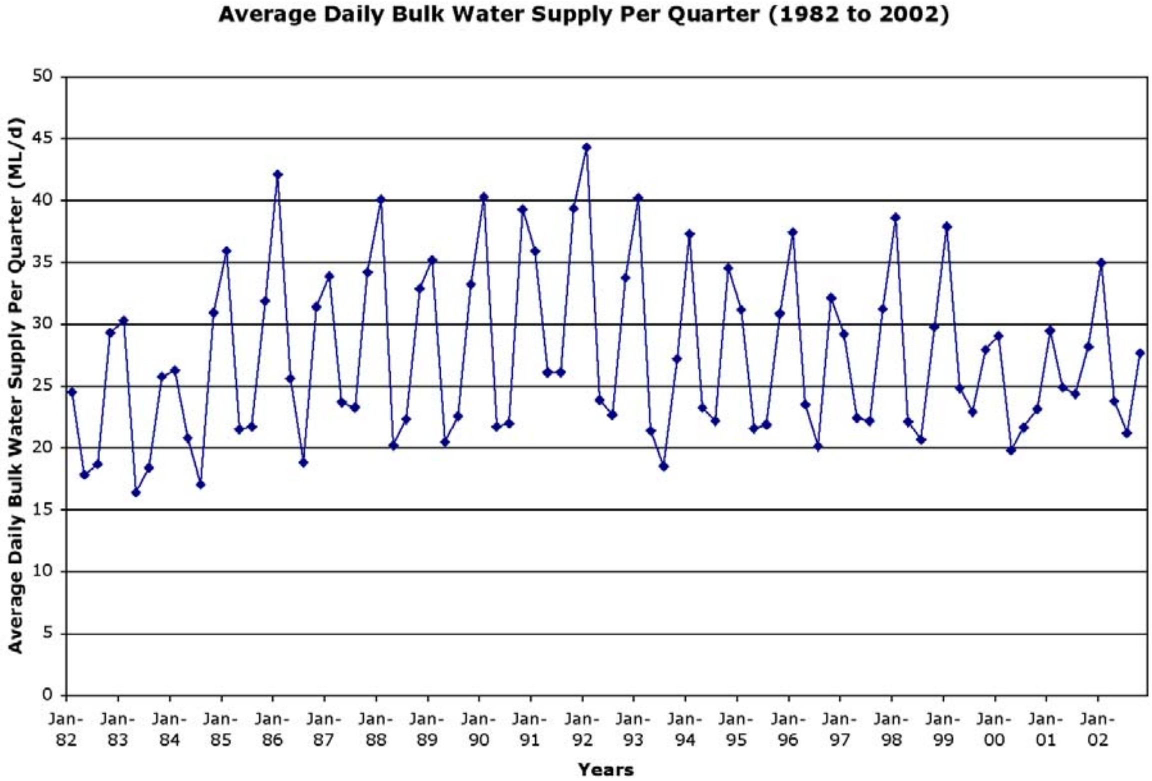
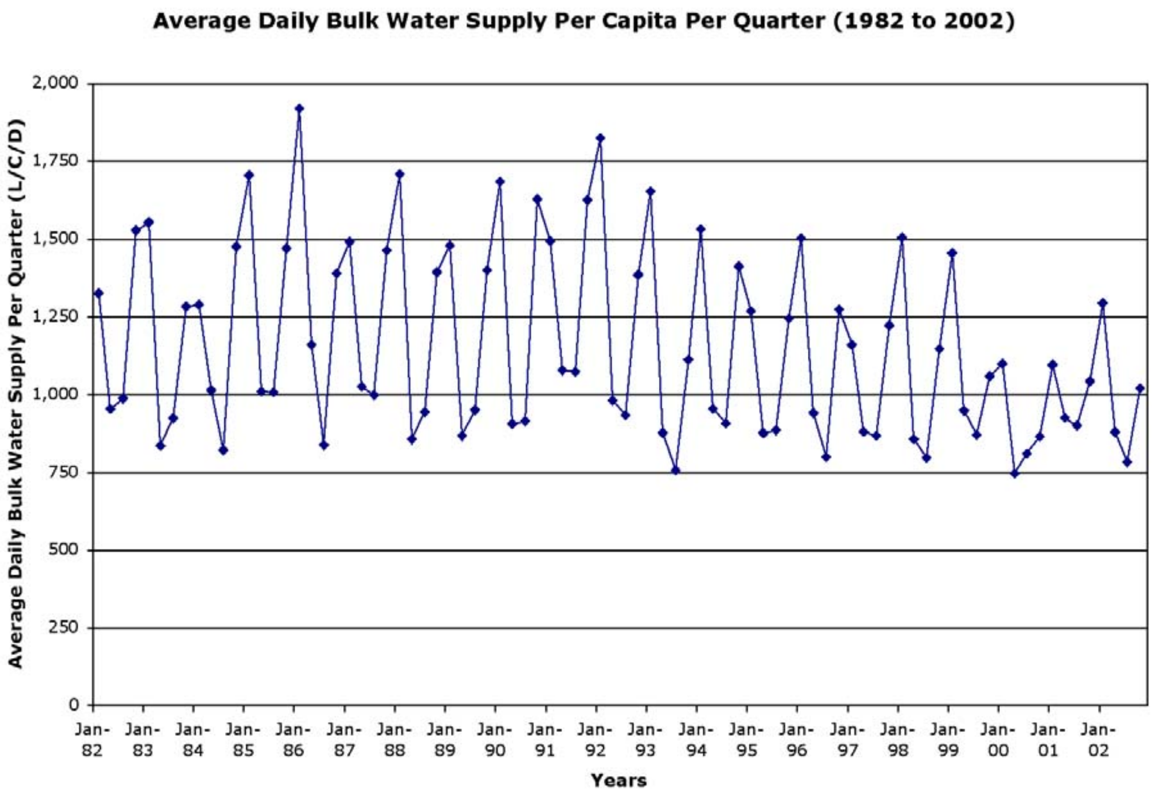


Figure 5-7 Average Daily Bulk Water Supply per Capita per Quarter



Figures 5.8 and 5.9 show the average daily bulk water supply per month and per capita per month respectively. These figures illustrate the distinct seasonal variation in water demand, with the lowest water demand generally occurring in June and July and the highest water demand occurring most frequently in January although peaks have been recorded anywhere between November and March over the 20 years assessed. This illustrates that the peak demand for water is generally related to outdoor water issues such as garden watering, pools and evaporative air conditioners. Hence, to reduce peak water demand, demand management options will need to focus on these end uses. The demand management options, identified in Section 8.0, have targeted both average annual demand and peak demand.

Figure 5-8 Average Daily Bulk Water Supply per Month

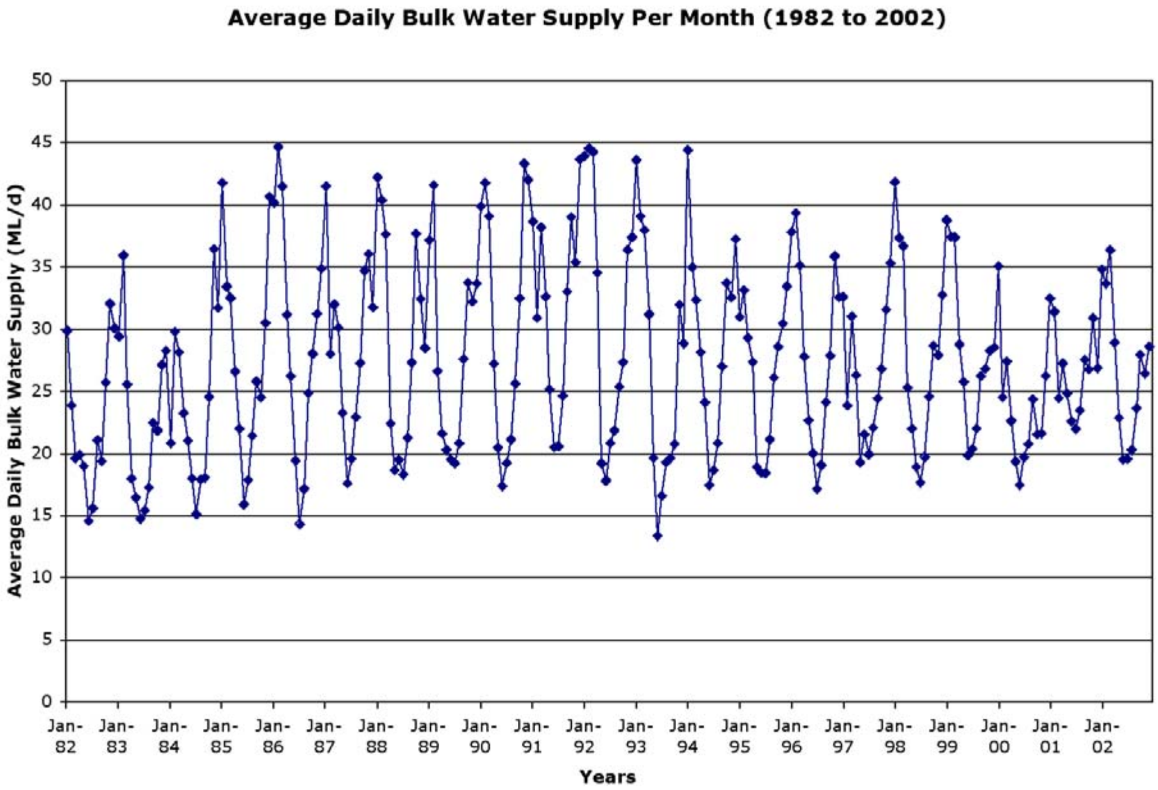
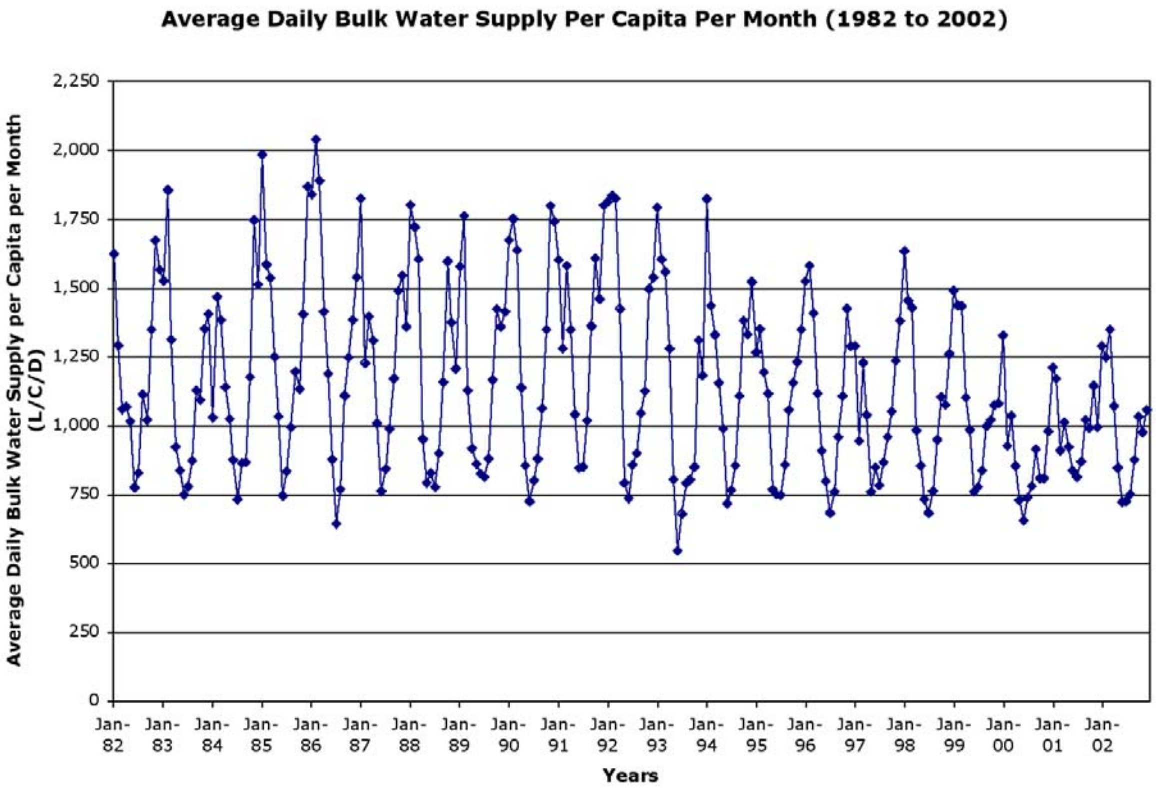


Figure 5-9 Average Daily Bulk Water Supply per Capita per Month



5.3 Water Balance

The difference between the bulk water supply and customer metered demand (the volume of water recorded on the customer meters) is the proportion of non revenue or unaccounted for water (UFW) effectively lost from the system before it reaches the customer meters. As indicated in Figures 2.1 and 2.2 these losses can occur at several points before and at the customer meter.

Figure 5.10 shows the difference between bulk water supply from Roe Creek and total recorded customer metered demand for the Roe Creek bulk water supply.

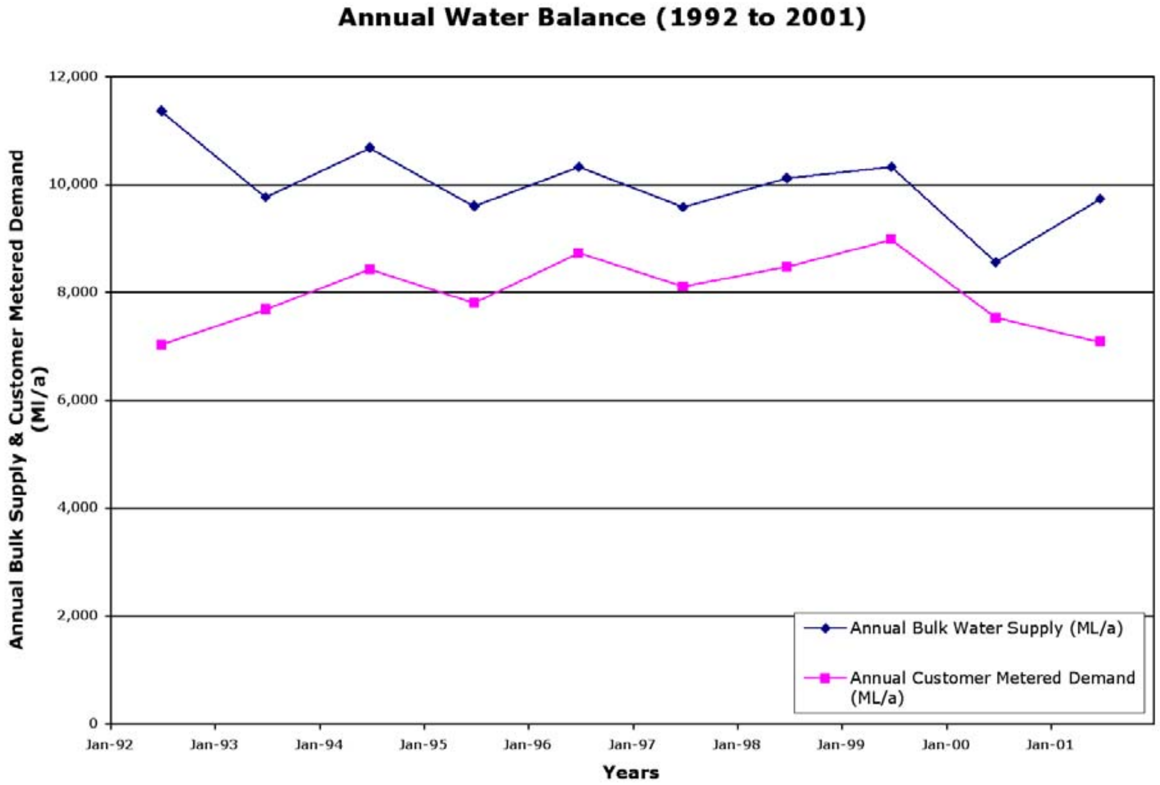
The UFW has only been considered between 1992 and 2001, as customer meter readings for the whole of 2002 were not available at the time of analysis. It should be noted that the customer meter readings for 1992 are incomplete because PW changed the customer information system (CIS) over at the beginning of that year resulting in a few early meter readings for 1992 remaining on the old computer system. This therefore results in UFW for 1992 being unrepresentative.

From 1993 to 2000, the UFW gradually reduced from 21% to 12%. However, in the last year, 2001, UFW appears to have increased substantially to 27%.

UFW can be divided into two main categories:

- real losses, which are physical water losses due to system leakage up to the point of customer metering; and
- apparent losses from unmetered water use such as slow running meters, unauthorised connections or maintenance.

Figure 5-10 Annual Water Balance

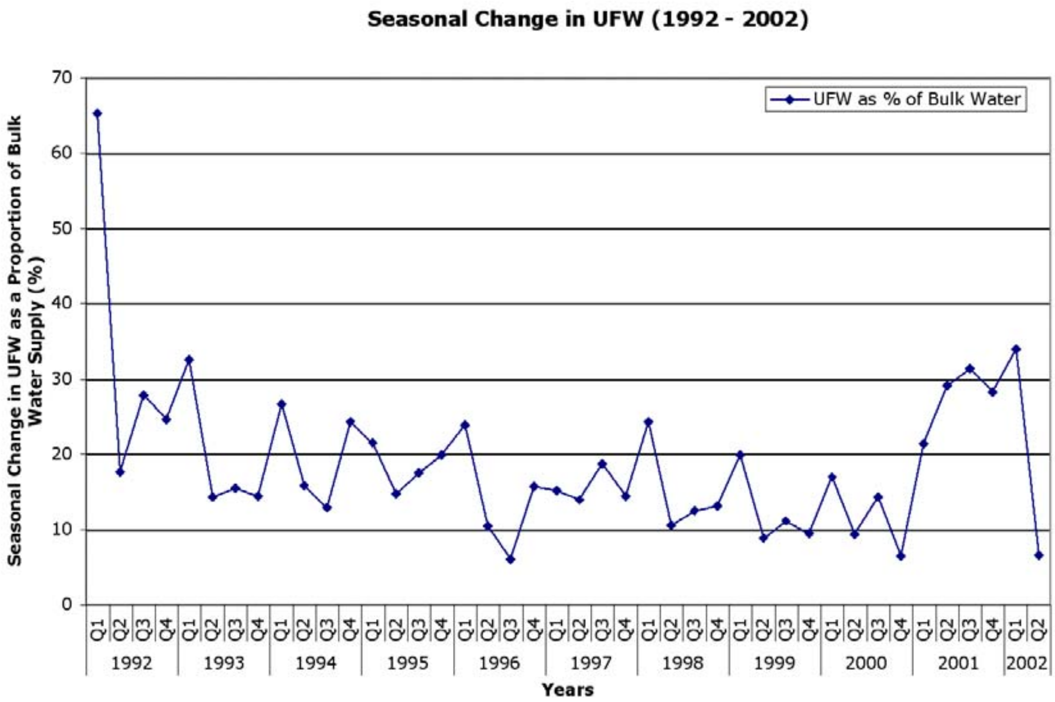


From further assessment of the seasonal change in UFW, shown in Figure 5.11, the high UFW in 2001 can be seen in more detail. From various discussions with PW staff, it appears that the main contributing factor to the large increase in UFW from approximately Q1 2001 to Q2 2002, was a mains leak found in March 2002 near Ilparpa swamp and the fact that meter replacement declined during this period. The seasonal variation in UFW shown over the period Q2 1992 to Q4 2000 is partially due to the way the analysis[13] has been carried out under this Study but is likely to be mainly associated with unmetered demand during the hotter summer quarters.

Since discovering and rectifying the leak, PW have and are planning to implement several demand management initiatives for the water supply system to reduce UFW and ensure large losses, similar to those in 2001, do not occur again. PW replaced a large number of meters in 2002 and carried out leakage detection, however, details of these initiatives and planned initiatives were not available and the responsibility for these initiatives was found to be unclear during discussions with PW.

[13] Under the Study it has been necessary to pro rata 30 and 90 day readings over the period for which they have been read, which causes a slight dampening of the customer demand compared to the visible peaking factors that can be observed from daily bulk water supply readings. This effectively splits some of the seasonal demand variation that may occur into two quarters.

Figure 5-11 Seasonal Change in UFW (1992 – 2002)



As demand varies from year to year, it is more useful to express system leakage as litres per connection per day (L/conn/day) rather than as a percentage of total demand because changes in demand from year to year (due to climatic variables) often mask the results.

Table 5.1 shows the recent trend in system water losses for Alice Springs reported in the Australian Water Performance Monitoring Report (AWA, 2002). These losses, as defined by this publication, are those losses not accounted for by metered and estimated uses or meter error (e.g. the difference between total water supplied according to the master meter and all reported uses). It should be noted that these reported losses are lower than those found during this Study because they have effectively removed an allowance for water demand associated with issues such as system maintenance and slow running meters (apparent losses).

Table 5-1 System Water Losses

	1997/1998	1998/1999	1999/2000	2000/2001
L/conn/day	205	244	228	472
As % loss of water supplied	7	9	9	21

Source – AWA, 2002

According to the PW Asset Management Plan 2001/02 (PW, 2003a) current losses figures for Alice Springs have been reported as current annual real losses (CARL[14]) and unavoidable annual real losses (UARL[15]), a component of CARL. In 2001/02, CARL were 537 L/conn/day and UARL were 76 L/conn/day.

[14] Accounts for losses due to joint weeps, leaks, breaks and apparent water losses averaged over the total number of service connections.

[15] Classified as those losses that are unavoidable considering the network, supply pressures and number of joints and connections.

From recent investigations, CARL in excess of 240 L/conn/day in Australia are considered high, while levels of 120 L/conn/day are considered low (WBW, undated). Assuming that most of the large increase in CARL in the past two years in Alice Springs is due to the leak that has now been repaired, there is clearly still some scope to reduce CARL when considering the 1997/98 to 1999/00 system losses shown in Table 5.1, which appear to be at the high end of water losses (especially when considering apparent losses have already been removed from these figures).

If it was assumed that system losses were reduced from the unusually high 2001/2002 level of 537 L/conn/day to the high Australian CARL value of 240 L/conn/day because the leak has been repaired, losses would reduce from the reported 1,861 ML/a (PW, 2003a) figure to about 830 ML/a (assuming approximately 9,500[16] connections). However if an active leakage detection and repair program was undertaken by PW that achieved a level of 120 L/conn/day (considered to be at the low end of Australian utilities losses but not international best practice), losses could be reduced to 415 ML/a, thus providing a saving of approximately 415 ML/a at current connection levels. This is considered achievable considering PW calculated UARL are 76 L/conn/day.

To calculate achievable leakage reduction below this level and the associated costs would require detailed analysis of the system. Demand management options associated with UFW are outside the scope of this Study but a saving of 415 ML/a with the current number of connections (which will increase gradually as the number of connections increases) has been identified in the options developed in Section 8.0.

As discussed in Section 4.4.1, to ensure UFW is permanently reduced and remains at or above current industry standards an UFW strategy needs to be developed and responsibility for that strategy clearly defined. Within the strategy aspects such as leakage reduction, pressure reduction, ongoing calibration of bulk meters and assessment and replacement of customer meters is necessary. It will be important to ensure that the bulk and customer meter reading databases are modified to incorporate a water demand variance warning system. Such a system would ensure that high water demand variances are investigated promptly. This is relevant for both individual customers and with respect to UFW to ensure that meter replacement or leaks can be detected and repaired quickly. For the CIS used for customer meters this will mean that the system will need to determine the variance for individual customers (allowing for seasonal variation in demand). This should highlight when meters become less accurate and allow for individual meters, which are failing, to be replaced as required.

It is essential that the UFW is reduced from historical levels as the community will find the core message of the demand management program to ‘save water’ difficult to appreciate if PW does not lead by example.

5.4 Climate Correction

The daily, peak and seasonal bulk water supply figures provided in the previous sections all show that climate is a significant factor influencing the demand for water in Alice Springs. Marked changes in demand can occur during for example unusually wet years such as 2000 and 2001, masking the real trend in demand for water and any results obtained from demand management initiatives.

As mentioned in Section 4.3 and shown in Appendix B, a number of demand management initiatives have been undertaken in Alice Springs over the last 15 years with the majority of initiatives having been implemented at intervals since around 1992. In order to see how these demand management initiatives have influenced demand in the past and how demand management options may affect demand in the future, a climate correction model has been developed.

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[16] There appears to be some inconsistency in the reporting of the number of connections between various PW and AWA reports. This figure has been derived by using the latest total loss figure (1,861 ML/a) and CARL figure (537 L/conn/d) presented in the latest PW Asset managemnt Plan (PW, 2003a).

Climate correction models take into consideration climate variables (e.g. temperature, rainfall and evaporation). This allows a water service provider to see how demand should have reacted due to climate variables alone. It reveals any other variations in demand that may have occurred due to factors such as demand management and source substitution, as discussed in Section 4.0. The details of the climate correction model, which has been developed using multiple regression analysis, are provided in Appendix C. A brief discussion on the interpretation of the results follows.

Figures 5.12 and 5.13 show the output of the climate correction model. Figure 5.12 illustrates the first 11 years of observed water demand against the predicted demand produced by the model, which has been calibrated over the period June 1986 to 1988. The observed and predicted demand curves follow each other very closely illustrating good agreement between predicted and observed demand.

In Figure 5.13 however, we see from 1992 that the observed demand line is generally less than the predicted demand line. This indicates that some factor other than climate caused demand to drop. It is not immediately clear which factor caused this change however it could be that the drop in demand is due to a demand management initiative. These demand management initiatives are identified in Section 4.3 and listed in Appendix B. A selection of the demand management programs already implemented have been plotted on Figure 5.13, to show when they may have influenced demand.

It should be noted that from January 2001 to 2002 the observed and predicted demand lines appear to track closely again, unlike the previous years. This may be due to the Ilparpa swamp leak, which is believed to have occurred during this period, as indicated in Figure 5.11. When data becomes available, plotting post Q1 2002 observed data (when the leak was rectified) against predicted average daily demand will enable PW to check whether the leak was responsible for this unexpected increase in observed average daily demand.

To enable PW to use the model to observe the impacts associated with the demand management options proposed under this Study after they have been implemented and other PW/DIPE initiatives such as source substitution using reuse, a version of the model will be re-calibrated using a more recent stable demand period between 1997 and 1999. Re-calibrating the model on more recent demand data and plotting observed and predicted average daily demand together with when individual demand management options and other PW/DIPE initiatives are implemented, will assist in the evaluation of the demand management program.

The two versions of the model will be provided to PW at the completion of the project for evaluation purposes.

5.5 Recommendations

5a – PW should ensure that both the bulk water and customer meter reading databases have a demand variance warning system to enable leaks, high demand and slow running meters to be detected quickly and facilitate rapid rectification.

5b - PW should ensure that calculation and reporting of UFW is consistent (e.g. by using the current CARL and UARL calculations) to ensure that losses can be compared accurately between years. In addition care should be taken when comparing bulk and customer metered data to find UFW by considering the time shift between bulk and customer metered data. For example bulk readings are obtained on a daily basis and are accurate to one day within any given month. However, the majority of customer metered readings are only available on a three monthly basis which means that actual use could be displaced by three months when compared with bulk meter readings.

5c – PW should use the climate correction model to evaluate whether the unexpected rise in demand during the period 2001 was associated with the Ilparpa swamp by inputting the latest bulk water supply data readings into the model. If the difference in observed and predicted demand returns to pre 2001 levels then this will verify whether the leak was the primary cause.

5d – PW/DIPE should use the climate correction model to assist in the evaluation of all future demand management, source substitution and reuse initiatives.

Figure 5-12 Climate Correction

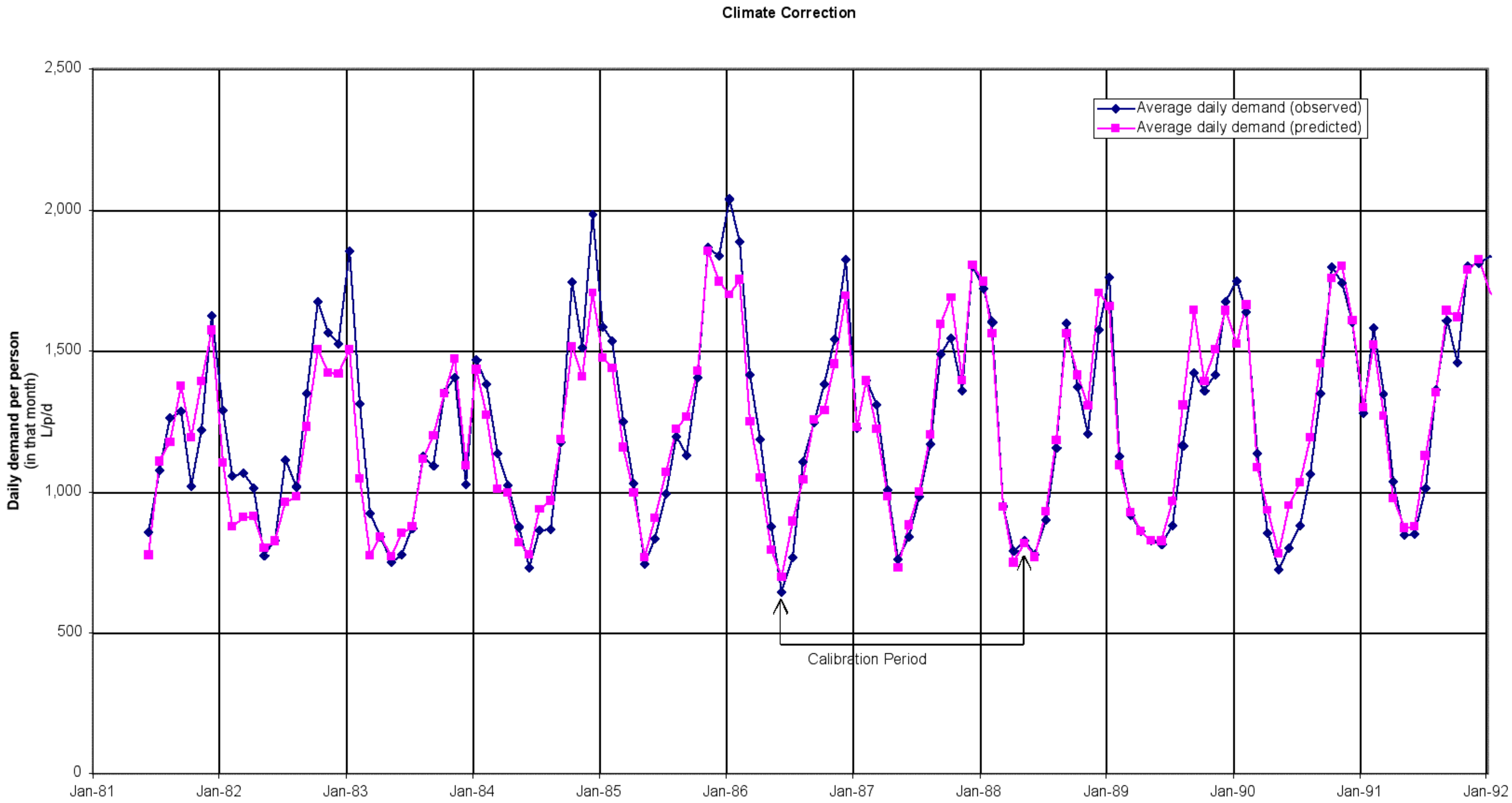
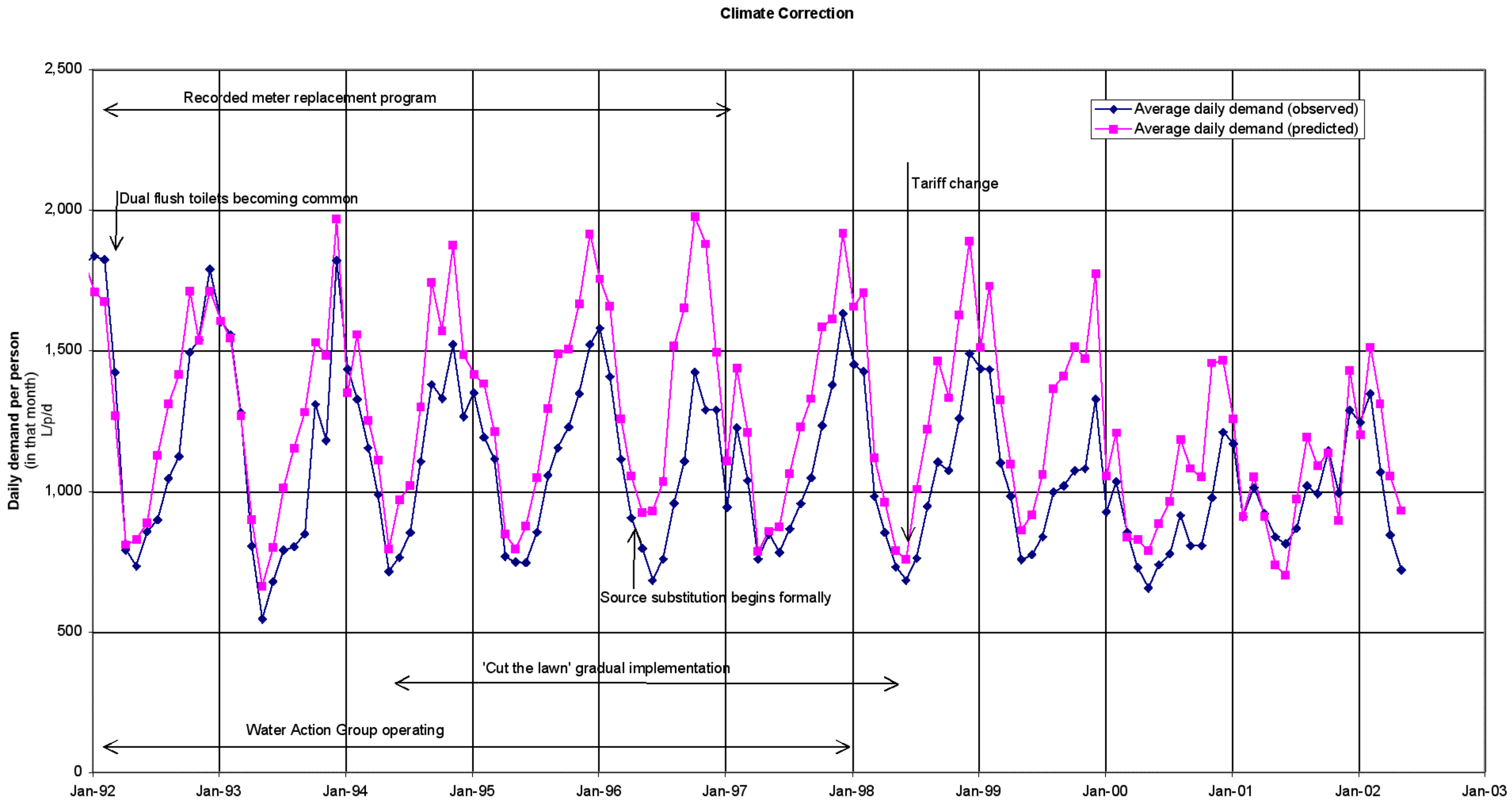


Figure 5-13 Climate Correction



6 CUSTOMER METERED DEMAND

6.1 Sector Disaggregation

To understand how individual customers have used water historically and how to project their future demand (to build the end use model and reference case), customer meter data has been disaggregated into individual sectors, which have been analysed separately.

The customer metered data has been disaggregated into the following sectors:

- Single residential (SR) – single dwellings.
- Multi residential (MR) – duplexes, terraces, town houses, flats, units and apartments.
- Other residential (OR) – Town Camps and Aboriginal communities of Amoonguna and Iwupataka, residential hostels (e.g. Red Shield and Hetti Perkins), rural residential properties which are not connected to town sewerage and a group of residential properties for which units of occupancy cannot be identified from the original data.
- Commercial/Industrial (C/I) – Typical commercial and industrial customers including tourist accommodation (hotels, motels, backpacker hostels and caravan parks).
- Institutional (I) – Typical institutional properties and customers including the hospital, schools, Alice Springs Town Council (ASTC) and other government properties.

Figure 6.1 shows the bulk water supplied and the customer metered demand in individual sectors on an annual basis and Figure 6.2 shows the same information on a quarterly basis thus indicating the seasonal variation of the individual sectors. It should be noted that Figure 6.2 shows the equivalent annual demand in individual quarters (i.e. the quarterly demand has been multiplied by 4).

Figure 6-1 Annual Sector Water Balance

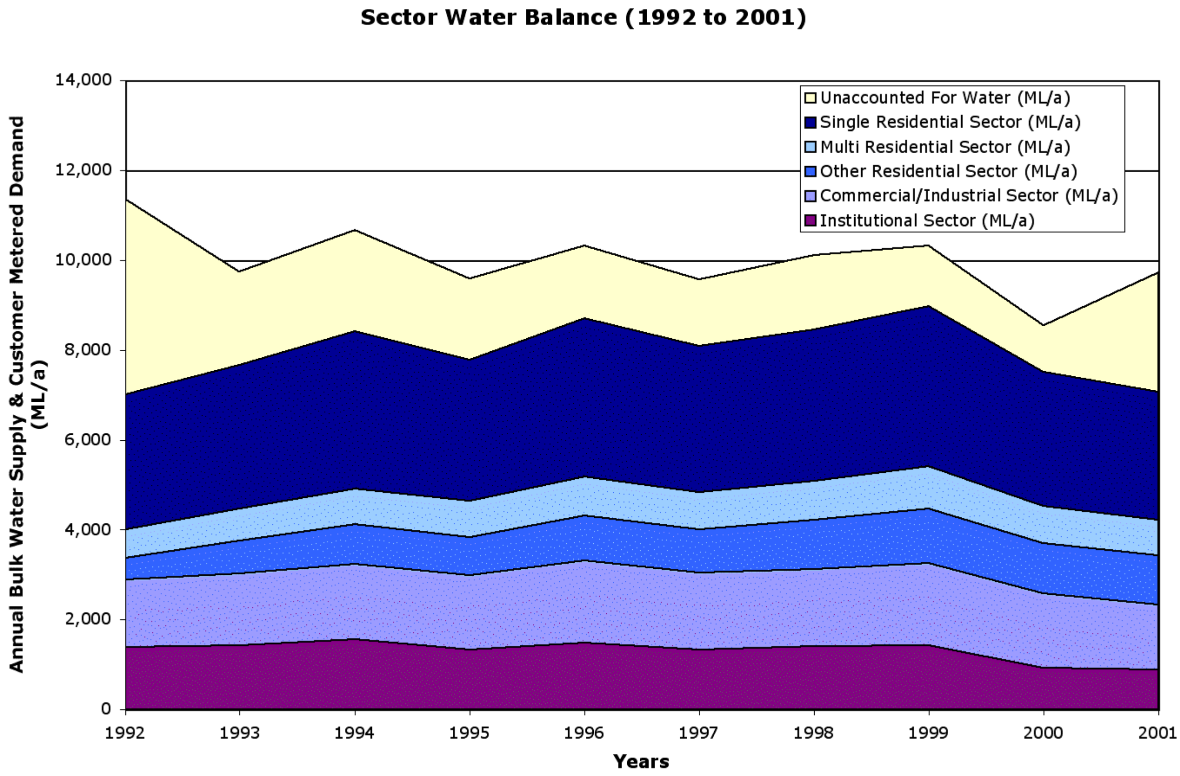
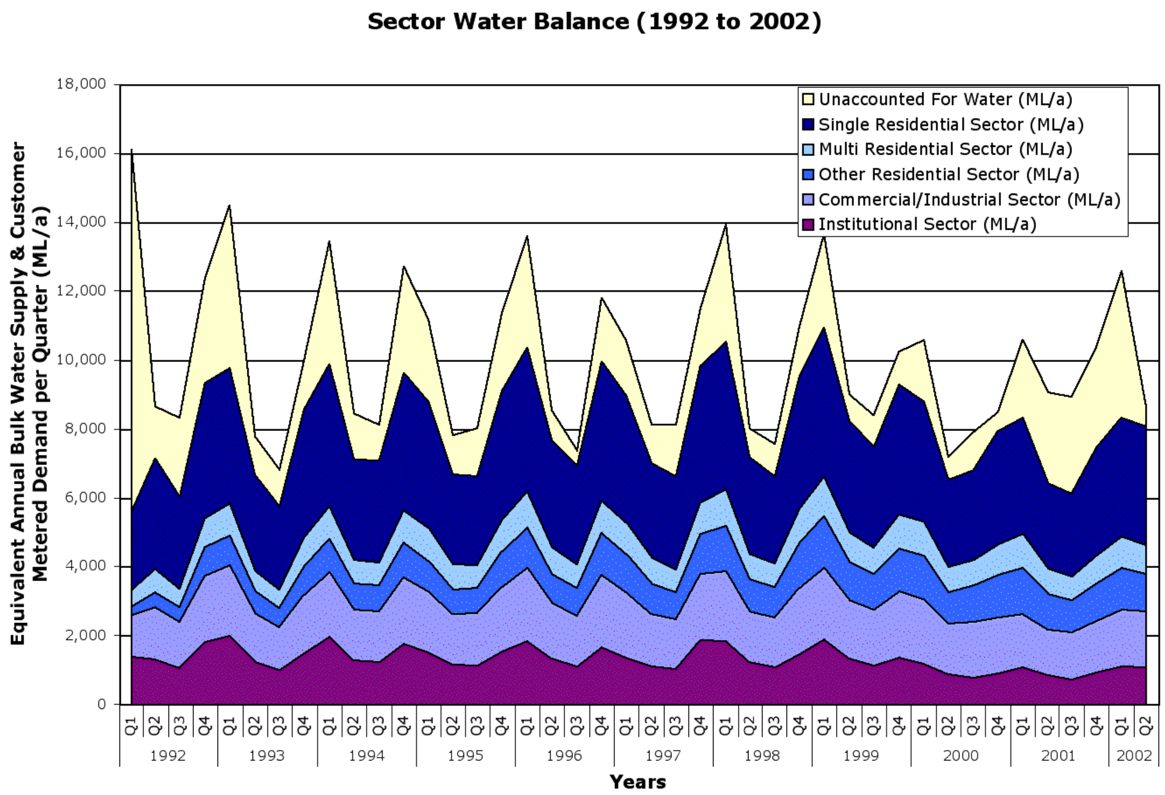


Figure 6-2 Sector Water Balance Per Quarter



Figures 6.1 and 6.2 show that the total residential sector represents a significant proportion of the total customer metered demand, with SR dominating all other sectors over the entire 10 year period. All sectors show some seasonal variation but SR has the largest seasonal fluctuation, although this can be more clearly seen in the individual sector analysis in the following sections. It is interesting to note the increase in demand in the ‘other’ residential sector, which includes rural residential properties, hostels, Town Camps, Aboriginal communities of Amoonguna and Iwupataka and a number of new properties that cannot be classified. In addition, it is interesting to see the significant decrease in the institutional sector over the last two years, which includes customer types such as ASTC and schools. It should be noted that ASTC and a number of the schools are using Town Basin supplies therefore the drop in demand is mainly associated with increased the use of Town Basin supplies and not reduction in total demand.

In Figure 6.1, the demand in all sectors dropped during 2000 and 2001 due to higher than average rainfall (refer to Figure 4.10). The dramatic increase in UFW can be clearly seen in both Figure 6.1 and in Figure 6.2 from Q1 2001 to Q2 2002. As mentioned in Section 5.3, the Ilparpa swamp leak was rectified in Q2 2002 and thus is likely to have been responsible for a considerable proportion of UFW during that time.

6.2 Individual Sectors & Customer Types

Average annual demand per sector between 1993 and 2000 is shown in Figure 6.3 and a further split showing customer types, which have been analysed individually, is shown in Figure 6.4. The period 1993 to 2000 has been chosen to eliminate the unusually high proportion of UFW in 1992 and 2001, which is not representative of the core years from 1993 to 2000 and the fact that the customer metered demand appears to be incomplete in 1992.

Figure 6-3 Average Annual Demand Split of Sectors (1993 – 2000)

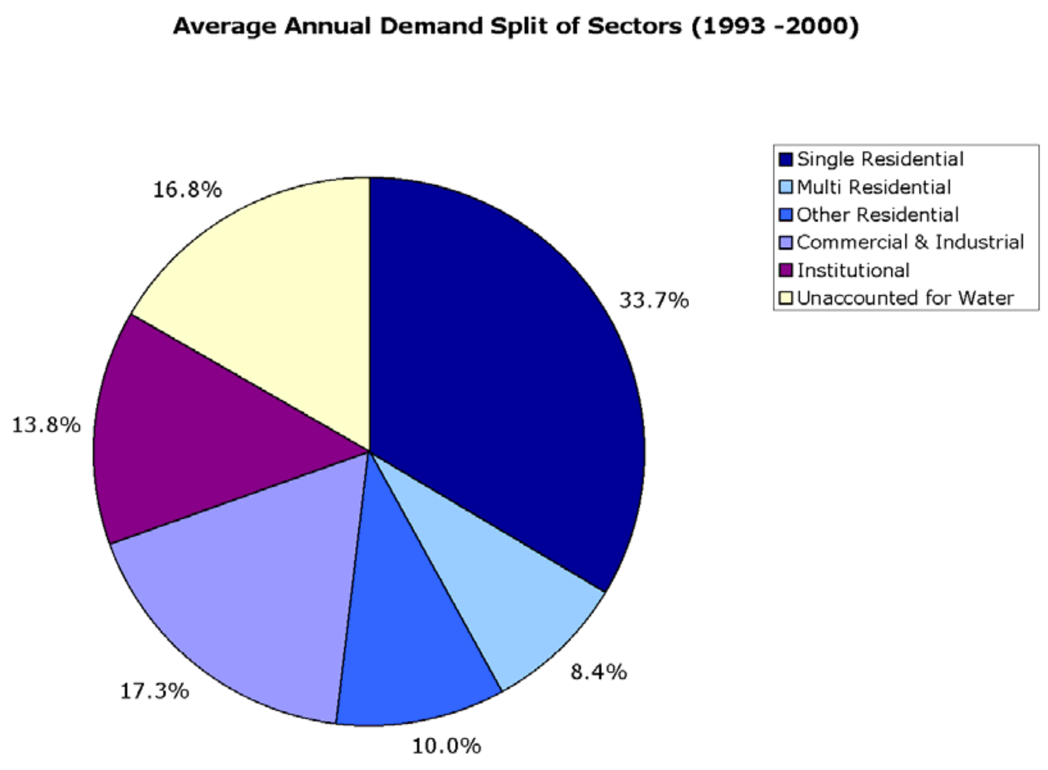
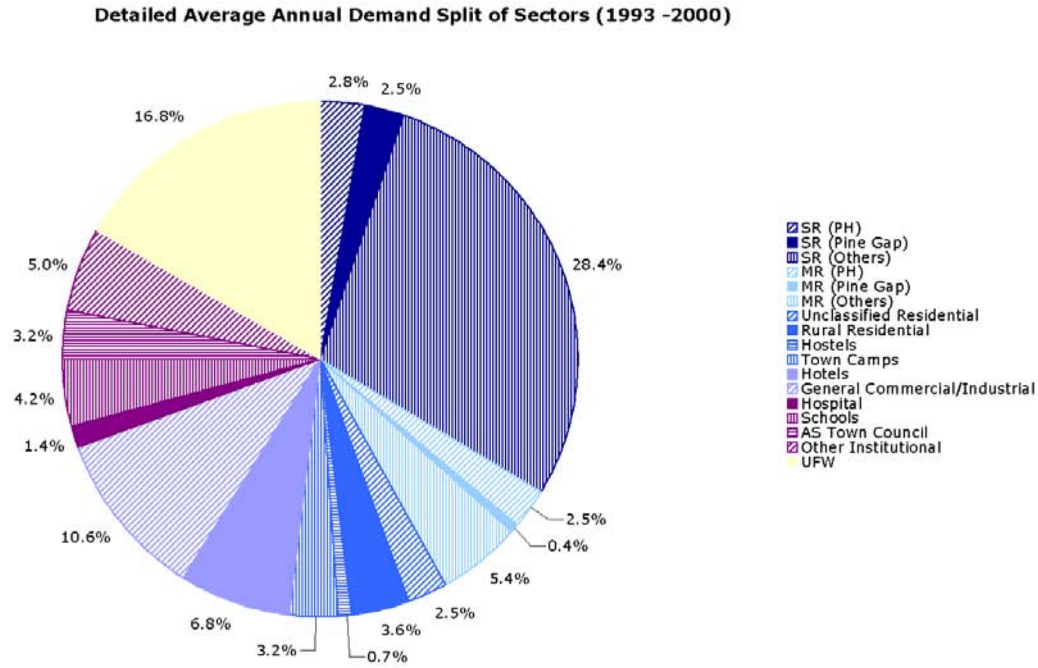


Figure 6-4 Detailed Average Annual Demand Split of Sectors (1993 – 2000)



Note – PH is public housing

Figures 6.3 and 6.4 illustrate that 52% of water supply is used by the residential sector, with 34% being used by SR customers alone and only 8% by MR customers. Within the residential sector, 2.5% of total water demand is associated with properties that cannot be classified as SR or MR due to current limitations within the PW CIS meter database. 3.6% is associated with a number of rural residential (non sewered residential properties to the south of the Gap), less than 1% of demand is associated with hostels not related to tourism and over 3% is associated with the Town Camps and Aboriginal communities of Amoonguna and Iwupataka.

The C/I sector represents 17% of total water supply, with tourist accommodation clearly being a significant customer type using 7% of total water supplied. The institutional sector represents nearly 14% of water supplied with the hospital being the largest single user at over 1%, schools using over 4% and the ASTC using over 3%. Other institutional customers such as the airport, gaol, individual government departments and charitable organisations use 5% of water supplied. It should be noted that both a number of schools and ASTC now use the Town Basin non potable supply as a form of source substitution which will affect the quantity of water they draw from the Roe Creek potable water supply.

The proportion of UFW is significant at just under 17%, which is equivalent to the total C/I sector. Hence UFW provides significant opportunities for water savings as discussed in Section 5.3.

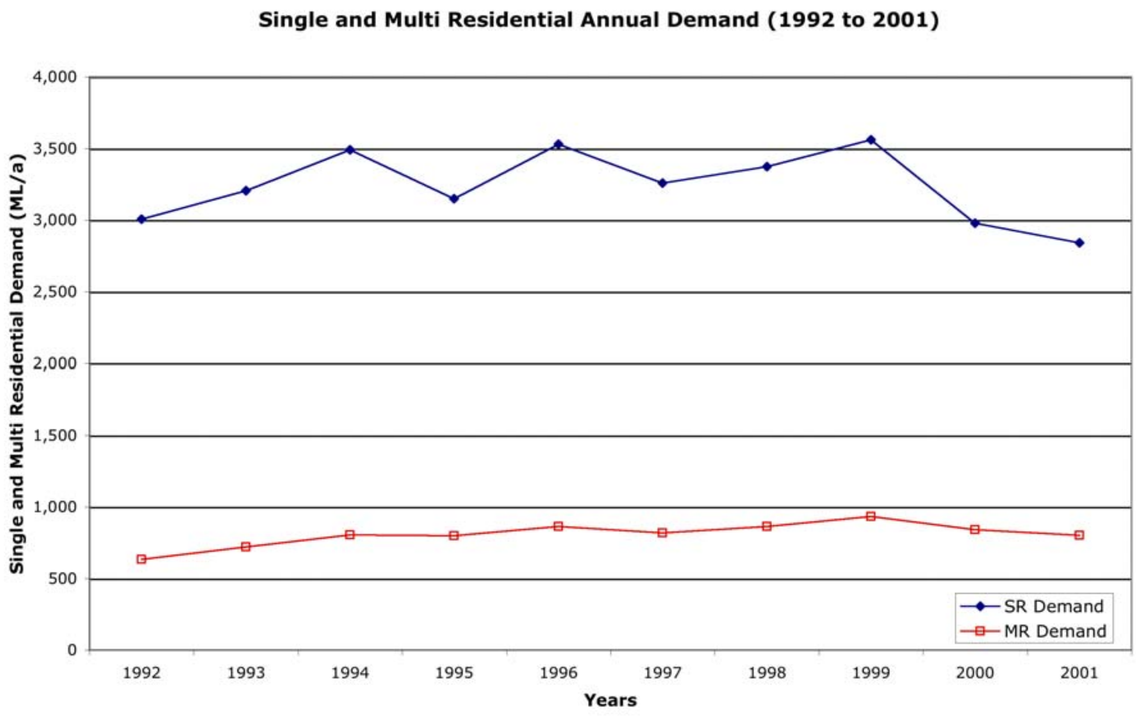
6.3 Sector Analysis

Sector analysis has been carried out to understand historical trends in water demand associated with individual sectors and customer types so that their trends can be taken into consideration when projecting future water demand. In the following sections, a brief discussion of trends in water demand for individual sectors and customer types has been provided together with details of specific events that may have caused those trends. In addition, projected trends to 2021 have been identified which are used to build the reference case in the end use model.

6.3.1 Single & Multi Residential Sectors

The single and multi residential demand sectors represented 42% of total bulk water supply for the period 1993 to 2000. Figure 6.5 shows that the SR sector dominates the residential sector demand and that there has been a gradual increase in demand in both SR and MR demand between 1992 and 1999 with a decline in demand occurring in 2000 and 2001 (related to higher than average rainfall in these two years).

Figure 6-5 Single and Multi Residential Annual Demand



To remove factors associated with population and household growth rates both of these sectors have been analysed in more detail by considering demand per unit of occupancy (e.g. a single house or a unit in a block of flats), which are termed households. Within these two sectors, two individual customer types have been analysed in detail (public housing and Pine Gap) for both SR and MR households. These two customer types have been analysed in more depth because a large number of properties are maintained by only two individual management organisations. This provides significant benefits when targeting demand management options on these groups due to ease of implementation.

Single Residential

SR household annual demand for the period 1993 to 2000 represented just under 34% of bulk water supply and is the largest single sector. The relative annual demand of overall SR households compared with Pine Gap and public housing households is illustrated in Figure 6.6. Pine Gap and public housing households represent more than 4.6% and 8.4% respectively of the total 2001 SR housing stock[17] of 5,550 households (ABS, 2002f). This provides significant opportunities for a targeted demand management option for these two customer types, which could capture 13% of the total SR housing stock.

As indicated in Figure 6.6 the annual water demand per Pine Gap SR household is considerably higher than the overall SR demand and public housing SR household annual demand is marginally lower. As indicated,

[17] From the PW CIS database 4760 SR households were found including 255 Pine Gap and 467 public housing households thus representing 86% of the total 5550 within the town. Although not all households were found within this sector the 86% found provide a representative sample.

the Pine Gap households appear to have gradually increased annual demand between 1992 to 1999 while all households (the average of all SR households including Pine Gap and public housing) and public housing households alone do not appear to have changed. All these customer types show the significant decline in demand associated with the wet years of 2000 and 2001.

Figure 6-6 Average Annual Demand Per SR Household

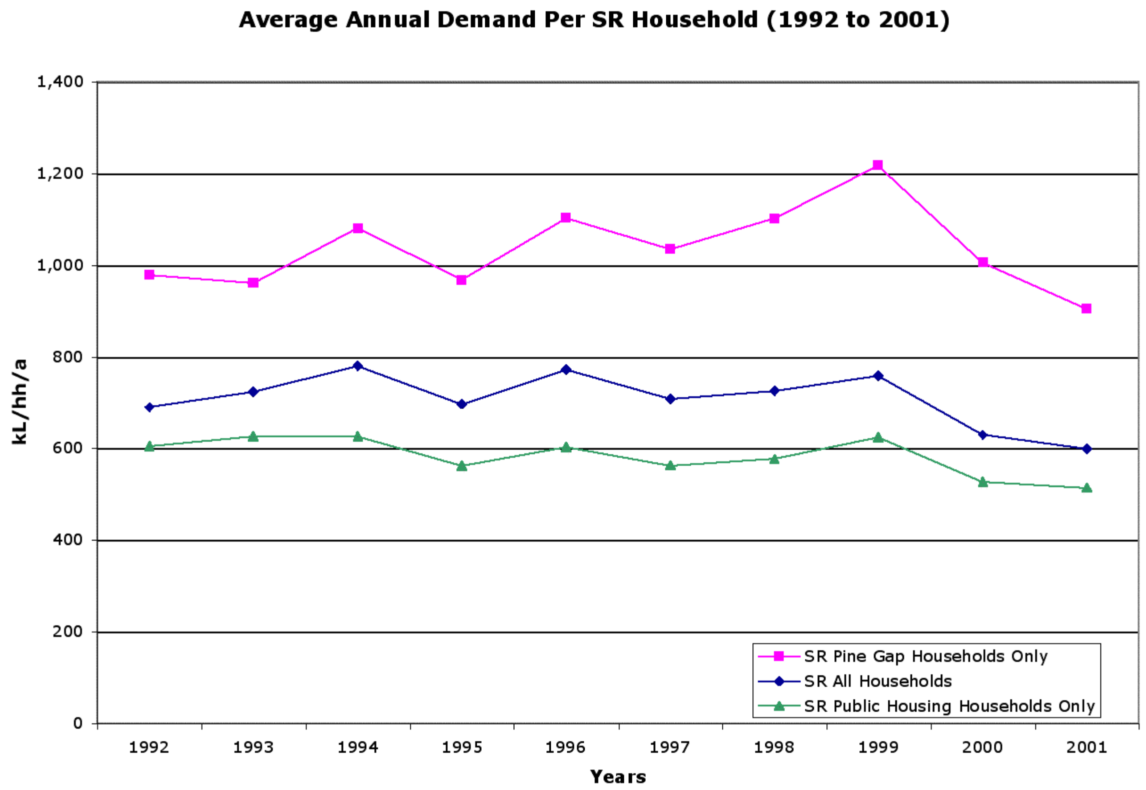
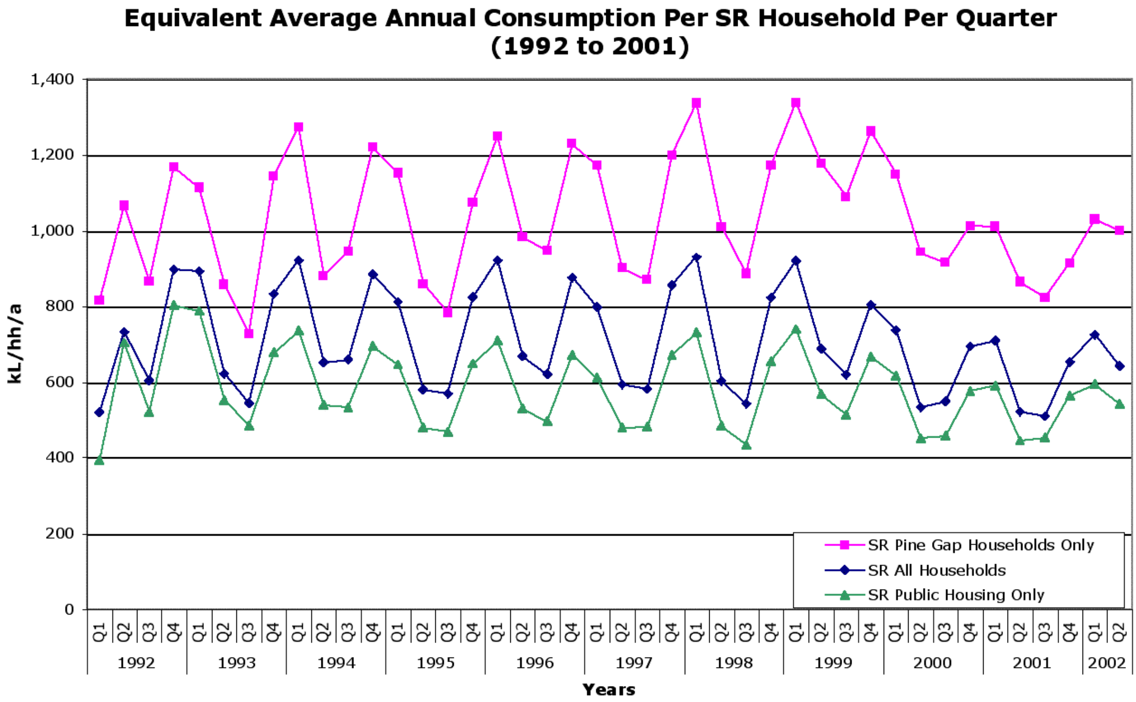


Figure 6.7 shows the seasonal variation for these customer types and illustrates the significant demand increase in the summer compared with winter. Pine Gap households have the largest seasonal variation and the public housing households have the lowest. The equivalent annual demand per quarter has been used in Figure 6.7 for individual quarters (i.e. the quarterly demand has been multiplied by 4) to assist in seeing how annual demand varies according to seasons.

Figure 6-7 Equivalent Average Annual Demand Per SR Household Per Quarter



During discussions at the ASUWMSRG meeting on 20 March 2003 it was identified that the above average demand in Pine Gap SR households may be attributable to the fact that Pine Gap households may have a slightly higher occupancy rate than the average[18] and do not pay for water. It was considered that public housing demand may be below average demand because they currently pay for water demand in excess of 500 kL/hh/a.

Multi Residential

MR household annual demand for the period 1993 to 2000 represented just over 8% of bulk water supply. The relative annual demand of overall MR households compared with Pine Gap and public housing households is illustrated in Figure 6.8 where Pine Gap and public housing represent more than 10% and 22% of the total MR housing stock[19] respectively. Targeting a demand management option around these two customer types alone would mean a third of all MR households could be reached.

Interestingly in the MR sector (unlike the SR sector) Pine Gap annual demand per household is lower than the overall MR demand and public housing MR household annual demand is higher. The MR public housing demand may be higher because unlike in the public housing SR demand, individual units of occupancy cannot be charged if they use more than a specific amount (e.g. 500 kL/hh/a in SR) as they do not have individual meters associated with individual units of occupancy.

While the annual MR household demand for the sector has stayed fairly constant, both the Pine Gap and public housing household demand has increased. Again all customer types show a drop in annual demand in the wetter years of 2000 and 2001. The dramatic increase in the Pine Gap annual demand per household in

[18] A large number of households are believed to have approximately six residents although exact figures are not available to determine whether the Pine Gap residents have above average occupancy or not.
[19] From the PW CIS database 2593 MR households were found including 265 Pine Gap and 574 public housing households thus representing 98% of the total 2656 within the Town. Although not all households were found within this sector the 98% found provide a representative sample.

1998/1999 is likely to be associated with a proportional increase in the number of duplex style MR households, which tend to have more garden area and often a higher occupancy than flat type MR properties.

Figure 6-8 Average Annual Demand Per MR Household

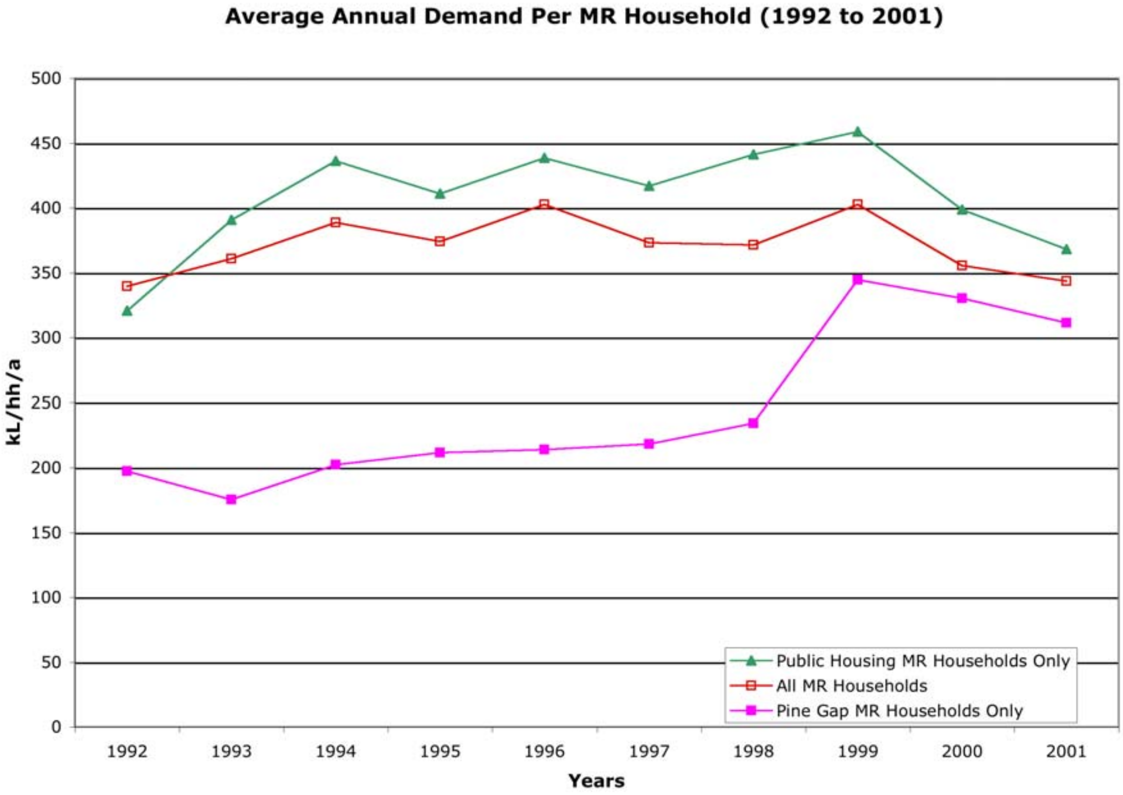
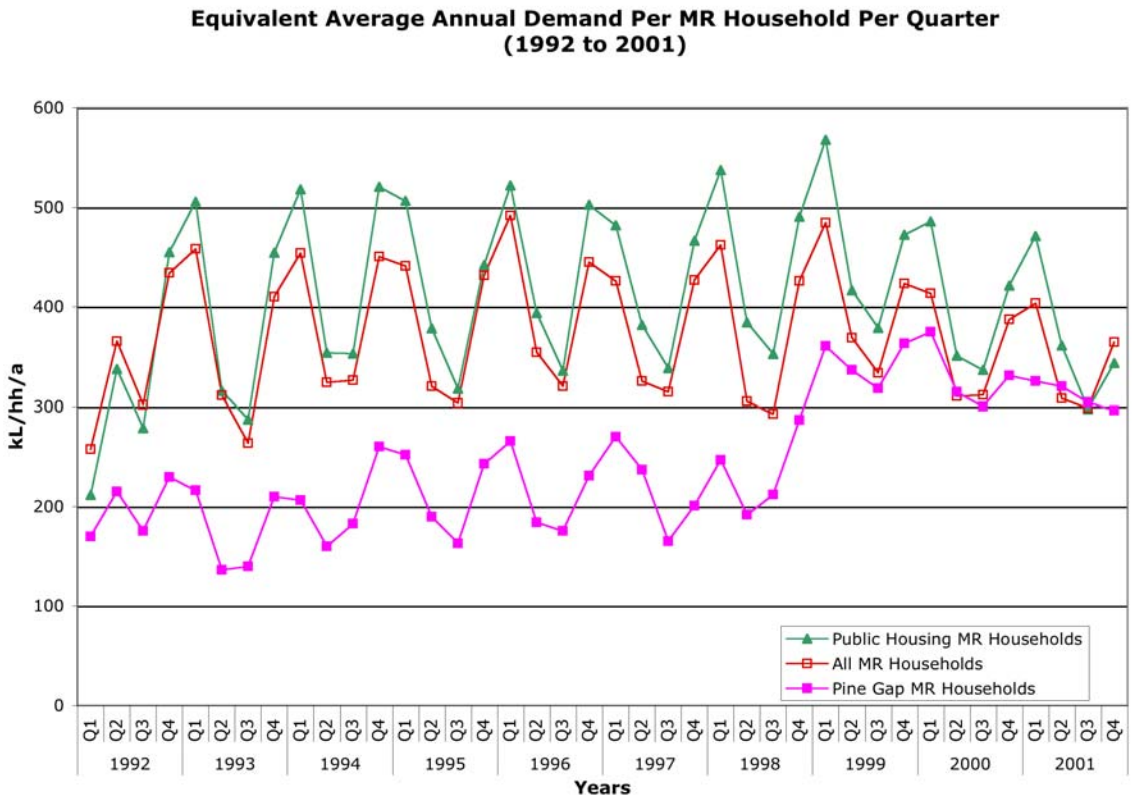


Figure 6.9 shows the seasonal variation for each customer type, indicating that public housing has a significant seasonal variation similar to the whole MR sector and that the Pine Gap seasonal variation has always been less than the whole MR sector, but since 2000 the autumn/winter quarter demand has increased to such an extent that seasonal variation appears to have virtually disappeared.

Figure 6-9 Equivalent Average Annual Demand Per MR Household



SR and MR Comparison

SR households have an equivalent average annual demand of 520 kL/hh/a in winter but 870 kL/hh/a demand in summer, resulting in an average annual demand of approximately 700 kL/hh/a. As to be expected, MR household demand is considerably less than SR demand at 280 and 440 kL/hh/a in winter and summer respectively, resulting in an average annual demand of 370 kL/hh/a. This lower average annual demand can mainly be attributed to factors such as lower occupancy and smaller gardens associated with this sector.

It should be noted that these average annual demand figures are more than double those of other cities situated in non-arid areas of Australia[20]. Hence, from the analysis of the SR and MR households it was decided that outdoor end uses related to temperature, rainfall and evaporation (e.g. air conditioners, gardens and pools) were extremely important and needed to be considered in more detail to identify how to save water. In addition indoor end uses needed to be considered in detail as the autumn and winter quarters were higher than those in other non-arid climates even when not affected by climate variables.

To clarify the end uses in SR and MR households for input to the end use model and to develop demand management options a number of sources of information were used. These include a residential survey at the Alice Springs Show, interviews with plumbing/air conditioner/pool/garden specialists as well as other local reports, literature and statistical data. Details of the disaggregation of SR/MR household demand (in terms of end uses) and the data sources used to obtain this information are provided in Section 7.0

[20] A study (ISF, 2002) carried out for Sydney Water Corporation identified a representative sample of single and multi residential households for the Sydney region. Average annual demand was found to be 287 kl/hh/a and 136 kl/hh/a for single and multi residential households respectively.

The differences in end uses between Pine Gap and public housing needed to be investigated to understand how water could be saved in a targeted demand management option. Appendix D provides details on interviews conducted with Pine Gap and public housing managers, which assisted in the development of options identified in Section 8.0. In the interview with the Pine Gap representative and the recent discussions held during the workshop of 20 March, Pine Gap are known to have fitted a number of water efficient fixtures and fittings. However, the analysis indicates that on average they are using more water per household. Hence there still remains significant opportunity to reduce demand in Pine Gap households.

Projection of demand associated with SR and MR is complex and related to population increase, housing type, occupancy ratio and fixtures and fittings within the house (stock, usage, technology). The details of these factors affecting projection are detailed in Section 7.0.

6.3.2 Other Residential

The 'other' residential demand sector represented 10% of total bulk water supply for the period 1993 to 2000. Figure 6.10 shows the individual customer types considered and Figure 6.11 shows their seasonal variation.

Figure 6-10 Annual Demand for Other Residential

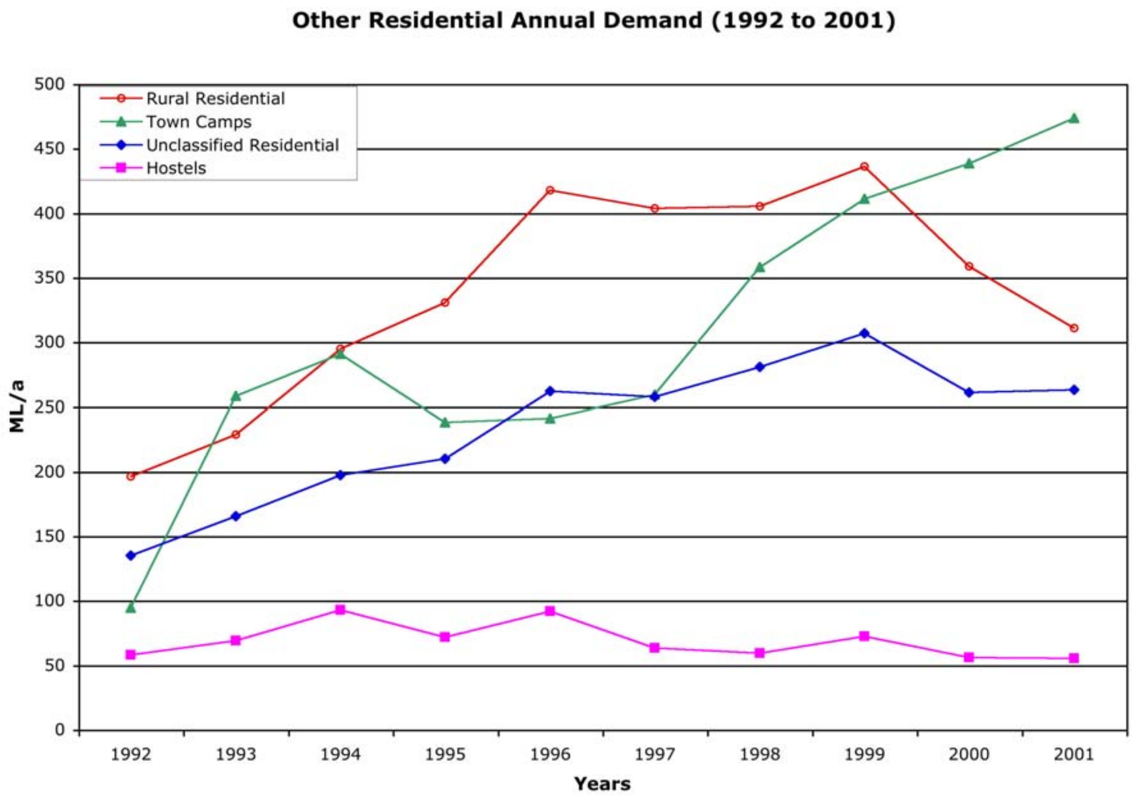
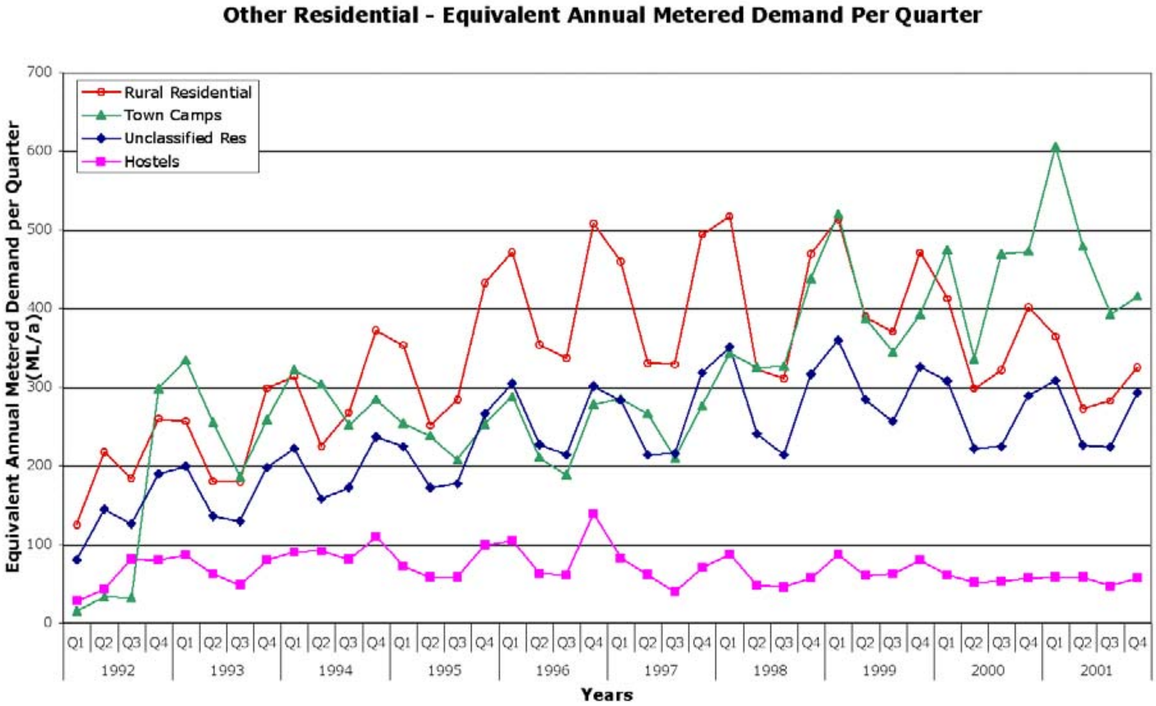


Figure 6-11 Equivalent Average Annual Demand for Other Residential



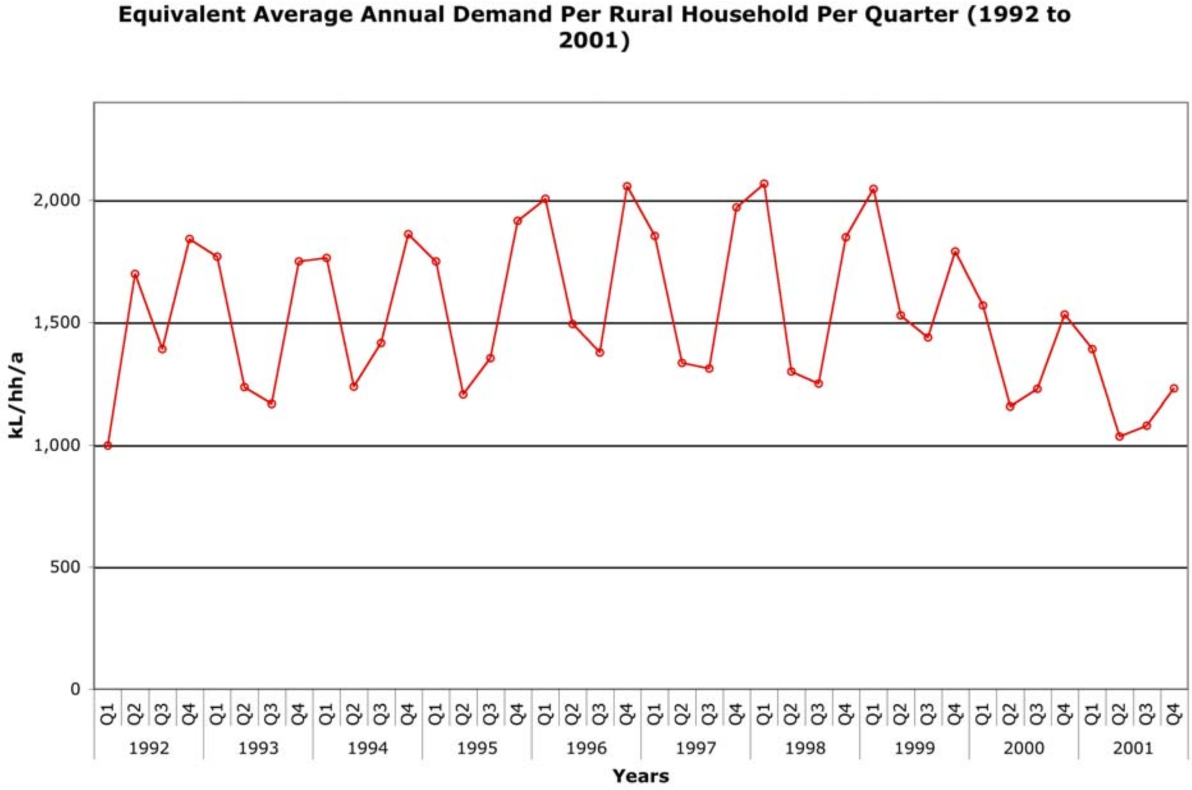
Unclassified Residential

The unclassified residential customer type represented 2.5% of total average annual demand between 1993 and 2000. As identified earlier the unclassified residential customer type is made up of properties that cannot be clearly defined as SR or MR due to limitations in the current PW CIS system. This customer type appears to be rising significantly over the period considered, however, the number of property connections has also risen. As the exact number of households (units of occupancy) per property connection is not known this customer type has not been analysed. However, it has been taken into consideration when developing the end use model to ensure that all households are accounted for.

Rural Residential

The rural residential customer type represented 3.6% of average annual demand between 1993 and 2000. This customer type currently consists of 267 SR type households to the south of the Gap, which are not connected to the town sewerage system. These properties are generally on larger blocks of land with more rural activities, which may be responsible for their high water consumption per property of 1,447 kL/hh/a (SR average 700 kL/hh/a) shown in Figure 6.12 along with seasonal variation. Again, water demand has dropped in the summer months associated with 2000 and 2001 due to higher than average rainfall. The number of properties associated with this customer type has doubled in the last ten years. As these properties are not connected to the sewerage system this has been taken into account in developing the sewage model. Due to the very high annual demand of this sector these customers have been targeted in the options developed in Section 8.0.

Figure 6-12 Equivalent Average Annual Demand for Rural Residential



Town Camps and Aboriginal Communities

The 18 Town Camps and two Aboriginal communities of Amoonguna and Iwupataka represented 3.2% of annual demand for the period 1993 to 2000. The exact number of houses and population associated with these Town Camps and communities and how they have changed over time is not known although some details on these issues are provided in Section 4.1.1.

It appears that the demand for water from the Town Camps and Aboriginal communities (refer to Figure 6.10) has grown markedly over the period being assessed with a drop between 94/95 to 97/98, which is thought to be associated with meter failure of the bulk meters. In the last two years, the population of Amoonguna has doubled in size from 150 to 300, which is likely to be the reason for the continued increase in demand in 2001 despite the exceptionally high rainfall that year. It should be noted that this is the only customer type to actually increase demand in this particular year. From the seasonal demand, (refer to Figure 6.11) the peak demand is virtually always associated with Q1 and not Q4 and Q1 as in the SR and MR residential sectors. This may indicate that the peaking is more related to population increase around Q1 than outdoor water end uses. Details on fixtures and fittings and opportunities for saving water have been collected through interviews and are provided in Appendix D. These details have been used to develop the associated demand management option for this customer type (refer to Section 8.0).

To project demand for the Town Camps and Aboriginal communities it has been necessary to consider only more recent data since the total average demand has been growing rapidly over the last couple of years. The modelling develops a relationship between the total Alice Springs population and the average annual demand by this group and projects this relationship (47 kL/p/d) to 2021. This results in a 22% increase in demand by 2021.

Hostels

Hostels that are not related to the tourist industry (e.g. Old Timer Nursing Home, Hetti Perkins Hostel) represented only 0.7% (72 ML/a) of demand for the period 1993 to 2000. There are currently only around seven hostels in town. Very little detail is known about these hostels, thus limiting the analysis undertaken. A demand management option for these could be beneficial to reduce both water demand and wastewater flows passing to sewer, however, since this sector is relatively minor no demand management options have been developed.

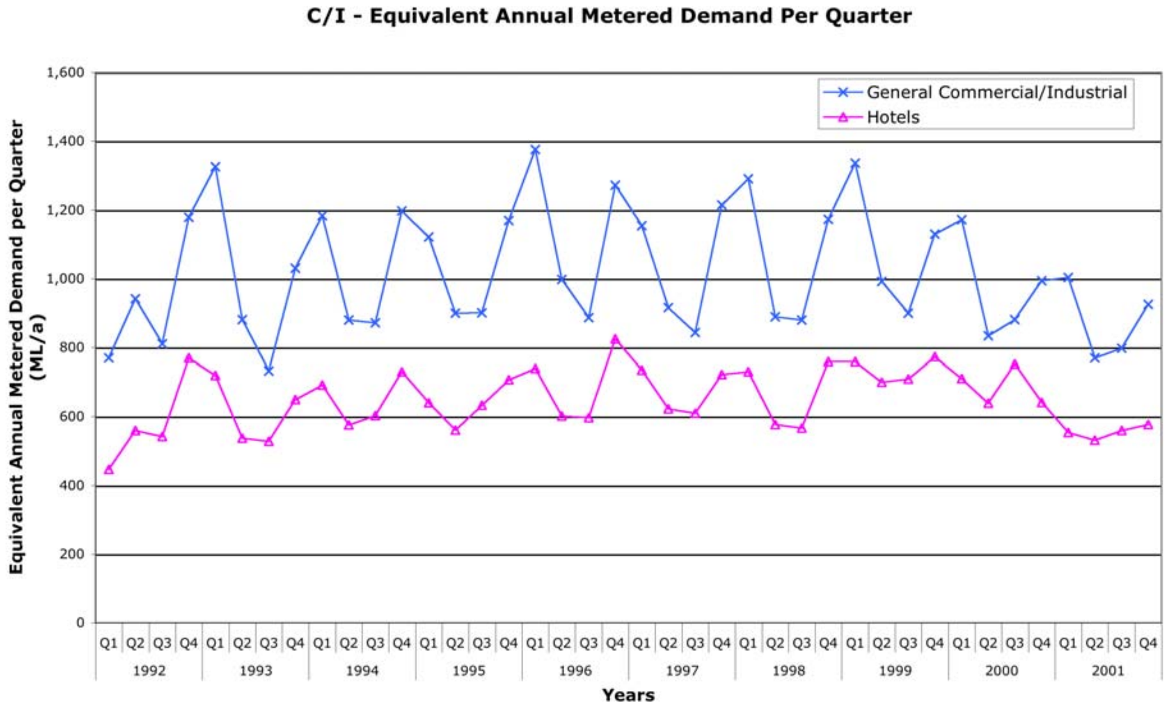
The demand for water by hostels has been projected to increase with population resulting in a 28% increase in annual demand by 2021, based on each property continuing to use an average of 11 ML/property/a.

6.3.3 Commercial/Industrial

The commercial/industrial sector represented over 17% of demand for the period 1993 to 2000. Within this sector, hotels have been separated from general commercial/industrial customers. As shown in Figure 6.13 the annual demand for water for both customer types has grown gradually over the period analysed except for the last two years, which have been affected by climate. Figure 6.14 illustrates the seasonal variation of both customer types, which indicates that both customer types increase demand in Q4 and Q1 and are thus likely to have a large outdoor water demand. Both of these customer types are considered in more detail in the following sections.

Figure 6-13 Commercial/Industrial Annual Demand

Figure 6-14 Commercial/Industrial Equivalent Annual Demand Per Quarter



Hotels

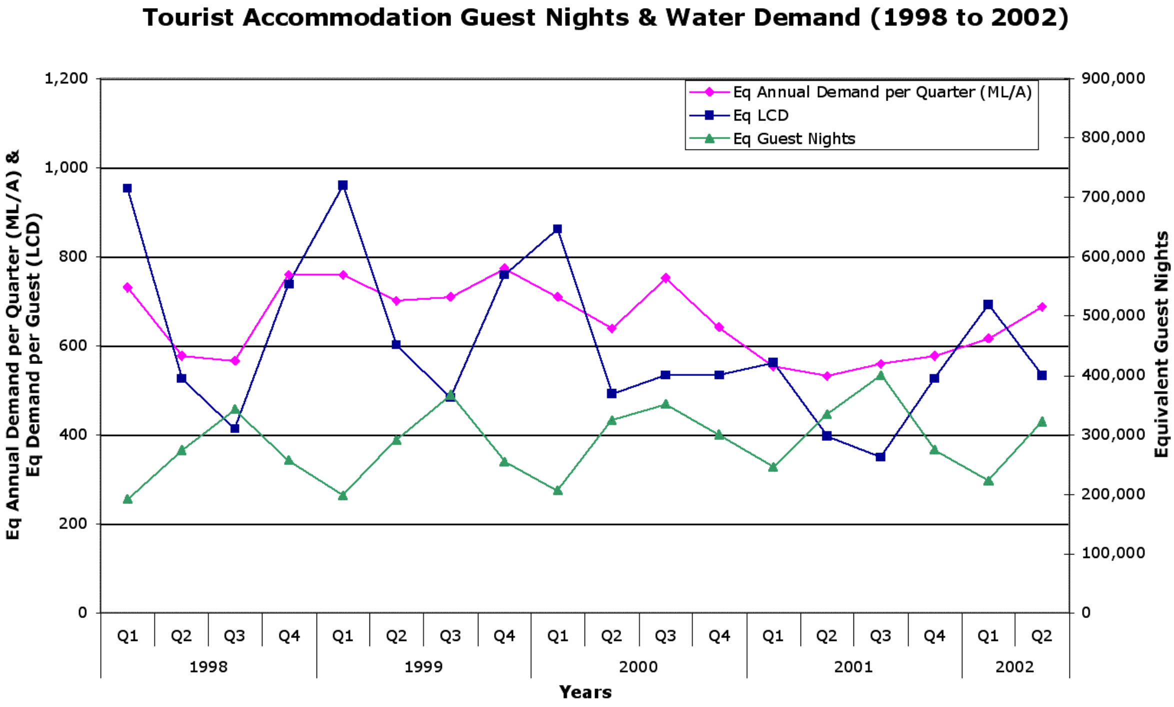
Tourist accommodation in Alice Springs represented 6.8% (667 ML/a) of total water supply between 1993 and 2000. There are currently approximately 50 tourist accommodation establishments in town including hotels, motels, backpackers, tourist hostels, guesthouses, caravan parks and serviced apartments. When looking at these customers more closely the top 17 establishments use on average over 30,000 kL/property/a and represent 82% of the demand for this customer type. Hence, targeting of these top water users in a demand management option could be extremely beneficial due to the large potential savings possible by visiting and liaising with only a limited number of establishments.

As indicated in Section 4.1 and shown in Figure 4.2 the number of guest and site nights occupied has grown gradually over the last five years. This is again shown in Figure 6.15 but compared against equivalent annual demand per quarter and equivalent demand per guest (Eq. LCD). As indicated the equivalent demand per guest appears to have a negative correlation with the equivalent guest nights. This shows that when guests are at their maximum in Q3 (winter), demand is at its lowest, yet when guests are at their minimum in Q1 (summer), demand is at its highest. This implies that water demand in hotels is predominantly outdoor water demand associated with end uses such as garden watering and pools and is only marginally affected by tourist numbers. The wastewater peak associated with tourist accommodation will, however, occur in Q3 when tourists are at their maximum and evaporation rates are at their lowest thus exacerbating WWTP overflow problems.

Hence, a demand management option concentrating on both indoor and outdoor demand will be beneficial in reducing both summer peak demand and winter peak wastewater discharge. An option dealing with both indoor and outdoor demand for this sector has been developed as discussed in Section 8.0.

This sector's demand is estimated to grow by 21% by 2021. Hotel property growth is linked to general population growth and assumes that the per property demand of the whole sector remains at an average of 13 ML/property/a for projection purposes.

Figure 6-15 Tourist Accommodation Guest Nights and Water Demand



General Commercial/Industrial

The remainder of the C/I sector has been classified as general C/I and represented 10.6% (1,041 ML/a) of potable water supply between 1993 and 2000. There are approximately 690 C/I properties in Alice Springs, which has grown from 650 in 1992. This is consistent with the gradual increase in demand illustrated in Figure 6.13. As indicated earlier and shown in Figure 6.14 outdoor water use appears to play a significant role in demand with peaks in Q4 and Q1.

C/I is often very hard to characterise due to the significant variation in types of businesses and their relative water use (e.g. bakeries, laundries, supermarkets). Little is known about this particular customer type in Alice Springs. However, from more detailed analysis, the top 40 properties in this customer type have been found to use over 10,600 kL/property/a which represents 40% of the water used by the general C/I sector. These properties include customers with large outdoor water demand such as The Turf Club, Blatherskite Park, The Memorial Club, Olive Pink Botanic Garden, Bowling and Social Club and Arunga Park Speedway.

A targeted demand management option to assist these top 40 customers to reduce demand would be beneficial due to the large proportion of water used compared to the rest of the general C/I sector.

This sector as a whole is projected to increase annual demand by 20% by 2021 based on a projection of water use in the C/I sector being directly related to population (i.e. using on average approximately 110 litres per person per day). This effectively assumes the C/I sector is providing services to the population and will therefore grow at the same rate. No other detailed information concerning the growth of the C/I sector is available at this time.

6.3.4 Institutional

Institutional annual demand for the period 1993 to 2000 represented 13.8 % of total system demand. Within this sector, individual customer types analysed include those shown in Figure 6.16. The relative equivalent annual demand per quarter is shown in Figure 6.17 indicating the significant seasonal variation for each customer type with summer being the peak demand season. Each of these customer types is discussed separately in the following sections.

Figure 6-16 Institutional Annual Demand

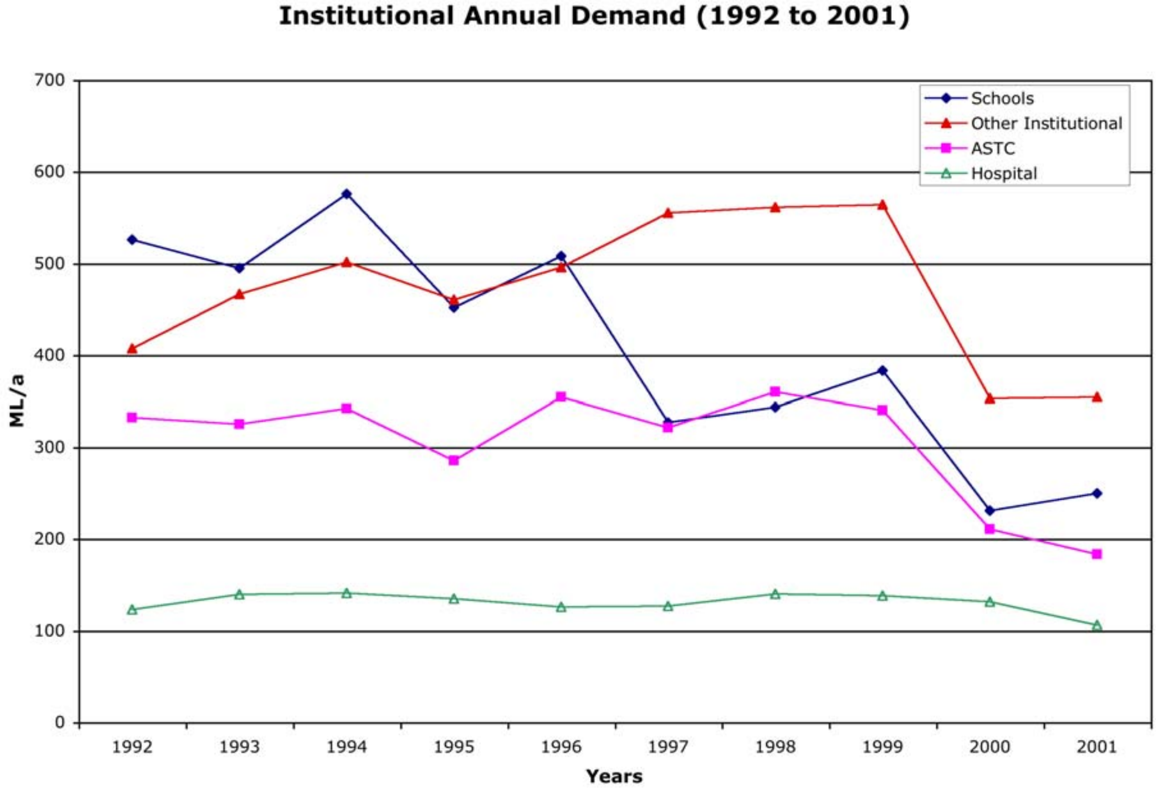
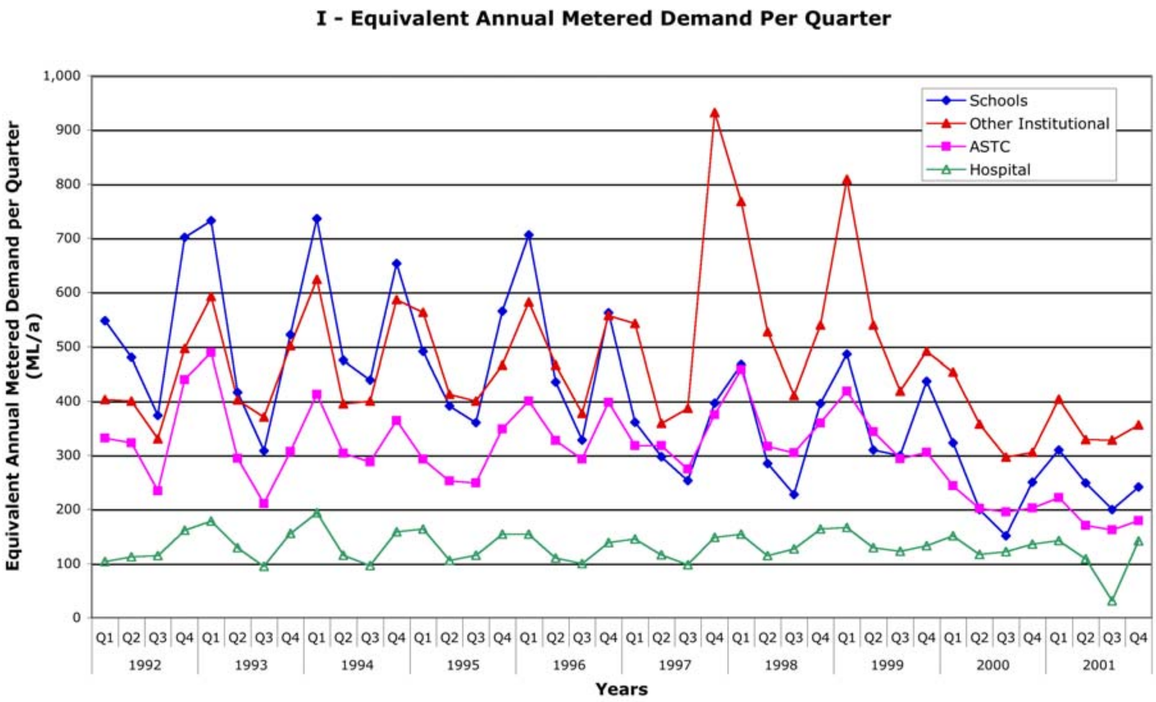


Figure 6-17 Institutional Equivalent Annual Demand Per Quarter

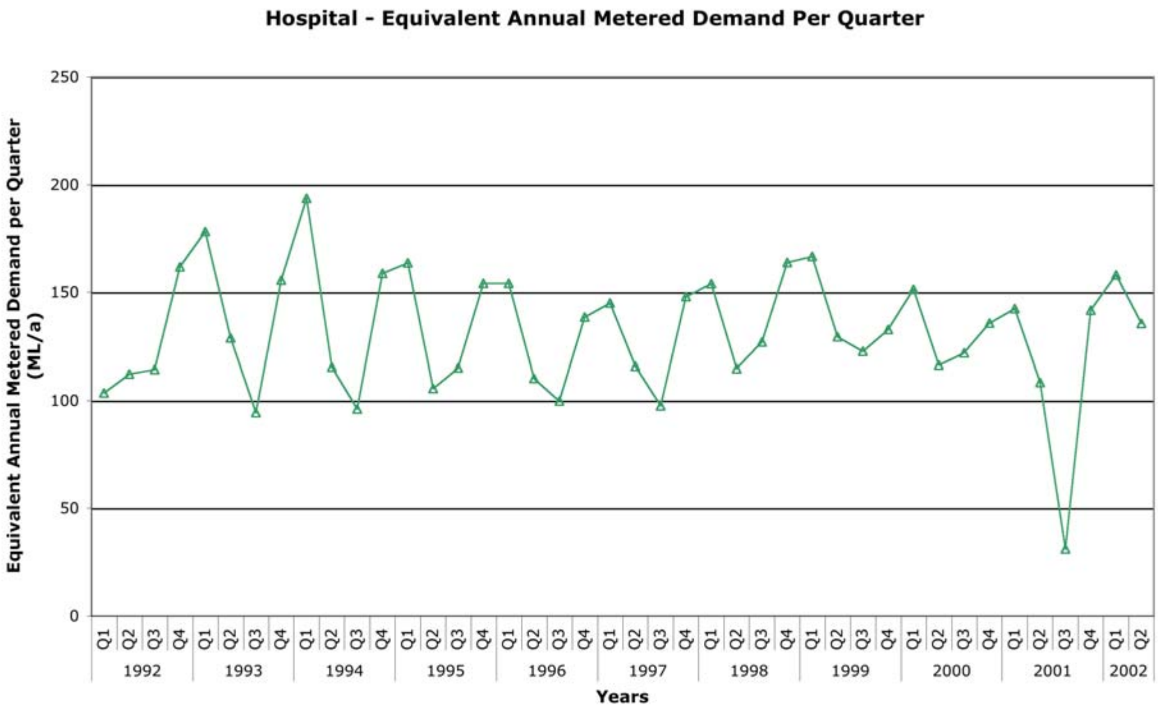


Hospital

The hospital is the single largest customer in Alice Springs using approximately 1.4% (134 ML/a) of total system demand between 1993 and 2000. From a recent trade waste assessment carried out in September 2002 it is believed approximately 65% of this water demand goes to sewer[21] (PW, 2002b).

Figure 6.16 indicates that the hospital annual demand has remained fairly constant over the period assessed. Figure 6.18 shows the quarterly seasonal variation (on a larger scale than Figure 6.17) and indicates that seasonal peaks have been lopped since Q4 1994 and that the base demand has increased since Q2 1998 with the exception of Q3 2001, which is likely to be a customer meter error/fault. The peak quarters are Q1 and Q4 thus indicating that peaks are likely to be associated with outdoor water uses. As with many of the customer types, summer water demand in 2000 and 2001 reduced due to higher than average rainfall.

Figure 6-18 Hospital Equivalent Annual Metered Demand Per Quarter



As the average annual demand has not changed over the period considered (even though the population of Alice Springs has increased), it is anticipated that this demand will remain relatively stable in future. Hence, the historical average annual demand has been used to project future demand (130 ML/a).

An audit of the hospital was carried out in 1998 by the Department of Public Works and Services (DPWS). A summary of the findings with regard to end uses and DPWS recommendations is provided in Appendix E. The end use split is identified in Table 6.1.

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[21] It was indicated that the temperature being discharged was approximately 40 deg C which may indicate that a considerable proportion of the flows are associated with laundry waste.

Table 6-1 End Use Split

End Use	Average Annual Demand%
Base flow/losses	24
Laundry	20
Cooling/boiler/pool	13
Internal (toilets, basins, showers, kitchen, other)	19
Irrigation	24

Source - DPWS 1998

At the time of the audit, it is understood that the hospital was about to undertake refurbishment and possible expansion. It is not known whether the hospital carried out the expansion or took on board any of the DPWS recommendations as no PW discussions have been undertaken since the presentation of the results in 1998 (pers comm. P Heaton).

The hospital has a private borehole for outdoor water use, which was installed by PW (DPWS, 1998, App B p3) and it was planned to link the borehole to the Town Basin supply. However, according to the DPWS audit, it was not being used in 1998 and according to PW staff it is believed that the borehole has not been used and is not currently connected to the Town Basin system (pers comm. P Heaton/J Gibbons). There is therefore potential to save a proportion of potable water used for irrigation by reactivating the hospital borehole.

The analysis results do not indicate a significant change in water usage therefore it appears there is likely to be considerable scope to obtain water and wastewater savings in the hospital in terms of both indoor and outdoor demand. Hence a demand management option has been developed (refer to Section 8.0) aimed at bringing the hospital closer to best practice in terms of water demand.

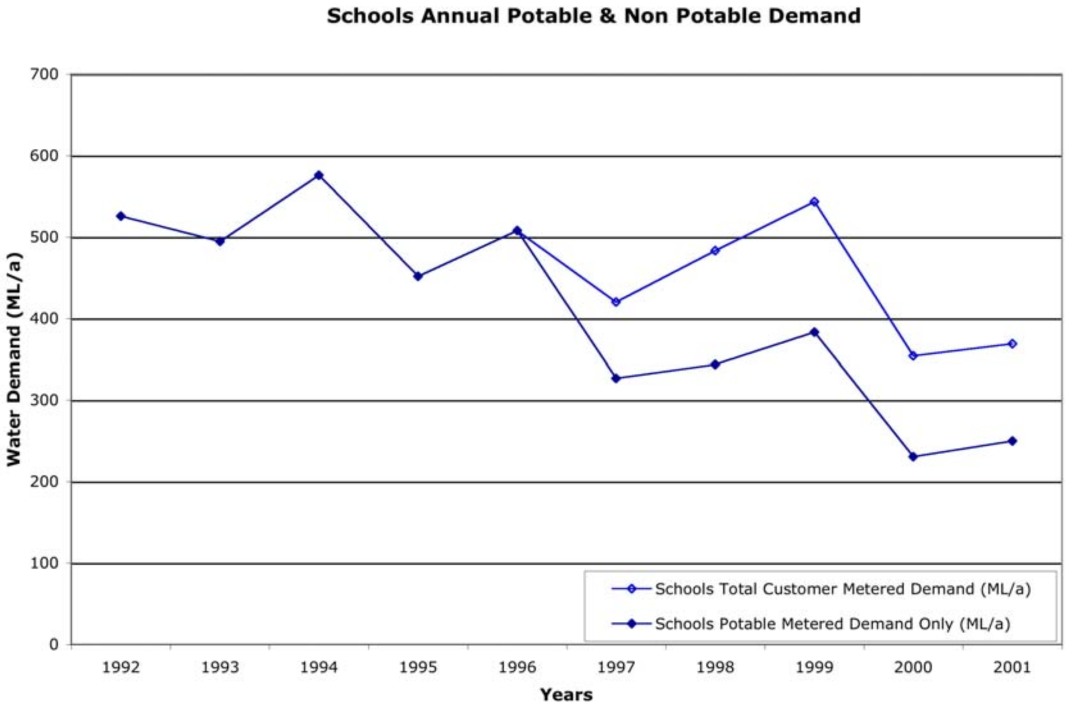
Schools

The average annual demand for schools between 1993 and 2000 was 414 ML/a and represented 4.2% of potable demand. Figure 6.19 shows the decline in average annual demand for potable water but indicates that actual overall demand has not changed significantly due to source substitution with Town Basin non potable supplies (used for irrigation purposes)[22].

There are around 18 primary/high schools and senior colleges in Alice Springs with over 7,000 students and staff recorded in 2001 (e-mail J Childs, 21/2/03). All of these schools have been in existence since 1992 according to customer meters. Of these schools Gillen Primary, Traegar Park Primary, Ross Park Primary, Bradshaw Primary, Alice Springs High School, Sadadeen College and Our Lady of the Sacred Heart College have connected to the Town Basin supply system gradually since 1997. In addition, St Philips College is using a private bore.

[22] The 'Cut the Lawn' initiative was implemented in a number of schools during this period. From the total schools analysis it is unclear whether this demand management initiative was successful. Only by investigating individual schools data could the effect of such an initiative be determined.

Figure 6-19 Schools Annual Water Demand



Not including the unmeasured bore demand for St Philips College, total average annual demand for the period 1997 to 2001 has been 434 ML/a including an average of 127 ML/a from Town Basin supplies (constituting 29% of total demand). These proportions of potable and non potable demand have been used to project schools demand (on average 19 ML/school/a) together with an assumption identifying an increase in the number of schools at particular points in time (relating to the number of schools per head of population (1 school/1,600 residents)).

An audit of five schools was carried out in 1998 (DPWS, 1998) representing approximately 25% of the school student and staff population. Details of the end uses and DPWS recommendations are provided in Appendix E. It is not known whether any of the schools took on board any of the DPWS recommendations as no PW discussions have been undertaken since the presentation of the results in 1998. However, it is unlikely that any of the fixtures would have been modified due to school budget constraints (pers comm. P Heaton). Hence, the options provided in Section 8.0 are based on the potential savings available from the original DPWS audit.

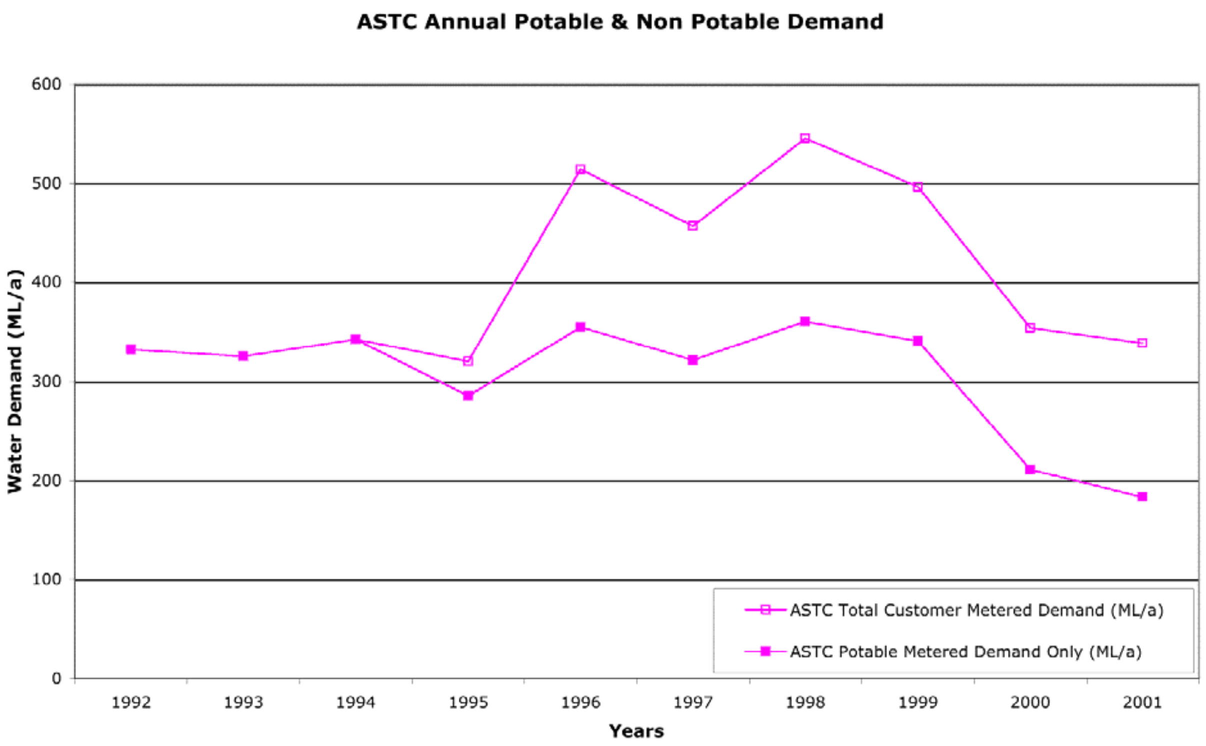
As indicated, a considerable proportion of the schools water demand is being met by the Town Basin supply. However, it appears that efficiency with respect to irrigation methods has not improved. In addition although Anzac Hill High, Braitling Primary, Gillen Primary, Ross Park Primary and two Pre Schools have all taken part in the 'Cut the Lawn Project' (refer to Appendix B) the over all demand for water does not appear to have reduced. This leaves considerable scope to reduce water demand associated with irrigation for both the potable and Town Basin supply.

Alice Springs Town Council

The average annual demand for Alice Springs Town Council ASTC between 1993 and 2000 was 317 ML/a and represents 3.2% of potable and Town Basin demand. Figure 6.20 shows the total water demand for ASTC including potable and Town Basin demand (used for irrigation). As with other sectors, demand reduced in 2000 and 2001 due to higher than average rainfall.

Figure 6.20 indicates that demand for Town Basin supplies significantly increased in 1995. However, it is understood that ASTC used the Town Basin supply prior to 1995 before it was handed over to PW for upgrade and management (pers comm. A Whyte) but the demand records before the handover are not kept by PW and therefore cannot be plotted. The majority of ASTC water demand is used for irrigation, although some potable demand is required for offices/depots. A demand management program has been incorporated as part of the overall institutional option described in Section 8.0.

Figure 6-20 Alice Springs Town Council Annual Demand



The average annual total demand for ASTC between 1996 and 2001 (complete data records) was 451 ML/a of which 35% has been Town Basin supply. To develop a projection of demand for ASTC, the average potable demand and additional Town Basin supply have been used together with a gradual increase in demand associated with population growth. This reflects the increased water use required by council to support the growing population, in the form of additional parks and recreational areas.

Other Institutional

The average annual demand for the remaining ‘other’ institutional customers over the period 1993 to 2000 was 5% of total potable demand (500 ML/a). The major customers within this sector include the airport with an average annual demand of 88 ML/a over 1993 to 2000 and the gaol with an average annual demand of 87 ML/a for the period 1997 to 1999 (limited years used as the gaol only came into operation during 1996 and the meter failed in 00/01). Only limited details are available on the airport and the gaol at this stage. Therefore demand management options for these properties have been included in the general Institutional option developed in Section 8.0.

The airport has applied some water efficient measures such as installation of an arid garden although detail on when this garden was installed and the percentage reduction in water demand is not currently available. From recent observations, there is still scope to apply water efficiency in indoor appliances, as appliances appear to include non efficient single flush toilets, standard tap fittings and showerheads.

From limited investigations, the gaol (with a current population of approximately 350) has a number of water efficiency issues (pers comm. J Childs). A number of water efficiency measures have been attempted since the gaol became fully operational in 1996 including installation of an arid garden and a water recycling plant. However, the arid garden is believed to have caused dust problems, which affected locks within the compound and required its removal and the recycling plant is currently inoperable although this could be rectified at some cost. Other water issues include a known leakage problem (approximately 20%) and the requirement for the gaol to have lawn and garden areas for occupants thus limiting the arid area feasible. Due to the size of population and the potential for indoor retrofits such as taps, showers, toilets and kitchen and laundry facilities as well as outdoor modifications concerning garden arrangements, reactivation of the water recycling plant and leakage detection, the goal could provide considerable water and wastewater savings.

Hence, both the airport and the gaol and other institutional properties such as departmental offices could provide considerable indoor and outdoor water savings. These properties should be amongst the first to be modified for water efficiency to show the government leading by example, to allow the government to trial various appliances before retrofitting in the wider community and to reap the benefits (e.g. reduced energy costs) at both a property owner level and as a service provider providing water and wastewater services.

6.4 Customer Metered Data

The analysis undertaken for this Study has relied on the data obtain from the PW CIS. During the manipulation and analysis of this data a number of difficulties were observed with respect to clarifying classification of customer types such as SR, MR, commercial/industrial, schools and hotels. In addition it was difficult to determine whether a residential property was SR or MR and if MR how many flats were associated with that particular property to assist in determining the demand per unit of occupancy. In a number of cases the data entry was found to be inaccurate.

It is understood that PW is currently investigating replacement of the current customer information system and data recording system. It is recommended that the new system should be as comprehensive and interactive as possible to allow extensive interrogation and manipulation of data to expedite data retrieval and to facilitate and simplify evaluation of data. It is recommended that the existing customer meter information is verified and extended where possible with the use of an audit (e.g. number of units of occupancy associated with a particular property/meter and the labelling of outdoor water meters), in order to assist in flagging high water users and outdoor water demand. Metering of all new individual units of occupancy should be made compulsory to ensure that the effects of user pays principles are maximised in all future dwellings and the use of separate outdoor meters to assist in the measurement of outdoor water demand. Such metering already exists in a number of locations such as Austin in Texas (T Gregg, 2003). In addition customers should be clearly identified using a standard industry coding system to assist in assessing the demand associated with specific sectors and customer types (e.g. tourist accommodation, schools).

6.5 Recommendations

6a – PW/DIPE should ensure that the Town Basin resource and any other source substitution adopted in Alice Springs is used efficiently to maximise reduction in demand on the potable supply and that individual initiatives are evaluated to assess their effectiveness in reducing demand.

6b - PW should investigate whether the hospital borehole can be reactivated for hospital outdoor water demand and/or linking in with the PW non potable operated system to assist in reducing demand on the potable supply.

6c – PW should consider auditing the existing CIS data base to check data entry accuracy and consider expanding fields in order to facilitate easy grouping of customer types for evaluation purposes (e.g. use standard industry codes, identify the number of units of occupancy in individual properties and outdoor water demand). PW should also consider using a meter variance option in the database to highlight when meters fail or water consumption is higher than expected which will assist in targeting demand management measures to high water users.

6d – PW should ensure that the proposed new customer information system allows extensive interrogation and manipulation of data to expedite retrieval and evaluation of data. PW should also ensure that all new multi residential properties have individual meters to ensure that the effects of user pays principles are maximised in all future dwellings and that outdoor meters are made compulsory.

Other recommendations have been incorporated into the options in Section 8.0.

7 THE END USE MODEL

7.1 Introduction

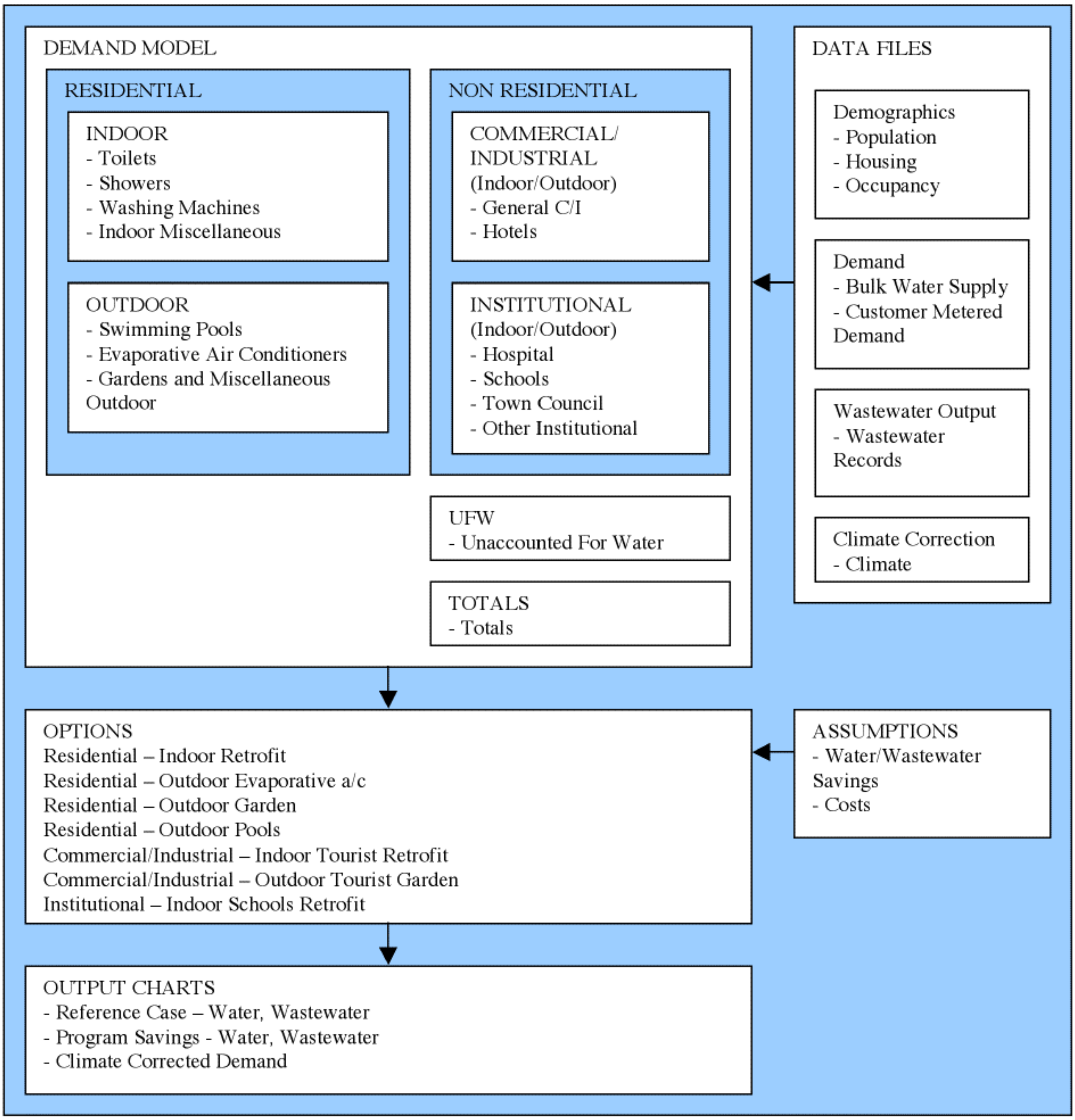
The end use model is simply a tool that is used to project water demand and wastewater production more accurately to enable a water service provider to determine when and how to cater for additional customers. This can be done through augmentation of the system, the use of demand management, source substitution, reuse or a combination of these options. The main output of the end use model is a business as usual or reference case of water demand and wastewater production, which assumes no significant intervention by the water service provider or other authorities (which for example may implement planning controls) that could affect water demand. This business as usual or reference case can be used to compare how demand management and source substitution options can defer augmentation requirements and ultimately reduce the costs of providing services to customers.

The various data sets identified in Section 4.0 (e.g. population, housing stock, occupancy ratios) and the metered water demand identified in Sections 5.0 and 6.0 and analysed in Section 7.0 (e.g. bulk and customer metered demand disaggregated into sectors and customer types), have been used together with data collected from various sources on end uses (e.g. toilets, showers, evaporative air conditioners and pools), to build the end use model and the associated water and wastewater reference cases. Figure 7.1 illustrates a simplified version of the various components that make up the end use model.

The heart of the model is the demand model (identified in Figure 7.1), which considers residential and non residential sectors slightly differently as discussed in the following sections. The full details of the development of the end use model and assumptions used are provided in Appendix F.

The output of the model, the water and wastewater reference cases, are provided in the following sections, and will be used to analyse the effectiveness of the demand management options developed in Section 8.0.

Figure 7-1 End Use Model



7.2 Single and Multi Residential

7.2.1 End Uses

As the SR and MR sectors make up such a large component of demand and are homogeneous in terms of end uses, these have been developed by considering the following individual end uses:

Indoor

- toilets and toilet leakage;
- showers;

- baths;
- taps (kitchen, laundry and bathroom); and
- washing machines.

Outdoor

- pools;
- evaporative air conditioners (a/c); and
- gardens and miscellaneous outdoor.

A series of assumptions about each of these end uses has been combined with data and projections of population and housing to provide an estimate of demand by end use.

The individual end uses have been modelled based on the best available data. The data sources include statistical information from the ABS, other reports by consultants and government departments on water use, published research about the demand for water by end uses and previous ISF work on end use modelling. In addition, a number of other sources have been used such as a residential survey carried out at the Alice Springs Show in July 2002, interviews with specialists on various subjects (e.g. plumbing, air conditioners, pools, gardens) and an experiment on a/c usage conducted by the Arid Lands Environment Centre. The details of these sources are provided in Appendix G. These local sources of information and data have assisted in supporting the assumptions used from other sources around Australia and other countries. This has been essential to obtain an accurate picture of water demand in the home specifically for Alice Springs.

7.2.2 The Alice Spring Show Survey

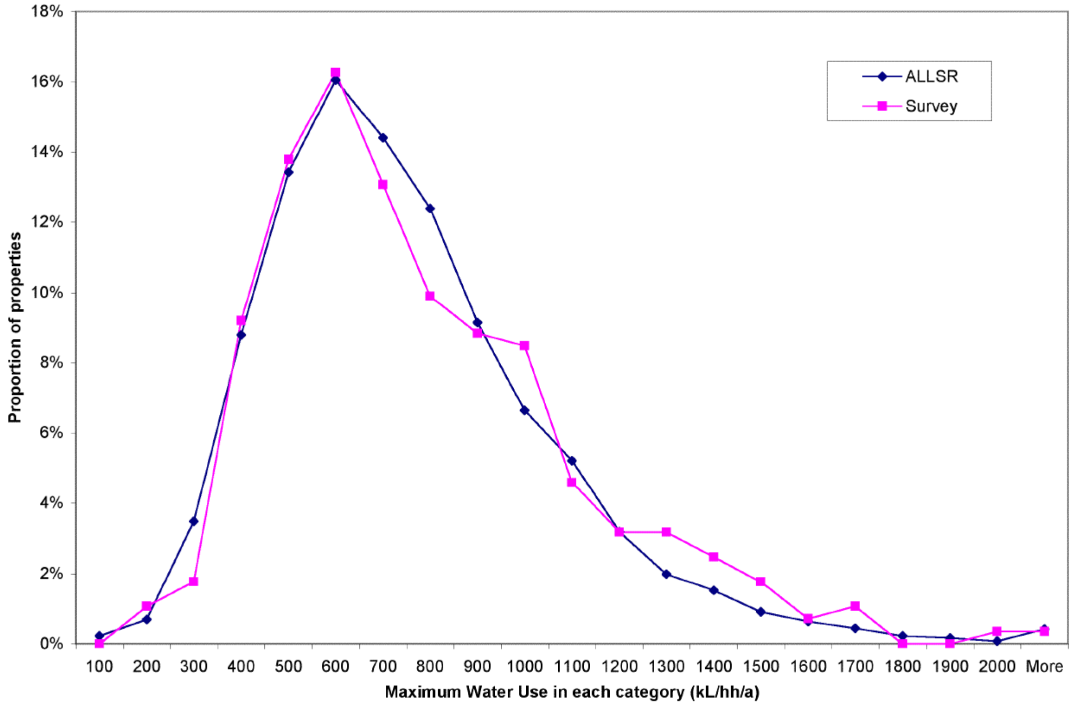
The Alice Springs Show Survey was particularly useful in assisting in identifying water using appliances in the home. The questions asked in the survey were designed to obtain information on:

- the proportion of dual flush toilets and efficient showers;
- types of washing machines and number of loads normally used each week;
- number of evaporative a/c units and their discharge point (e.g. sewer, stormwater system, garden);
- types and size of gardens watered;
- types, timing and duration of garden watering; and
- number of swimming pools and pool cover ownership.

Figure 7.2 shows how the demand of a stratified sample of 258 SR participants in the Alice Springs Show survey, relate to the total SR sector. As indicated the characteristics of the household water demand represented in the survey is highly consistent with the total SR sector water demand. Hence, many[23] of the survey results have been used to assist in testing assumptions in the local context.

[23] Survey respondents were asked to authorise the linking of their survey with their customer metered demand. Only those who agreed could be used in the analysis.

Figure 7-2 Annual Water Demand of All SR Households Compared with Alice Springs Show Survey SR Customers



7.2.3 Current and Projected Demand

Two stages are required in end use modelling. The first is a snapshot of current demand and the second is a projection.

The *current demand* usually includes some form of stock modelling to understand the range of technology currently in use and the range of efficiencies of these technologies (e.g. inefficient 12 litre single flush toilets compared to efficient 6/3 litre dual flush toilets). Then there is a need to consider usage patterns.

The basic questions therefore are:

- What appliances do people have?
- How often do they use them?
- How much water is used each time?

This 'building of demand from first principles' is compared with the average demand from metered data analysis to help calibrate the model.

In order to *project demand* by end use, trends and changes in ownership need to be considered. This can include new technology entering the market and the take up rate of that technology or changes in efficiency of existing appliances (e.g. top and front loading washing machines). There may also be planned regulations or other changes that could affect the usage behaviour of individuals.

Generally, data is available for 'residential properties', without distinction between SR and MR properties. For this reason the model has been developed to provide an average consumption per person per day, (i.e. litres per capita per day, LCD). This average demand can be combined with occupancy to provide separate projections for SR and MR properties.

7.2.4 Residential End Use Splits

From the end use analysis carried out to build the end use model the breakdown of SR and MR household demand has been developed. These are illustrated in Figures 7.3 and 7.4 respectively.

Figure 7-3 SR End Use Split

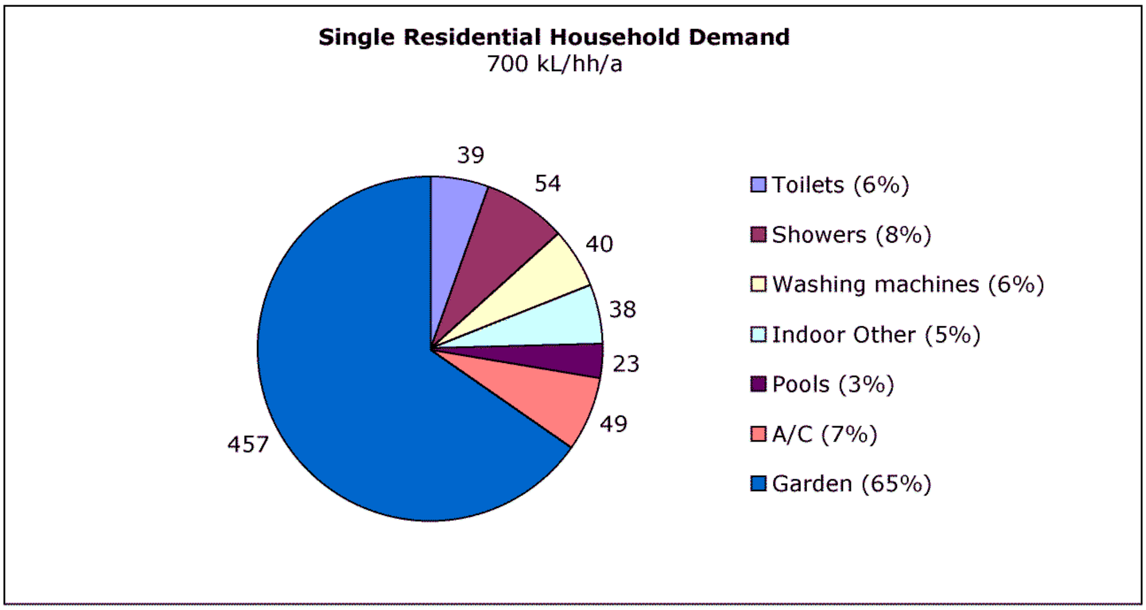
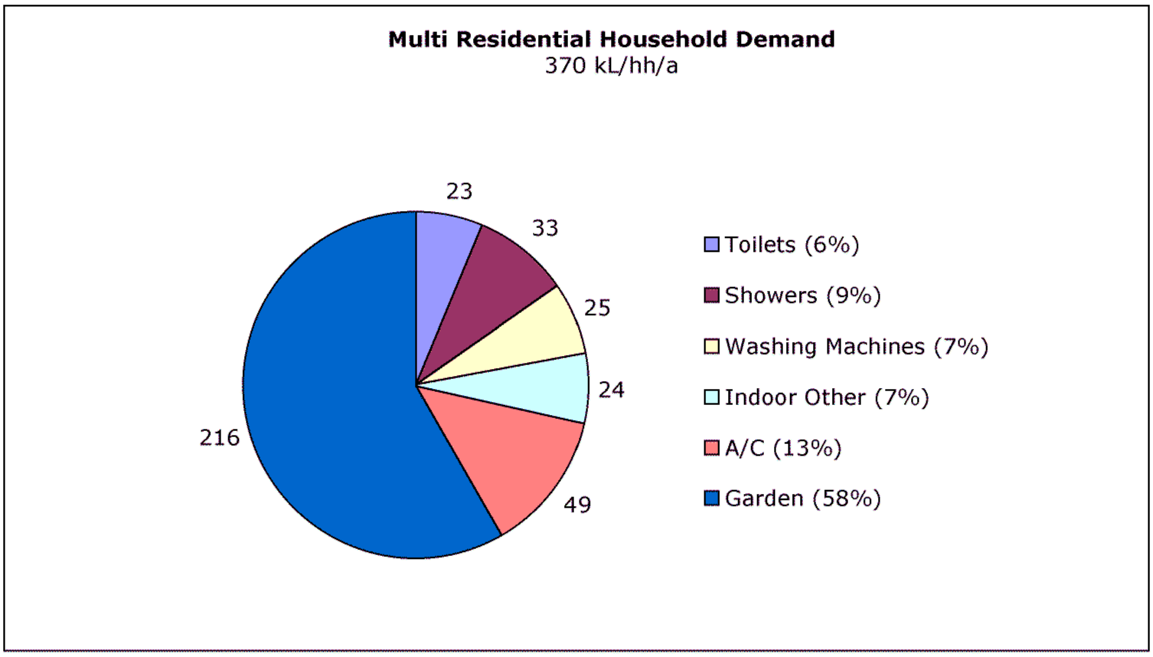


Figure 7-4 MR End Use Split



As can be seen the annual demand for SR and MR households is very different, with SR households having almost twice as much overall annual demand as MR households (mainly associated with occupancy and garden watering). The significant outdoor component of demand in the SR sector related to garden, pool and a/c use has been targeted in the demand management options identified in Section 8.0. A comparison showing seasonal variation in outdoor water use, is provided in Appendix F.

7.3 Other Residential, Non Residential & UFW

As the end uses of the other residential and non residential sectors are less homogeneous, it is difficult to develop an end use model for these sectors. Hence, the historic demand for individual customer types (as detailed in Section 6.0) is used to first understand demand and then used to inform the projection of demand, taking into consideration any other factors that may have affected historical demand, such as the use of source substitution. This can result in average demand for a shorter, more stable period being used in projections. The historic and projected demand are then added to the model together with projections on UFW to build the total projected demand.

Table 7.1 shows the sectors and customer types considered in this way and the basis for the projections, including identification of the periods used to determine the most likely future water demand. The 2002 column shows the model's start point for projections (the average of selected preceding years).

Table 7-1 Summary of Other Residential, Non Residential & UFW Projections

Sector	Projection basis	Result (ML/a) 2002	Result (ML/a) 2021	% change	Notes
ASTC	Constant demand/property (3 ML/a: average between 1996 and 2001) with property numbers increasing with population (1 property for every 286 people)	295	354	20%	Additional 156 ML/a of Town Basin supplied water
Hospital	Very stable demand. Projected with constant average demand of 130 ML/a	130	130	0%	
Hostels	Constant demand/property (11 ML/a: average between 1992 and 2001) with property numbers increasing with population (1 property for every 4,400 people)	69	88	28%	
Hotels	Constant demand/property (13 ML/a: average between 1992 and 2001) with property numbers increasing with population (1 property for every 52 to 60 people)	647	782	21%	
Institutional	Projection based on average demand/property between 1997 and 1999 as these are the most complete years of data (6 ML/a per property) with numbers increasing with population (1 property for every 268 to 120 people).	560	644	15%	
Schools	Constant demand/property (19 ML/a: average between 1996 and 2001) with property numbers increasing with population (1 property for every 1600 residents)	307	397	29%	Additional 127ML/a of town basin supplied water
General C/I	Constant equivalent demand/person, i.e. related to total population (110 L/p/d: average between 1992 and 2001)	1,081	1,301	20%	
Town Camps	Constant equivalent demand/person, i.e. related to total population (47 kL/p/d: average of 2000 and 2001, since demand has been significantly increasing in recent years)	456	554	22%	
UFW	Based on 240 L/connection/day UFW would be 830 ML/a in 2002. Using residential demand to indicate the increase in connections UFW has been projected at 16% of total residential demand.	830	1052	27%	

7.4 Sewage Model

Since the overflow of effluent to Ilparpa swamp is an issue of concern, a sewage model has been developed. The sewage model relies in part on the end use model and in particular, the division of ‘indoor’ and ‘outdoor’ uses. For the residential sector, this is taken as the indoor component of demand (identified in Section 7.2.1). For the other residential and non residential sectors, specific data[24] has been used where possible. When no data was available, a discharge factor was applied to the winter component of water demand.

As with the water demand model the sewage model is calibrated using available flow records (e.g. the Alice Springs WWTP inflows). From discussions with PW (pers comm. K Mashford) it has been found that the flow records available are inaccurate due to the measuring device on one of the inlet streams to the WWTP being inoperable at times. Therefore, accurate calibration of the model using this data cannot be achieved at this time.

Investigations have indicated that a number of properties to the south of the Gap are not sewered and therefore should be removed from the sewage model. These properties include the rural residential properties and a number of other commercial/industrial and institutional customers (e.g. the airport, gaol and brewers industrial estate). These properties have been removed from the sewage model, however, the historic sewage volumes in the model still appear to be slightly higher than those identified by the limited sewage flows recorded. No additional data on sewage flows is currently available to make this model more accurate. However, if the details of the trade waste investigations and more accurate sewage flows are collated by PW, the model can be modified accordingly later.

No allowance for exfiltration and a small allowance for infiltration have been incorporated into the model as no specific details were available at the time of this Study. However, as indicated earlier the model can be adjusted by PW later if these details become available.

7.5 Peak Model

Annual peak day demand has been analysed using the daily bulk meter supply records and forms the basis of an annual peak day model. This model is to assist PW in identifying how individual demand management options can assist in reducing peak day demand. For example, the replacement of a single flush toilet with a dual flush toilet will not significantly affect seasonal water demand. However, a demand management option that focuses on water efficiency in the garden is likely to have a considerable effect on water demand on peak days in the summer and less effect in the winter when garden watering is at a minimum.

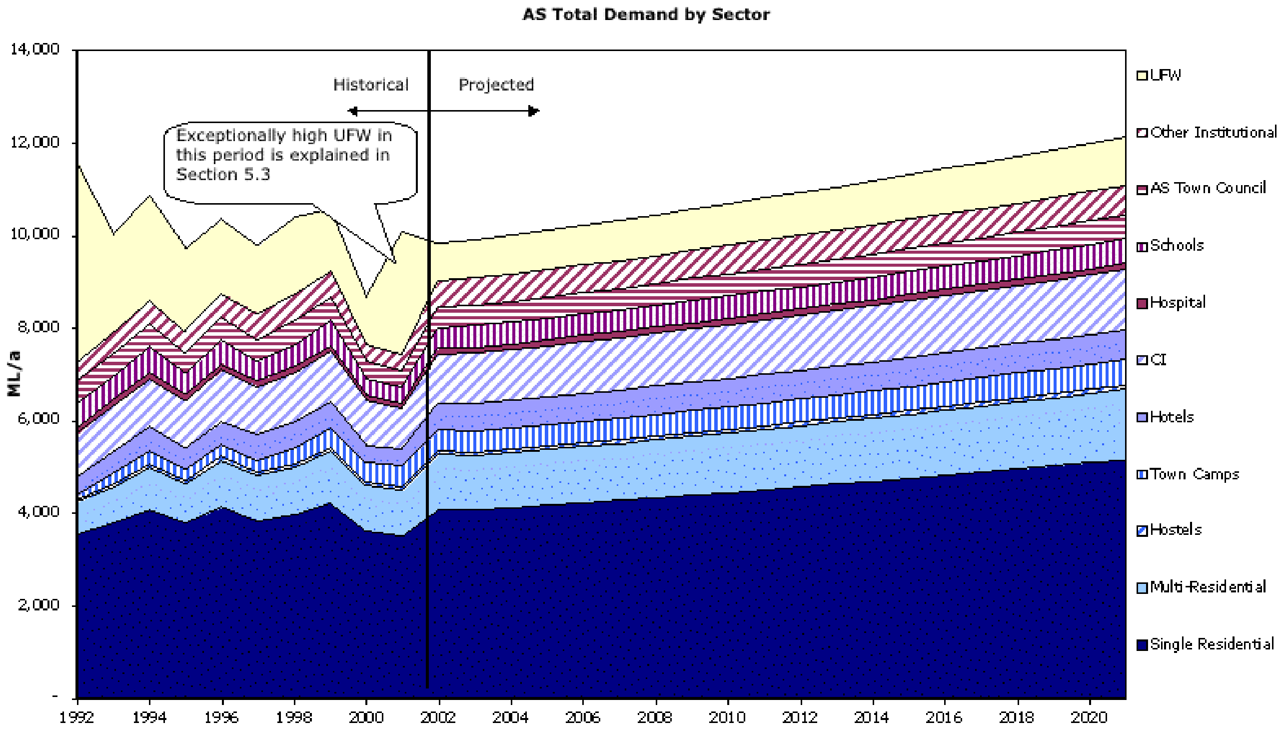
The analysis undertaken shows that annual peak day demand has been on average 1.66 times the average annual demand over the whole 21 year period assessed. Although this ratio, known as the peaking factor has ranged from 1.81 to 1.42 in 1993 and 2001 respectively, no specific trend is evident. Based on this analysis the average peaking factor for the period 1997 to 1999 (1.61) has been applied to the projected demand in the reference case to generate the peak demand model. Using the shorter period of 1997 to 1999 allows for peaking differences associated with the Town Basin supply and removes any anomalies that may be due to the unusually wet years of 2000 and 2001. Although the demand reference case is developed in ML/a, this has been converted to equivalent average ML/d for generating the peak day model.

[24] Investigation of the hospital discharge carried out by PW indicated that sewage discharge was 65% of potable water demand.

7.6 Reference Cases

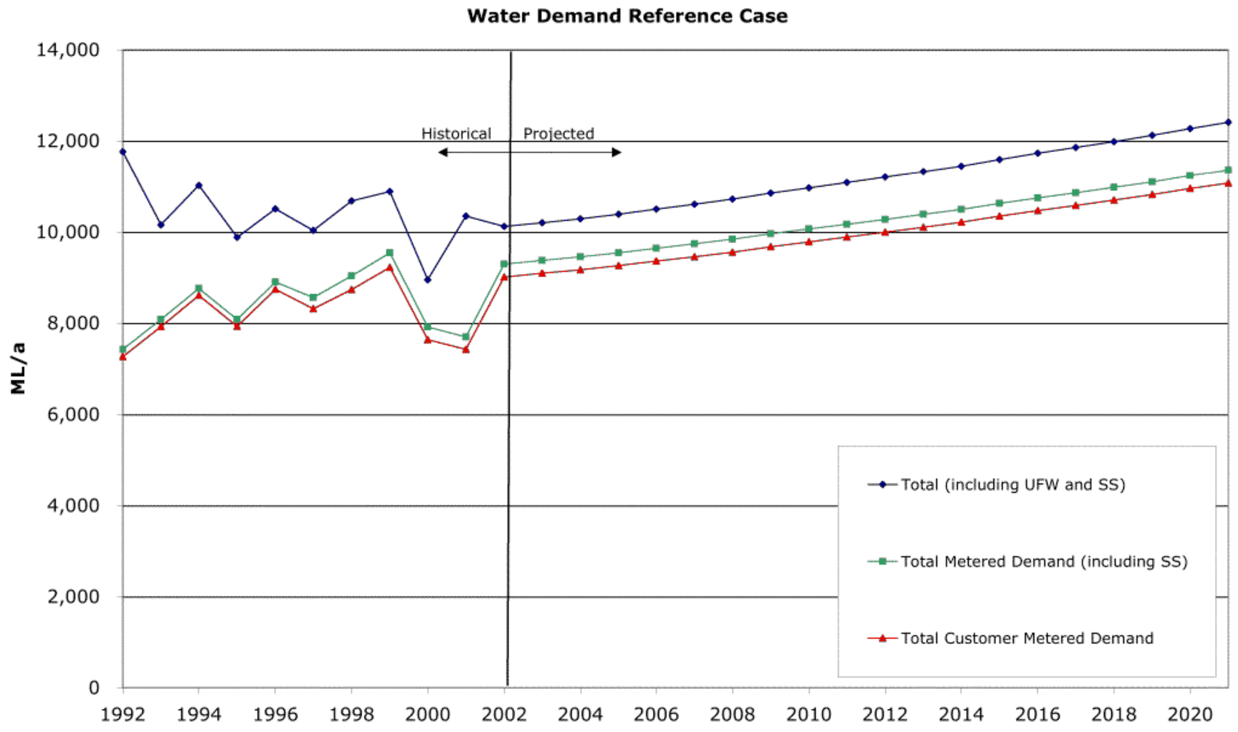
From the end use model the total historical and projected demand for potable water by sector (including UFW) is shown in Figure 7.5.

Figure 7-5 Total Historical and Projected Demand for Potable Water



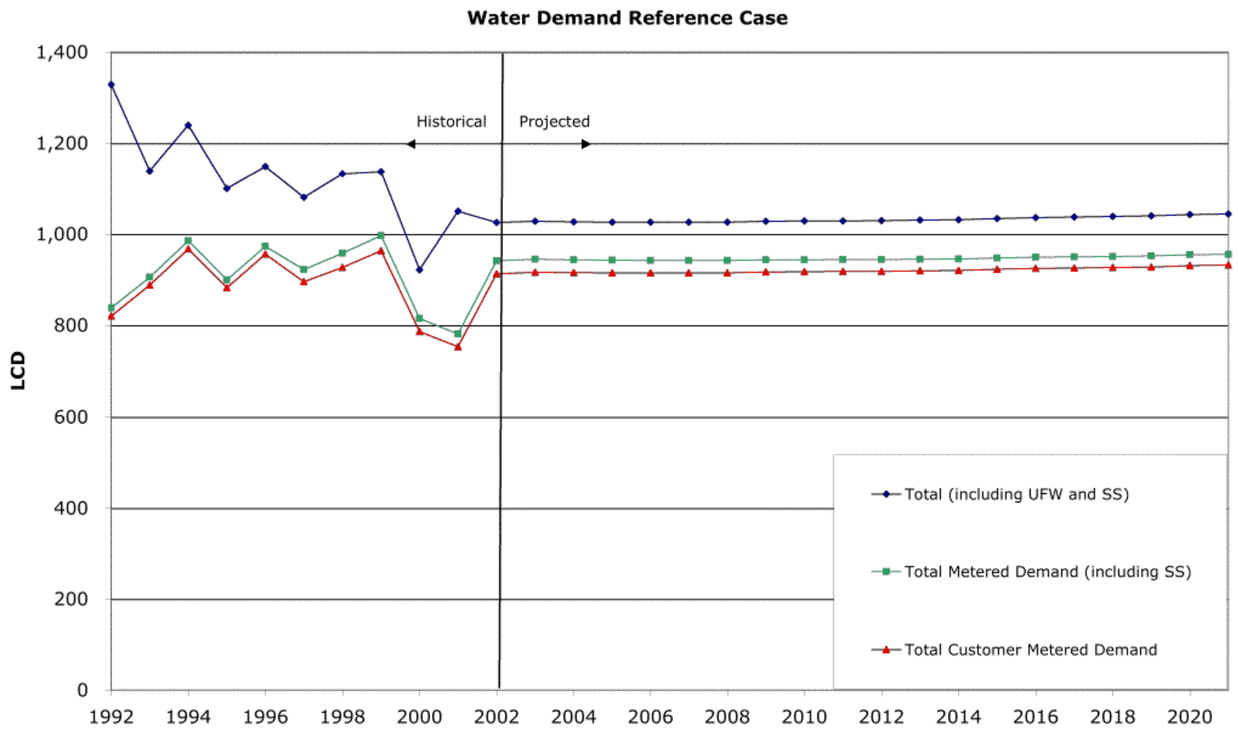
The reference case for water, which will be used to assess the options in Section 8.0, is shown in ML/a and LCD in Figures 7.6 and 7.7 respectively. In both Figures 7.6 and 7.7 the total water demand is shown, including both potable and PW supplied source substitution (Town Basin). Figure 7.6 shows a significant increase in total demand over the next 20 years, which appears to be in contrast to the gradual decrease in total demand experienced over the last 10 years. However, Figure 7.7 which shows the LCD, indicates that the drop in demand experienced over the last 10 years has been mainly associated with a decrease in losses (UFW) and increase in non potable supplies and that demand per person has actually stayed fairly constant. Figure 7.7 also shows that the projected demand per person is expected to remain at a similar level to historical demand (not including UFW) and thus the increase in total demand shown in Figure 7.6 will be mainly associated with population increase.

Figure 7-6 Water Demand Reference Case (ML/a)



Note SS is source substitution.

Figure 7-7 Water Demand Reference Case (LCD)



Figures 7.8 and 7.9 show the sewage model reference case in ML/a and ML/d respectively, which has been derived from the indoor component of the demand model. These figures show the total historical and projected sewage flows, the residential component and the actual metered flows entering the WWTP. As indicated the metered flows vary substantially over the limited period monitored and the modelled historical flows appear higher than actual recorded flows although as identified in Section 7.4 these recorded flows are likely to be low due to an inoperable flow meter at the WWTP. The sewage reference case will assist in assessing the options developed in Section 8.0.

Figure 7-8 Sewage Model Reference Case (ML/a)

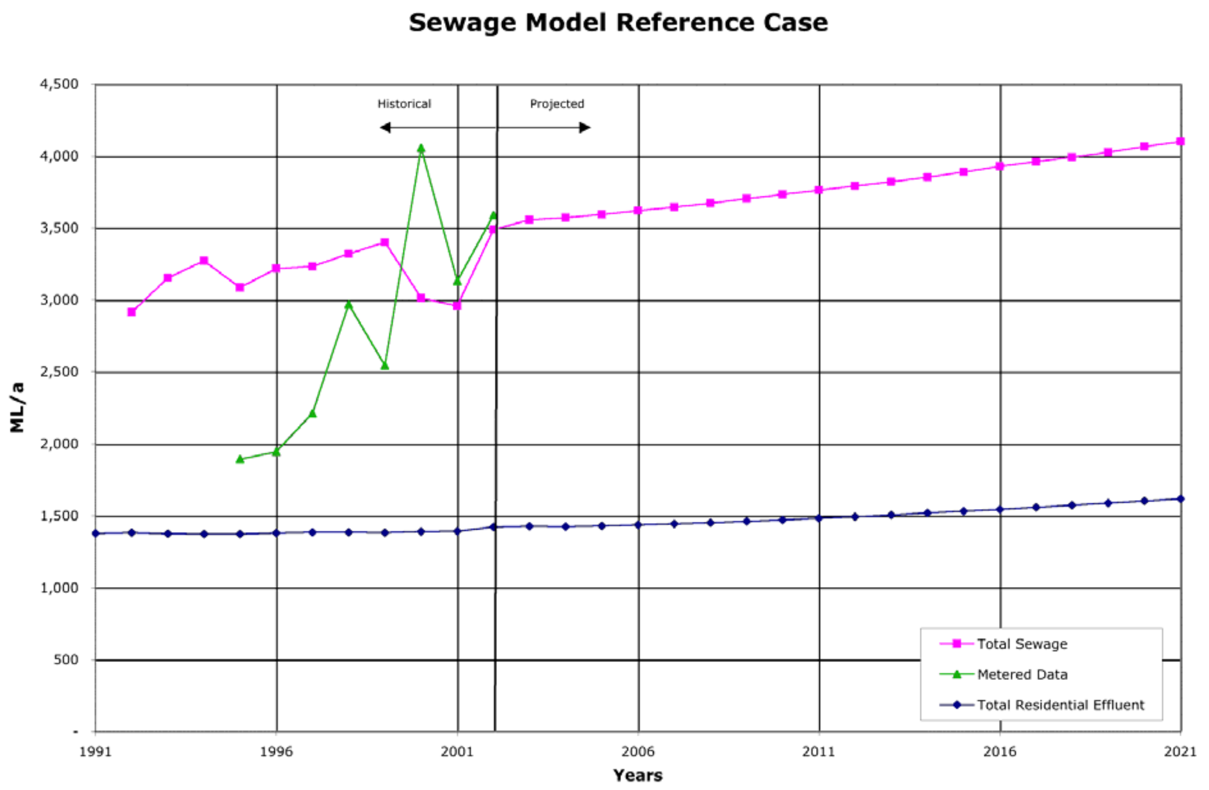


Figure 7-9 Sewage Model Reference Case (ML/d)

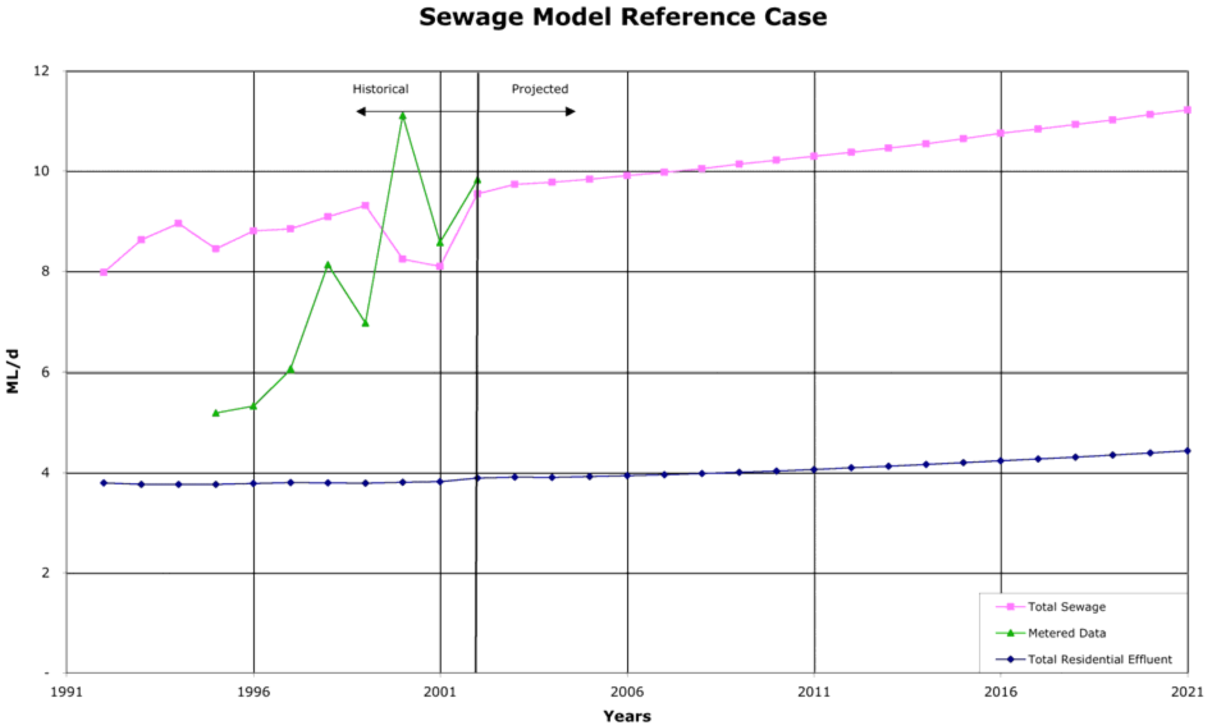
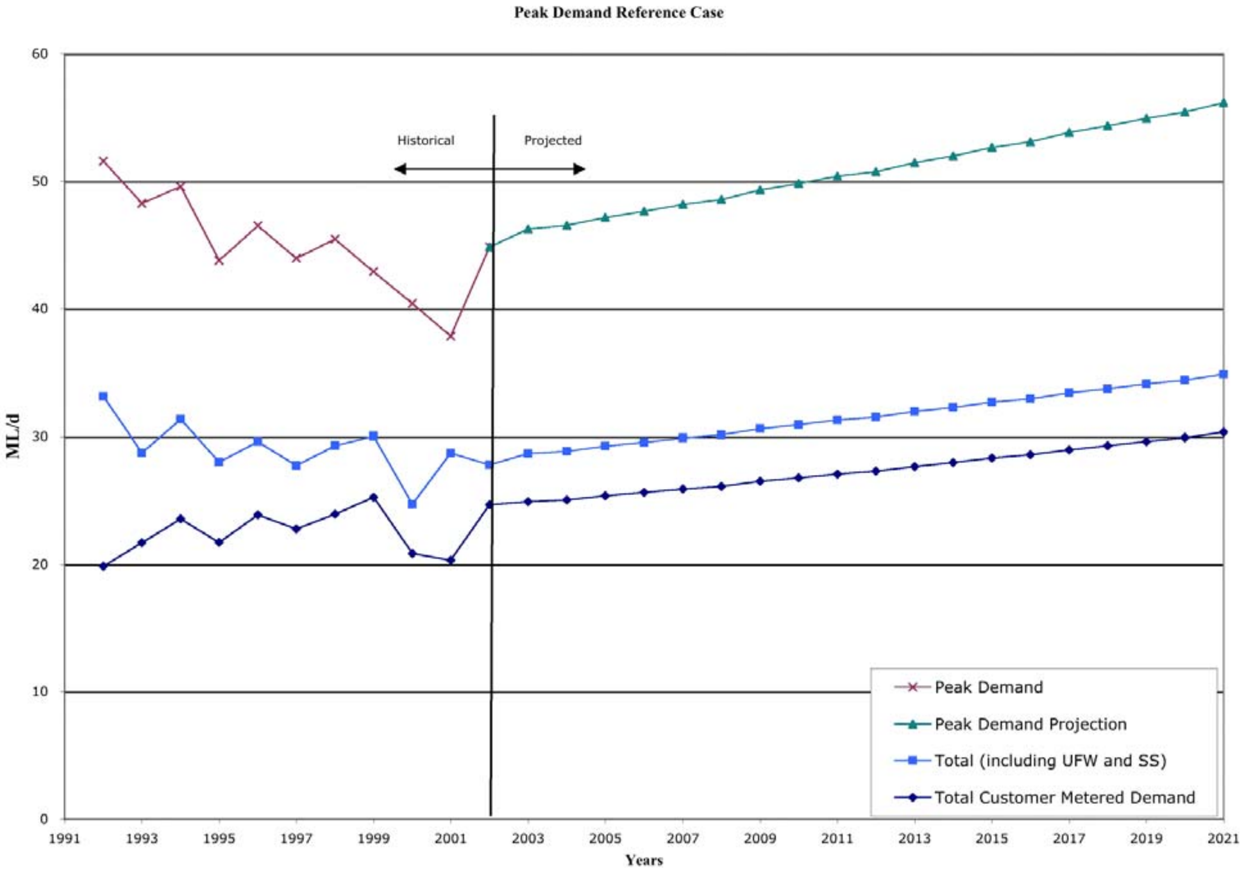


Figure 7.10 shows the peak day water demand reference case in ML/d associated with the peak model described in Section 7.5 and illustrates the significant difference between historical peak day and average day demand. The peak day demand is likely to continue to be an issue in Alice Springs as shown in the projection unless demand such as outdoor water usage can be targeted under a demand management program. This reference case has again been used to assist in the assessment of options in Section 8.0.

Figure 7-10 Peak Day Water Demand Reference Case (ML/d)



7.7 Recommendations

7a – PW should use the data obtained as part of the Trade Waste investigations to refine the sewage discharge assumptions contained in the sewage model. In addition when reliable WWTP sewage flows become available these should be used to calibrate the sewage model.

7b – PW should ensure that accurate flow meters are installed at the WWTP at various locations such as the inlet, treated outlet and overflow to Ilparpa swamp to assist in future evaluation of demand management options undertaken and to assess requirements for upgrade.

8 THE DEMAND MANAGEMENT PROGRAM

8.1 Introduction

Having obtained an understanding of the historical water demand in individual sectors and projected demand in terms of total and peak water demand and wastewater production (illustrated in the reference cases in Section 7.0) a suite of demand management options have been developed which when combined form a demand management program. The options target all water using sectors, water demand, peak demand and wastewater production and take into account work already complete or current (e.g. water efficiency audits of government buildings and the NT Waterwise for Schools program).

Using the water and wastewater reference cases developed in the end use model it is possible to assess how individual demand management options, that make up a demand management program, affect the projected annual and peak water demand and wastewater production. The suite of demand management options that make up the program can be tailored to achieve the required goal at the lowest cost by considering the present value unit cost ($ per ML of water saved) for each individual option.

PW/DIPE in consultation with the Alice Springs community have identified preliminary targets of:

- a 25% reduction in total annual water demand over the first three years, with a further 10% reduction in the following two years;
- a 10% reduction in peak day demand over the first three years, with a further 5% reduction in the following two years; and
- a reduction in inflows to the WWTP from 8 ML/d to 7 ML/d.

During the development of the options under this Study, which are described in detail in the following sections, it has been found that the preliminary targets identified will be difficult to achieve through the use of demand management alone. Hence three scenarios have been considered (1-low, 2-medium, 3-high) which assist in illustrating the level of savings attainable from the options developed depending on the level of investment provided to implement the demand management options.

It should be noted that the targets identified are only preliminary and that they should be reviewed in the light of the findings of this Study by PW, DIPE, ASUWMSRG and the Study Team. The targets set should be based on the desired outcomes in terms of deferred augmentation, level of investment the NT Government is prepared to commit to a demand management program and commitment of other initiatives such as leakage control.

The following sections provide details of: the overall program management requirements; the options developed that will target a broad range of customers and water efficiency issues; the scenarios; other options that should be considered; the water savings, costs and benefits of the individual options developed; and brief discussion on ranking of the options. It should be noted that the options have been developed to be implemented as part of a program and not in isolation. Isolated implementation of any of these options is likely to lead to higher costs and potentially lower water savings. Further details on assumptions for each option are provided in Appendix H.

8.2 The Program

8.2.1 Program Manager & Staff Resources

To maximise the success of a demand management program it is essential that it is planned, controlled and documented in a similar way to a capital works project, as the benefits achieved and money invested will be equivalent. Hence, the demand management program will require a project manager (the Program Manager) and a number of trained supporting staff (the Program Team) for a minimum period of five years. To achieve the required goals it may be advantageous to employ the Program Manager on a performance contract linked to water and wastewater savings. Both the Program Manager and the Program Team will require a wide range of skills to carry out the implementation of the demand management program.

The key tasks of the Program Manager will include:

- control of the overall demand management strategy, recruitment of staff required, control of customer action plans and sign off;
- negotiation and liaison with trade allies and other stakeholders;
- organisation of training courses and trade allies accreditation;
- co ordination of communication and education material, vouchers, media releases;
- arrangement of tenders for elements of the program; and
- management of the monitoring and evaluation of the program.

8.2.2 Integration of the ASUWMS

As the demand management program will be an integral part of the ASUWMS it will be essential that the Program Manager and Team are kept up to date with the progress of the rest of the Strategy and that the Team provide feedback to the ASUWMS Team on progress and uptake of various elements of the demand management program. It will also be essential for the ASUWMSRG to remain engaged in the Strategy to provide feedback from the community.

8.2.3 Communication Strategy

An important element of the demand management program is the communication strategy, ensuring that the water saving message reaches a diverse cross section of the community. It will be vital that the message and advice provided by the Program Team and trade allies is of ‘one voice’ and that the communication and education materials used are well presented, easy to understand, informative and practical. The communication strategy will involve elements such as:

- a generic advertising campaign through radio, newspapers and television (when required);
- information booklets/pamphlets/stickers covering a/c, pools, garden watering, water efficiency tips around the house and more focussed material on hotels and the non residential sector for use in general and specific options respectively;
- mail out and point-of-sale vouchers and information for general and target groups;
- general enquiry telephone number for information on promotions available and where advice can be obtained; and
- training material for trade allies, auditors and specialists.

The costs of training materials, including the courses by which trade allies would gain certification to be involved in the program have been distributed across the options. The Program Team would organise the training of participants for relevant options.

To increase awareness of water issues among the general public it may be advantageous to use more innovative communication strategies such as art work in public or prominent places, periodic competitions for water efficiency ideas, games for families and calendars that provide advice on water scheduling in the garden and reminders on when to check for leaks. These more innovative communication approaches can be explored during the development of the implementation plan under Stage III of this Study.

8.2.4 Monitoring and Review

A vital element of a demand management program that is often overlooked is monitoring, review and evaluation. Demand management programs often reap an enormous benefit when this review process occurs in parallel to implementation. This means that the later phases of the program can be adapted according to the strengths and weaknesses found (a process also referred to as adaptive management). For example, a common leakage problem associated with outdoor taps might be found during a number of garden specialist visits to SR households. Future visits could be modified to include the costs of additional materials and time to fix such leaks as well as carrying out the garden advice service. In addition, assessing the water savings resulting from an option by analysing the meter readings of participants against a control group can be undertaken part way through implementation. This has the added advantage of allowing that option to be modified if the estimated savings are not achieved.

8.2.5 Implementation Issues

Another vital element of demand management programs is the thorough consideration of implementation issues. Stage III of this Study will be required to develop the implementation plan for the proposed demand management program. Hence, implementation issues have not been fully addressed in Stages I and II summarised in this Report. However, to ensure the options developed under Stages I & II are practical and applicable to Alice Springs, implementation issues have been considered to a limited extent. This has been addressed in part by conducting interviews with specific customer types and specialists such as plumbers and evaporative air conditioning contractors and by consulting with the ASUWMSRG.

On 20 March 2003, a workshop was held in DIPE offices where the Study Team presented Stages I & II of the Study to the ASUWMSRG (including the draft options developed). After the presentation a workshop was convened to discuss the concerns and opportunities of the options developed and to suggest modification where necessary. The details of the workshop discussions are provided in Appendix I. During the workshop, it became evident that the ASUWMSRG had the view that implementation issues were extremely important and needed to be investigated thoroughly. Thus indicating that Stage III will need to include investigation of a number of implementation issues to ensure the smooth implementation of the options developed.

Some of the key implementation issues identified during the Study and by the ASUWMSRG during the workshop are:

- Concerns associated with hard water deposits affecting water efficient showerheads and other water efficient devices. It has been proposed to trial a number of water efficient appliances for suitability in the Alice Springs environment before a widespread retrofitting program is implemented or to use a survey to gather information on efficient appliance that are already being used in Alice Springs.

- It will be essential to ensure that trade allies such as garden specialists and plumbers, who will be critical to the successful implementation of a number of programs, trust and support the programs being implemented, the equipment installed and the message being given to the customers. Hence, during Stage III, it will be essential to bring representatives of trade allies into discussions on individual programs. For example, a number of plumbers in Alice Springs are sceptical of water efficient appliances and believe that hard water will be an issue with respect to performance. Carrying out trials or surveys and identifying appliances that work effectively in Alice Springs should allay these concerns. Other issues such as the watering requirements for various plants, the best way to present outdoor water efficiency tips and the way to engage with local residents to obtain the maximum uptake of outdoor programs developed will require close liaison with garden specialists. In addition, novel ideas such as the use of centrally controlled watering systems or pager information systems on when to water (which have been used in the U.S.) could be advantageous and should potentially be trialled in Alice Springs.

- There is a need to link the proposed programs with other initiatives such as the ALEC Myer Foundation funded project on water conservation, Cool Communities, Desert Knowledge and CRC projects to take advantage of synergies that may be available and to ensure that the programs complement other initiatives being implemented and advance knowledge where possible.

- A clear and consistent message on water efficiency that will engage the residents and visitors of Alice Springs, is required. Innovative ideas and advertising will be required to change attitudes and behaviour. A brand name for the demand management program may be required and the use of brand distinction may aid in identifying appliances that are water efficient.

Consideration of these and other implementation issues will be undertaken in more detail during Stage III of the Study, which will help to secure the savings estimated in this Report. Where possible and appropriate, trials, pilot studies or surveys should be conducted and close liaison maintained with specialists to ensure the implementation plan developed is as robust as possible and ready for the implementation phase of the demand management program.

8.3 The Options

To maximise the success of individual options and ultimately the overall demand management program, it is essential to use a combination of measures and instruments. Water efficiency measures are the actual changes needed and instruments are the means by which those changes are encouraged or required. A measure, for example, might be the fitting of a AAA-rated water efficient showerhead and this might be combined with the instrument say an economic incentive, where PW pays for the showerhead and labour cost of fitting. It can also be advantageous to add a second instrument, for example a communicative aspect where the plumber provides the customer with information prepared by PW about water saving tips around the home. By combining water efficiency with financial incentives and communication and education, PW is likely to obtain a higher uptake of customers interested in the demand management option and is likely to achieve both structural and behavioural changes leading to water savings.

This Study has involved the development of a suite of options covering a number of sectors and customer types. These options have been chosen based on analysis of the individual sectors discussed in Section 6.0 and the interviews carried out with various specialists on specific issues (e.g. a/c, swimming pools, plumbing, gardening) and discussions with customer types (e.g. public housing, Pine Gap, Town Camps and Amoonguna). The preliminary version of these options were discussed with PW/DIPE and the ASUWMSRG at the workshop of 20 March, and many of the issues raised in the workshop have been used to refine the options. As identified earlier some issues raised at the workshop related to implementation issues, which will need to be addressed during Stage III of the Study.

A brief description of each option is provided under the following headings:

- residential indoor;
- residential outdoor;
- other residential;
- commercial/industrial;
- institutional;
- new developments; and
- other options.

Further summary details of the options are provided in Table 8.1, together with potential savings and preliminary present value unit cost estimates. Issues relating to the program scenarios, costs and benefits, ranking and other options to consider are discussed in the subsequent sections.

8.3.1 Residential Indoor Options

This section includes residential indoor options for each of the end uses typically contributing to SR and MR indoor household water use.

Residential Indoor Retrofit[25]

PW would establish a retrofit initiative where householders are offered the opportunity to improve their indoor water efficiency. The associated communication strategy would use direct mail, letterbox drop, community-wide advertising, door knocking or a combination of approaches. Once a household was booked in, a plumber would visit the house and complete the following:

- replace an inefficient showerhead with a AAA-rated water efficient showerhead (additional showerheads could be purchased separately depending on program budget);
- install tap flow regulators and stainless steel seatings on kitchen and bathroom basin taps;
- install a toilet displacement device in single flush toilets (to reduce the single flush volume); and
- check for leaks around the home (including leakage from pressure relief valves on water heaters, which appears to be an issue in Alice Springs).

The plumber would also provide advice on continuing maintenance and checking for leaks, and provide information including a leaflet on tips for saving water around the home. The cost of this option includes plumber training, hardware and labour costs. To maximise the uptake of the initiative the cost of the retrofit would be borne by PW with only a small charge to the householders if considered necessary.

To maximise potential savings PW may consider including a dual flush toilet retrofit in preference to using the toilet displacement device, although this option would be more expensive because of additional capital and labour costs. This sub option could be investigated further in Stage III if deemed necessary. However, the Alice Springs Show survey found that around 80% of households already have at least one dual flush toilet. Although it should be noted that a high proportion are likely to be 11/6 litre or 9/4.5 litre models rather than the more efficient 6/3 litre models.

Washing Machine Rebates[26]

In this option, PW would provide a rebate (credited on the water bill or sent via cheque) on the purchase of a new AAAA-rated water efficient washing machine[27], which must use no more than 12 litres of water per wash for each kilogram of rated load capacity. The option seeks to increase the sales of AAAA-rated machines, which can provide on average a 50% reduction in water demand for this end use. Similar initiatives implemented elsewhere have effectively paid for the difference in the purchase price between efficient and inefficient models, which is typically around $150. Historically front loading machines have been more water efficient than similar sized top loading washing machines. However, a number of efficient top loading machines are now currently available. Hence, for a rebate option it will be essential to give guidance on the most efficient models available in Alice Springs.

[25] Sydney Water Corporation has carried out a similar program on over 185,000 households to date.
[26] Sydney Water Corporation recently commenced a similar program which offers a $100 rebate.
[27] QLD EPA supports minimum performance standards and the Melbourne Water Strategy Committee has also recommended appliance efficiency regulation (White and Campbell, 2002).

To maximise the impact of this option, PW should consider using a ‘trade-in’ scheme. Eligibility for the rebate would require proof that an inefficient washing machine was being replaced. This would minimise the incidence of ‘free riders’ (e.g. those people who were likely to buy a new efficient washing machine anyway) and ensure the removal of inefficient machines from the stock.

Public Housing Retrofits

Public housing represents 8.4% and 22% respectively of the SR and MR housing stock in Alice Springs and analysis has revealed that these properties have an average water demand only slightly lower than the average in the SR sector and a higher average in the MR sector. Given the advantages of dealing with one property manager and the potential to reach a large proportion of the SR and MR houses in Alice Springs, public housing has been considered a target customer.

This option would be similar to the residential indoor retrofit option. A plumber would visit the house and replace one inefficient showerhead with a AAA-rated showerhead, install tap flow regulators and stainless steel tap seating, install a toilet displacement device and check for leaks (e.g. taps and toilets). The option includes an annual maintenance check to ensure leaks are detected quickly both indoors and outdoors. Under the medium scenario, ‘Scenario 2’, additional savings have been included by considering the repair of any toilet leaks found although this would incur extra costs. The cost of this option includes plumber training, hardware and labour costs.

Outdoor water savings associated with public housing MR households have been considered under the Cooling Alice 2 option in Section 8.3.2.

8.3.2 Residential Outdoor Options

Considering the high outdoor water demand in Alice Springs, it will be essential to set up a strong outdoor foundation program to raise general awareness on garden watering. The foundation program would involve setting up a demonstration garden either in a prominent position such as the centre of town (e.g. on ASTC maintained land), at a series of locations in town to provide an arid garden trail (which could potentially reach more people), or adjacent to existing garden interest areas such as garden centres. The existing demonstration gardens are located in more remote locations such as the airport and the power station with the power station demonstration garden having fallen into disrepair and the airport demonstration garden not being obvious to visitors coming into town. Therefore, a more centrally located, informative demonstration garden could reach more local people including home owners, tenants and tourists, thus raising general awareness and interest in water efficiency.

In addition, water efficiency tips/brochures/promotions would be provided at key locations such as ALEC, the Olive Pink Botanical Gardens, garden centres, PW/DIPE offices, the ASTC offices and irrigation specialists’ centres with at least one member of staff being able to provide additional advice to interested customers. Additional information on changing watering regimes/water efficiency tips/latest promotions would also be posted in the local newspapers, on the radio and provided by letter drop at specific times of the year. The foundation option would also require water restrictions to be implemented such as complete bans on the use of irrigation systems during peak evaporation times during the day in the summer months. Such restrictions would need to be enforced by using fines or other penalties.

This general raising of awareness through the ongoing foundation program would assist in increasing the participation rate of the Outdoor Water Efficiency Visit Option offered by PW and described below.

Importantly, the Outdoor Water Efficiency Visit Option described below has been developed assuming that the foundation option would be implemented first and the Targeted Outdoor Visit Option also described in the section would follow. This results in the Targeted Outdoor Visit Option having much lower costs as most of the training and establishment costs need to be spent to implement the foundation program.

Outdoor Water Efficiency Visit

PW customers would be offered a free or minimal cost visit to their home by a water efficiency landscape advisor. The advisor would visit the home and together with the owner, complete an inspection of the garden. The major points to note would include the type of watering system (e.g. fixed, pop up) and any water saving devices (e.g. tap timers). Where these devices are in place the advisor would confirm with the owner how they currently use the item and together they would carry out routine maintenance including flushing of lines and unclogging of drip lines. Where these are not in place, the advisor could provide free devices including tap timers, drip irrigation system components, and rebate vouchers for the purchase of native plants and mulch up to a maximum value of $50 per household. The customer would also be provided with a brochure on water saving in the garden.

This Outdoor Option includes a Pool Option component where PW would also subsidise the cost of purchase of a pool cover ($500) where the advisor had identified that no pool cover was currently being used. If a cover existed but was not being used by the customer the advisor would encourage the customer to use the pool cover to reduce evaporation losses and advise of the advantages of using a cover, particularly during summer months.

This option would be implemented in spring and summer only, over approximately three years, with a repeat visit by the garden specialist at the end of the summer period to ensure the equipment was still being used effectively and to advise on changing the watering schedule for the new season.

If this initiative was implemented over a number of years the option could be modified according to the strengths and weaknesses identified by evaluating the initial implementation phase.

Targeted Outdoor Visits

This option is similar to the Outdoor Water Efficiency Visit Option but it requires PW to specifically target high water using SR properties. With this targeted approach, it is reasonable to assume that savings will be significantly higher because of the higher average demand.

Similarly, this option offers a visit by a landscape advisor. However, customers will be targeted and telephoned by PW after assessment of the customer water meter database. Their high water bill will be mentioned to indicate the financial savings they could accrue by participating in the Outdoor Water Efficiency Visit Option. In this way, the option is proactive and does not rely on participants calling PW. Similar levels of giveaways will be provided (i.e. $50 per participating household and pool cover vouchers where assessors deem this appropriate).

Pool Cover Rebates

This is a stand alone option in which PW would subsidise the cost of the purchase of a pool cover (approximately $500) and broadly communicate the advantages of using a cover during summer to reduce evaporation losses. Although this option has been considered in isolation it is recommended that it is combined with the Outdoor Water Efficiency Visit Option and the Targeted Outdoor Visit Option described previously in order to reduce the cost of this option and to minimise the effect of ‘free riders’ (participants who already have a pool cover and wish to update it).

Cooling Alice

The Cooling Alice Option involves a communications campaign to encourage residents to use their evaporative air conditioner in the most efficient and effective way possible. The communications strategy would involve developing a brochure detailing maintenance steps for managing an air conditioner, including simple steps such as providing adequate ventilation by opening doors and windows. The brochure would be sent to all households with their pre-summer water bill together with a voucher for a subsidised air conditioner maintenance service visit (to be redeemed before Christmas). The service technicians would be trained to use the opportunity to communicate with residents about how regular maintenance will save them water and cool their houses more effectively.

After the first round of services, the program should be evaluated (participants compared with non participants) to ensure its effectiveness. In the following year, the program may be repeated subject to this evaluation.

Another option that could be developed under this campaign, would be for PW to subsidise the costs of collecting bleed off from MR public housing and use it for garden irrigation. This would illustrate the concept of 'the Government leading by example'. Cooling Alice 2 Option combines the Cooling Alice Option and the MR public housing collection initiative. Although the unit cost of the Cooling Alice Option has been considered it is recommended that the Cooling Alice 2 Option is taken forward for implementation (refer to Table 8.1).

8.3.3 Other Residential Options

Other residential options include those that combine indoor and outdoor options for specific customers. The customers considered under these options are Pine Gap households and the Town Camp and surrounding Aboriginal communities.

Pine Gap Water Saving

Similarly to public housing, Pine Gap manages a substantial number of the SR and MR houses in Alice Springs (4.6% and 10% respectively) and thus provide an opportunity to deal with one property manager responsible for a large number of houses. In addition, analysis (refer to Section 6.3.1) has revealed that the SR Pine Gap properties have a significantly higher water demand than the average SR demand and thus provide a greater opportunity for savings.

From the interviews with Pine Gap housing management representatives (refer to Appendix D) and discussions during the workshop held on 20 March 2003 (refer to Appendix I) it has been found that Pine Gap has taken steps to fit water efficient appliances and to manage outdoor water demand. However, the analysis shows that these steps have had little affect on the per household demand. Hence the option for Pine Gap has been modified from that presented at the workshop in that instead of clearly identifying which items would need to be retrofitted, an allowance per household would be used and a target water demand level developed.

It is suggested that targets be established for these SR and MR properties and steps taken to ensure that demand is reduced to equal or less than the average demand per property in Alice Springs. Funds would be provided on a per property basis in an individualised manner to achieve these savings through innovative steps as deemed necessary by audits. It is likely that although some devices have been fitted in the Pine Gap households that they are not achieving the anticipated result for a number of reasons. For example, it is known that many of the Pine Gap households have been fitted with flow controllers on the showerheads which restrict flows to 10 L/min. However, research indicates that when such devices are fitted on a standard efficiency showerhead (designed for flows around 21 L/min) that the quality of the shower is often compromised and customers may resort to removing the device. It is often better to actually invest in a well designed AAA-rated water efficient showerhead (designed for lower flows) which will be accepted by the customer and is more difficult to remove once installed. Another example is when automatic irrigation systems are installed in gardens. When well designed and used efficiently such systems can dramatically reduce outdoor water demand. However, if set up and managed incorrectly they can lead to significant water demand increase.

This option would be designed so that the Program Manager would consult with Pine Gap housing management representatives and investigate what has been implemented and what needs to be done to achieve a target level of average Alice Springs household demand in terms of both indoor and outdoor water demand. Details of the analysis of individual households would also be provided indicating households with above average demand, which could be targeted by the Pine Gap housing managers for both structural changes (e.g. retrofitting of devices) and behavioural changes (e.g. discussions with the residents on how water is currently being used in the home and discussion around how to reduce this). The Pine Gap housing managers would then ensure that all new houses and refurbishment of houses use the most appropriate water efficiency devices, all new residents receive information on water efficiency practices, outdoor water efficiency is regularly checked and modified and on going review of water records becomes embedded in the management of the Pine Gap households.

Although not conducted for this phase of option development, it would be possible to target the highest water using households for implementing these options first which could provide higher savings at less cost.

Under Scenario 2 this option has been further developed in that additional funds for retrofitting purposes would be provided, to assist households to achieve significant savings and bring demand in Pine Gap households down significantly to the levels found in Sydney.

Town Camps & Surrounding Aboriginal Communities

This option would see the Program Manager liaising with groups already working in the Town Camps and the surrounding Aboriginal communities of Amoonguna and Iwupataka. Given that established relationships exist between advisors and residents in the camps, it is recommended that PW provide funding directly to those groups undertaking the work. The funding should be directly linked to water efficiency measures that may include retrofitting high quality and robust water efficient devices and may be used in education or communication initiatives as determined by the long-term advisors in the area.

PW is not advised to undertake their own retrofitting or other water efficiency actions in Town Camps or the surrounding Aboriginal communities, as the established relationships are very valuable and not easily replicable. Although, discussions between the Program Manager and individual property managers to assess the best strategy considering the history of demand on each site, would be valuable. In addition PW assistance with leakage detection and rectification in the more remote locations of Amoonguna and Iwupataka would be advantageous.

The option would require submissions from property managers or groups already working in the Town Camps to PW. The submissions would need to include details of what is proposed and the evaluation steps to be undertaken after implementation. PW would establish effective metering before implementation for evaluation purposes. Continuing funding would be provided with additional PW support if savings were not being achieved.

8.3.4 Commercial/Industrial Options

It is important to also target the non residential sector in a program of this type. Although the industrial sector can often achieve long-term savings through installing water efficient equipment, in the commercial sector operational changes are usually also required.

General Commercial/Industrial Auditing

The top 40 C/I properties with the highest average annual demand in Alice Springs represented 40% of water demand in the general C/I sector. Many of these properties also have very high seasonal water demand variation indicating high outdoor water use. Targeting of these top 40 properties could provide significant savings.

PW would contact these large water users and arrange to conduct an indoor and outdoor audit to identify high water using practices. In consultation with the property manager an action plan would be developed to reduce both indoor and outdoor water demand. Subsidies would be provided for work required with sign off necessary following implementation. Ongoing liaison would be required with these participants to ensure the savings are maintained.

Hotels

Of the 50 tourist accommodation establishments in Alice Springs, 17 represented 82% of the hotel sector water demand between 1993 and 2000. By targeting this relatively small number of properties, a significant volume of water and wastewater could be saved.

PW would implement a combined indoor/outdoor hotels efficiency option, which involves establishing management level sign off to an action plan developed in consultation with the hotel. The plan would include aspects of staff training (e.g. laundry, cleaning, kitchen practices, ongoing leak detection), indoor efficiency, retrofits of showers/taps/toilets (e.g. displacement devices), outdoor garden advice and subsidies for equipment and materials and communication strategies and materials for guests. This option would result in the need for significant long-term commitment from hotel management. Hence, continued liaison/signoff with the individual hotels would be required to ensure the ongoing checks and training were effective.

A mail-out of standard brochures would also be sent to all other hotels (approximately 33) and they would be invited to send participants to the hotel staff training courses to be run by PW.

PW would also need to clearly identify the outdoor water meter in the customer database for evaluation purposes or install one if separate meters do not exist. Many of these hotels already have additional outdoor meters and many are in the process of installing them to clarify the outdoor component of their water demand to enable them to reduce their trade waste charges. However, outdoor meters are not compulsory and those meters on the PW CIS are not clearly identified.

8.3.5 Institutional Property Options

The institutional sector represents nearly 14% of total potable demand and virtually all of the Town Basin non potable demand. Customers include the hospital, schools, ASTC, the airport, the gaol and various government offices, which are amongst the largest water users in town. Many of these properties/customer types are known to have leaks, inefficient appliances and large outdoor water usage and thus provide considerable opportunities for water savings. They also present the benefit of only needing to approach a limited number of property managers and ease of implementation due to the ownership of the buildings concerned. A further benefit is that the government reaps the water and energy savings in terms of expenditure on a per property basis as a customer and from the point of view of supplying water and energy as a service provider.

Government owned premises present the government with important opportunities to lead by example in terms of reducing water and energy demand. It is recommended that PW seek to use this opportunity to implement what can be highly visible changes and thereby demonstrate its commitment to reducing water demand. It also presents the opportunity of fitting or modifying appliances such as waterless urinals and efficient AAA-rated showerheads, which introduce the public to new appliances thus raising awareness of water efficiency.

General Institutional

The NT Government would use this option to demonstrate ‘Government leading by example' in this major water efficiency undertaking. Over a period of three years, all government owned institutional buildings in Alice Springs would be retrofitted with efficient appliances. The option would involve visiting each of the properties and carrying out an indoor/outdoor audit to identify high water using practices and an action plan would be developed for each property to reduce both indoor and outdoor water demand. Typical water saving actions may include retrofitting dual flush toilets/tap regulators/water efficient showerheads/waterless urinals, replacement of irrigation systems/use of remote controlled watering systems/removal of lawn, replacement or retrofitting of industrial washing machines, use of additional metering and leakage detection and monitoring of evaporative air conditioning systems and collection/reuse of bleed off. Ongoing liaison would be required with the property managers to ensure savings are maintained and any issues addressed. Integrating changes into management practices would be a major aspect of this option, including changes to garden watering practices. This is especially important, as watering can be a highly visible activity and should be used to demonstrate good practice at all times.

The institutional sector would be one of the first sectors to be targeted to allow trialling of appliances before widespread retrofitting in other sectors, to assist in resolving audit and implementation issues before they arise in programs developed for other sectors and to show the government leading by example. Promotional material/brochures/water saving tips could also be distributed through government workplaces to obtain easy access to a large proportion of the residential population. Feedback would be sought on this material, which could then be modified and then distributed to the wider community.

Hospital

As the single largest water customer the hospital would be targeted. A DPWS audit was conducted on the site in 1998 however, it is not known whether any of the limited recommendations were implemented. Hence this property could potentially provide significant indoor and outdoor savings.

As with the general institutional option, indoor and outdoor end uses would be investigated and retrofitting or modification carried out where necessary on end uses such as taps, showers, toilet and washing machines as part of an action plan. Leaks would be investigated and the current management practices associated with cleaning, laundry facilities, outdoor irrigation practices and cooling maintenance checks. A management action plan would also be set up to ensure management is in line with best practice and ongoing liaison and evaluation would be undertaken between the hospital and the Program Manager to ensure savings are maintained.

Schools

PW would establish a relationship with all schools and colleges in Alice Springs (approximately 18 customers). Firstly retrofits would be carried out on all taps (the use of flow regulators and stainless steel seating) and on any single flush toilet or inefficient urinal (installation of displacement devices).

Significant base flow has been indicated in the DPWS audits and this will be targeted in all schools. A thorough audit will be carried out to detect existing leaks. This may include installation of additional meters on a/c units or outdoor end uses. These additional meters will provide greater surveillance capability and facilitate early detection of leaks in the future.

Average potable demand for outdoor water use in schools is estimated to be as high as 50% with additional outdoor water demand being satisfied by Town Basin supplies. This demonstrates significant demand and illustrates a need for efficient watering practices. PW would offer a garden specialist visit to advise on efficient watering practices (duration, timing and frequency). Moisture sensors would be provided and subsidies towards mulch would be offered.

DIPE is currently developing an NT Waterwise program for schools, which offers a grant of $5,000 per year with a maximum of $1,500 available per school (or school campus). The program is an accreditation system that encourages schools to meet essential criteria which are designed to meet both educational and 'action' orientated outcomes (i.e. saving water). The criteria also require the school to make an ongoing commitment by developing a school policy statement about water conservation. The program provides information resources, staff support, excursion guide, and links to other educational materials and programs that deal with water.

The schools program developed as part of this Study would build on the NT Waterwise program by allowing additional funds to be made available to develop a curriculum package and enable at least one class in each school each year to undertake a project on water efficiency around the school. For example activities may include: monitoring meters around the school associated with irrigation systems, evaporative air conditioners, kitchen usage; and assessing trends to observe seasonal variation and identify leaks. This would raise awareness in the school and allow children to discuss water efficiency with their friends and parents at home having gained practical knowledge around school.

Savings for this option have been estimated based on current potable demand. It is likely that savings would also be achieved through increased efficiency in the use of non potable Town Basin supplies and allow further substitution of potable supply with Town Basin supplies.

8.3.6 New Developments Options

One of the major opportunities for more innovative steps to reduce water use is available to the community in the form of new developments. Planning controls in many different forms can be effectively used to ensure that new buildings have the most efficient means of providing water services. In NSW this is being embraced by PlanningNSW, which is undertaking a cost benefit analysis to demonstrate that resource efficiency (including water, energy and waste) is most effective when undertaken in new residential buildings at the time of construction. The BASIX index for efficiency in new residential buildings (currently being developed by PlanningNSW together with the cost benefit analysis) is likely to become a regulatory tool, which could be adopted by other states/territories.

Residential Building Controls

In this option a planning control[28], similar to those used by Marrickville Council in Sydney, would be developed requiring the installation of water efficient fixtures in all new residential developments. The development and exhibition phase has been anticipated to take twelve months and six months later the control is expected to affect all new properties. The control is likely to include a requirement for AAA-rated showerheads, flow regulators in taps and 6/3 litre dual flush toilets combined with mandatory annual a/c maintenance by an accredited service agent. As part of the design, the positioning of the a/c units would be considered to minimise exposure to full sun and take into consideration accessibility for maintenance. In addition, the control would require either the installation of a water efficient washing machine (usually applicable only in a MR context where laundries are part of the development) or a minimum efficiency points score attained, based on a landscape plan submitted to the regulatory authority.

Compliance with this control is to be secured by a bond, submitted at the time of application for development. The bond would be returned twelve months after completion of the property upon inspection of the garden or the installed washing machine, together with submission of an invoice for inspection and maintenance of any a/c device installed on the property.

This form of option could be extended to include renovated buildings where all renovated buildings are required to comply with a specific water energy standard and are inspected to check compliance and ensure issues such as stormwater/wastewater cross connections are not an issue of concern.

Non Residential Building Controls

A non residential planning control would be developed involving a points system. The system would be designed to require new developments to prove that they have incorporated water efficiency measures, saving at least 25% relative to current standard practice. Compliance with this control is to be secured by bonds, submitted at the time of application for development. The bond will only be returned twelve months after completion of the building, following an inspection of the property and submission of an invoice for an annual maintenance/inspection of any a/c device installed.

8.3.7 Other Options

Leakage

Leakage reduction by PW could also provide significant savings. Although leakage savings are not required to be considered under this Study, an estimate of savings has been determined, which is shown in Table 8.1 and Figures 8.1 and 8.2. The possible savings from an active leakage reduction program which brings PW in line with other utilities with losses at the lower end of current Australian practice (which still provides considerable opportunities to reduce losses further and come in line with international best practice) has been calculated using available figures (refer to Section 5.3). It is considered that PW could achieve a saving of approximately 415 ML/a with the current number of connections by reducing losses to 120 L/connection/day with savings increasing as the number of connections increases over time.

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[28] The NT Government would need to determine the best method to achieve desired outcomes (e.g. installation of AAA-rated showerheads, tap flow regulators, Xeriscape) with respect to current and prospective statutory control mechanisms.

The cost of this option has not been included in the analysis, however, Figures 8.1 and 8.2 show an indication of the considerable additional savings that could be achieved through such a demand management option. Reduction of losses through leakage control and improvements in system management can often be one of the cheapest options in a demand management program.

It should be noted that as with the institutional options, government should be seen to be leading by example. It will be extremely important to ensure that the system losses are minimised and that PW is seen to be sharing the responsibility of reducing overall water demand in Alice Springs.

8.4 Scenarios for Savings

As indicated in Section 8.1, during the development of the options described in Section 8.3 it was found that a demand management program alone would not achieve the preliminary targets set. Hence three scenarios have been considered (1-low, 2-medium, 3-high) which assist in illustrating the level of savings attainable from the options developed depending on the level of investment provided to implement individual options. Each of the scenarios uses the options developed with varying levels of implementation. Scenario 1, with the lowest costs, shows the baseline savings achievable and represents a standard efficiency options program. In this scenario the participants in a retrofit program might be assumed to be 50% of all available households. Scenario 2, the mid-range scenario, has involved consideration of which of the model's assumptions may reasonably be increased (for example take-up rates) and at what cost. In this scenario the participants in a retrofit program might be assumed to be considerably more at 75% of all available households, which could potentially require additional incentives and thus cost more to attract the level of participants needed. By changing the take-up rate of those options with the lowest cost first ($/kL), it has been possible to develop Scenario 2 at the lowest cost. The high scenario (Scenario 3) has not been fully developed, as it is considered that Scenario 2 pushes the demand management options considered to the limit of their application (in terms of their uptake) and that a more holistic approach combining demand management, leakage control and source substitution would provide the overall savings required at a lower average present value unit cost.

8.5 Demand Reduction

All of the options described in Section 8.3 have been modelled and full details of the assumptions are provided in Appendix H. Table 8.1 compares the options for Scenario 1 showing the savings attributable to each option (ML/a) over set time intervals (2006, 2008, 2011 and 2021). Time intervals have been chosen to indicate how the individual options within the demand management program take into consideration the gradual implementation of the options and a savings decay factor[29] that can occur with education/ communication measures.

Table 8.1 also shows the present value unit cost ($/kL), which has been calculated over a 20 year period using a 7% discount rate. A discount rate of 7% has been chosen as this is in line with industry practice, even though PW currently use 9% in their borefield model. The present value of the cost of the option is divided by the present value of the water savings over the same timescale to provide a unit cost in dollars per kilolitre. The unit cost represents the monetary costs of a demand management measure (e.g. financial benefits are not included). The unit cost provides an indicator of the 'best buy' to achieve the objective of reducing demand at the least cost, and can be used to rank the cost-effectiveness of different options. As the total cost is included, even in the event that customers do not contribute towards the cost of a measure, it will not affect the unit cost as it is the cost of the program that is considered, irrespective of who pays. Having obtained the unit cost other benefits can then be used to assist in the ranking process. Other benefits are considered later in this Section.

[29] Savings decay can typically occur on educational/communicative measures such as television adverts concerned with outdoor water use. Water demand is generally reduced during a period of intense advertising, however, this demand reduction can decay over time as the public are affected to a lesser extent by the adverts once they are no longer being shown.

Table 8-1 Summary of Options (Scenario 1)

Option Name	PV Unit Cost ($/kL)	Cumulative Demand Reduction			
		ML/a (2006)	ML/a (2008)	ML/a (2011)	ML/a (2021)
Residential Indoor Options					
Residential Indoor Retrofit	0.53	117.73	117.73	117.73	117.73
Washing Machine Rebate	1.39	3.49	3.49	3.49	3.49
Public Housing Retrofit	0.27	25.76	25.76	25.76	25.76
Residential Outdoor Options					
Outdoor Water Efficiency Visit	0.26	109.01	99.65	87.30	57.50
Targeted Outdoor Visit	0.05	69.91	63.19	54.33	32.94
Pool Cover Rebate	0.63				
Cooling Alice	0.51				
Cooling Alice 2	1.32	26.32	20.29	14.23	6.49
Other Residential Options					
Pine Gap Saving Water	0.28	153.59	153.59	153.59	153.59
Town Camps & Aboriginal Communities	0.14	0.00	68.39	68.39	68.39
Commercial/Industrial Options					
General C/I Auditing	0.53	107.25	107.25	107.25	107.25
Hotels	0.19	99.94	99.94	99.94	99.94
Institutional Property Options					
General Institutional Buildings	0.38	85.97	85.97	85.97	85.97
Hospital	0.56	11.78	11.78	11.78	11.78
Schools	0.18	101.19	101.19	101.19	101.19
New Development Options					
Residential Building Controls	0.30	15.19	30.77	54.89	143.18
Non residential Building Controls	0.55	5.88	11.78	20.67	51.12
TOTALS	**0.46***	**933**	**1001**	**1007**	**1066**
Other Options					
Leakage		*420*	*429*	*443*	*496*

Note – Options in italics are not included in the totals as they are either wrapped into another option or not costed (e.g. leakage)
* - average

Figures 8.1 shows the significant cumulative impact of the savings on the total Alice Springs demand, which would commence to a limited extent in 2003 as implementation of the program could start towards the end of 2003 after development of the implementation plan (Stage III) has been completed. Figure 8.2 shows the reduction in demand on a per capita basis.

Figure 8-1Combined Option Savings for Sceanrio 1 (ML/a)

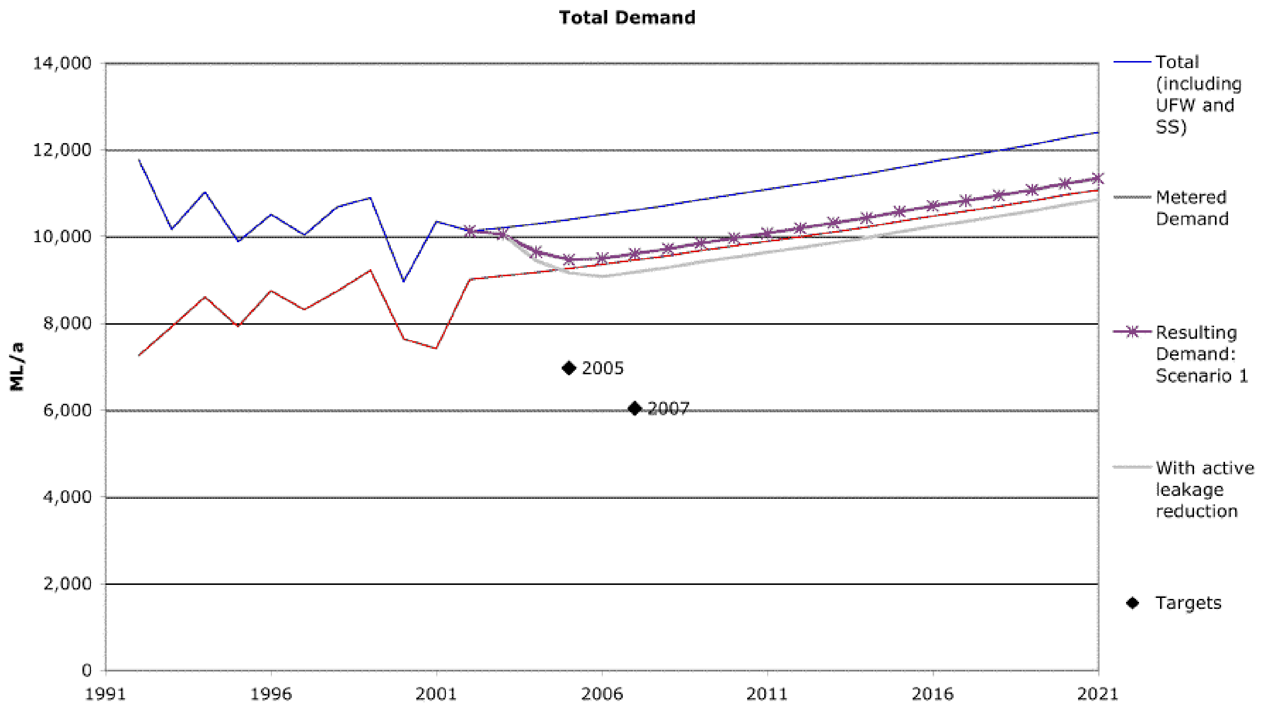
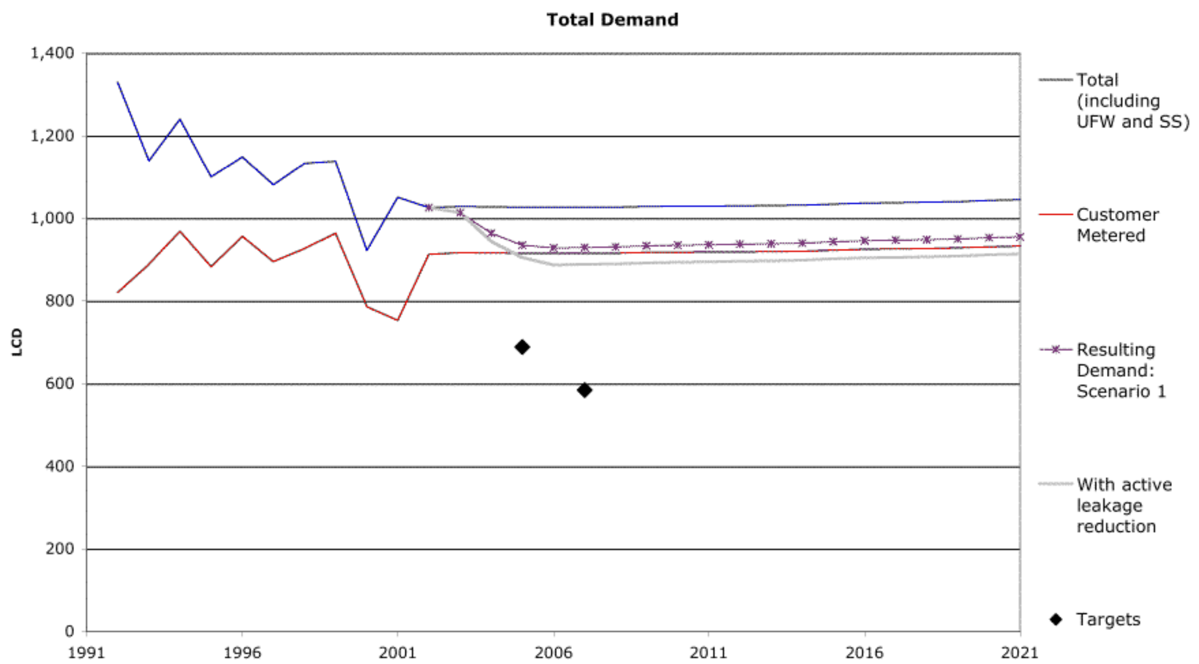


Figure 8-2 Combined Option Savings for Scenario 1 (LCD)



Figures 8.3 and 8.4 show the sewage savings (ML/d) and the peak water demand savings (ML/d) for Scenario 1. This assists in illustrating that the suite of options in Scenario 1 not only achieve considerable water demand savings but also provide significant sewage effluent reductions and contribute to reducing peak water demand. Figure 8.3 clearly shows that the level of savings under Scenario 1 could achieve the level of savings identified by the ASUWMSRG in the targets.

Figure 8-3 Sewage Model Savings (Scenario 1)

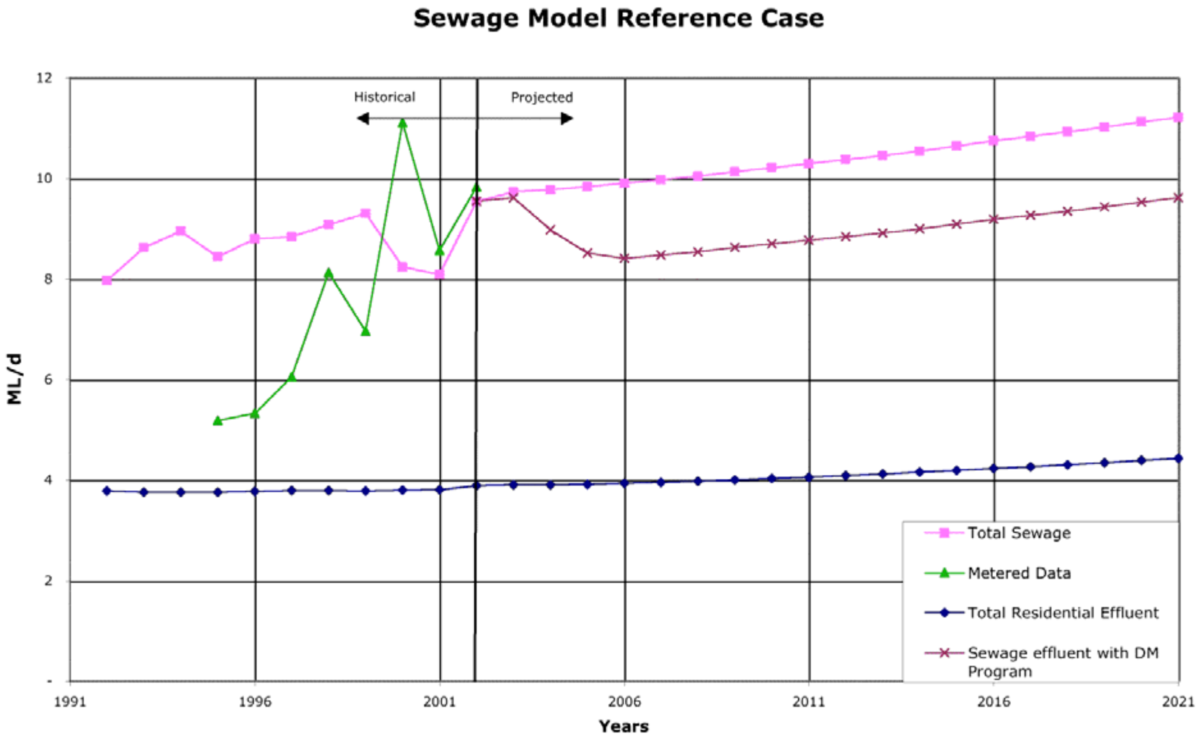
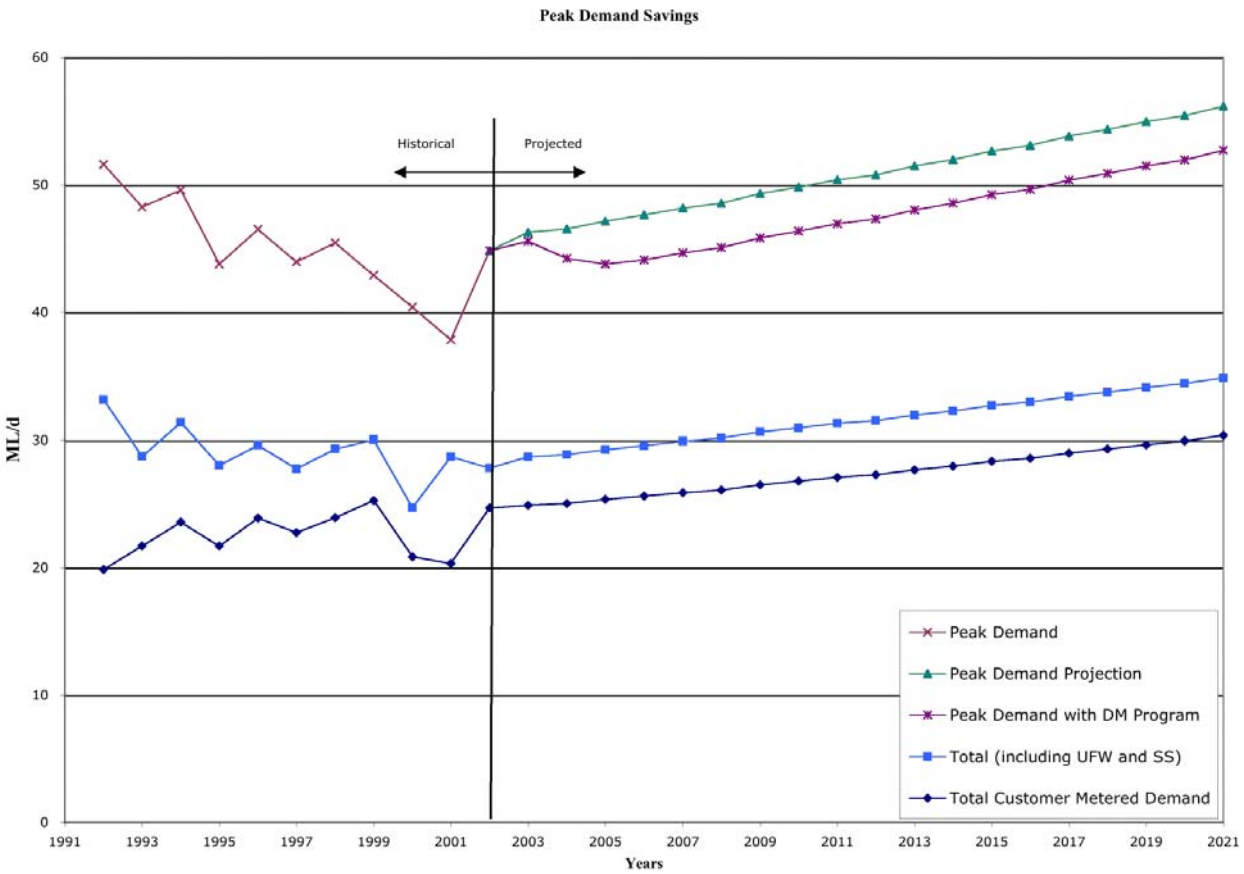


Figure 8-4 Peak Day Water Demand Savings (Scenario 1)



The figures show that significant savings in total water demand, sewage production and peak day water demand can be achieved by implementing the suite of options under Scenario 1. These savings can be achieved with an investment of $3.8M (present value). However, this level of investment does not achieve the preliminary targets set by the ASUWMSRG. By investing $10.2M (present value) in Scenario 2 additional savings in total water demand, sewage production and peak day water demand can be achieved. However, again the preliminary targets are not attained. Table 8.2 summarises the levels of total water savings achieved and present value costs for each scenario against the reference case.

Table 8-2 Demand Management Program Scenarios

Scenario	Resulting Demand (ML/a in 2008)	Demand Reduction Achieved (ML/a in 2008)	Resulting Demand (ML/a in 2021)	Demand Reduction Achieved (ML/a in 2021)	Present Value of Total Cost ($M)
Reference Case	10,715	N/A	12,405	N/A	N/A
1	9,714	1,001	11,339	1,066	3.8
2	8,020	2,695	8,979	3,426	10.2
3*	N/A	N/A	N/A	N/A	N/A

* - Scenario 3 not developed

Figures 8.5 and 8.6 illustrate the water demand savings for Scenario 1 and 2 against the reference case in terms of ML/a and LCD.

Figure 8-5 Demand Management Water Demand Savings for Scenarios 1 & 2 (ML/a)

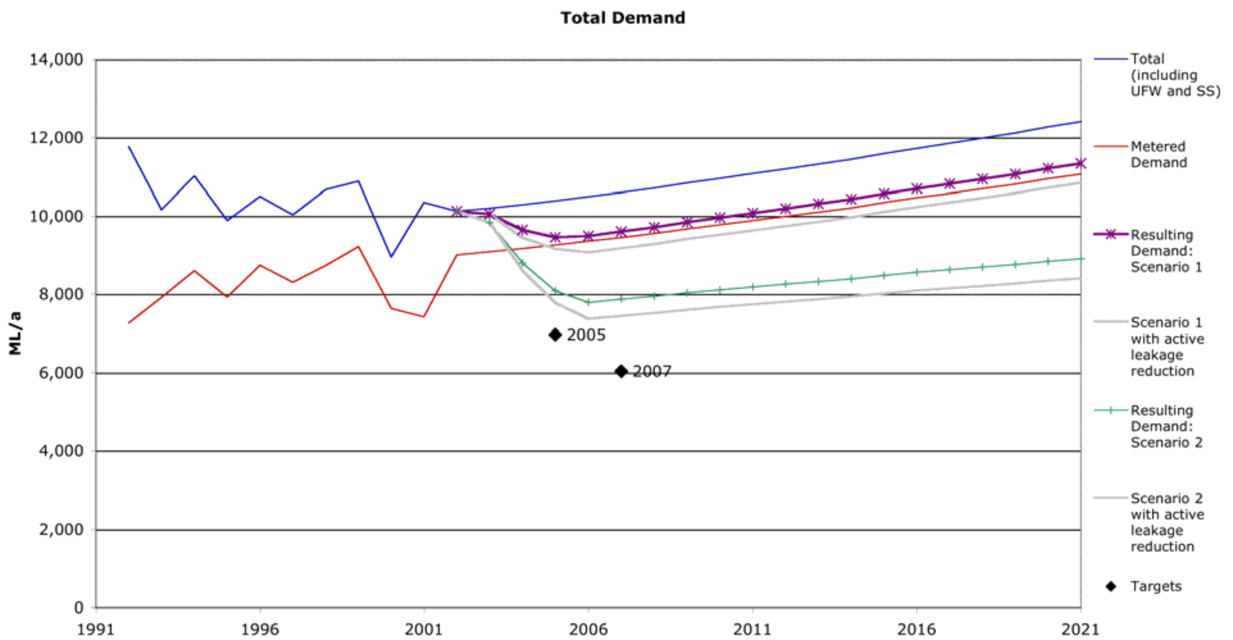
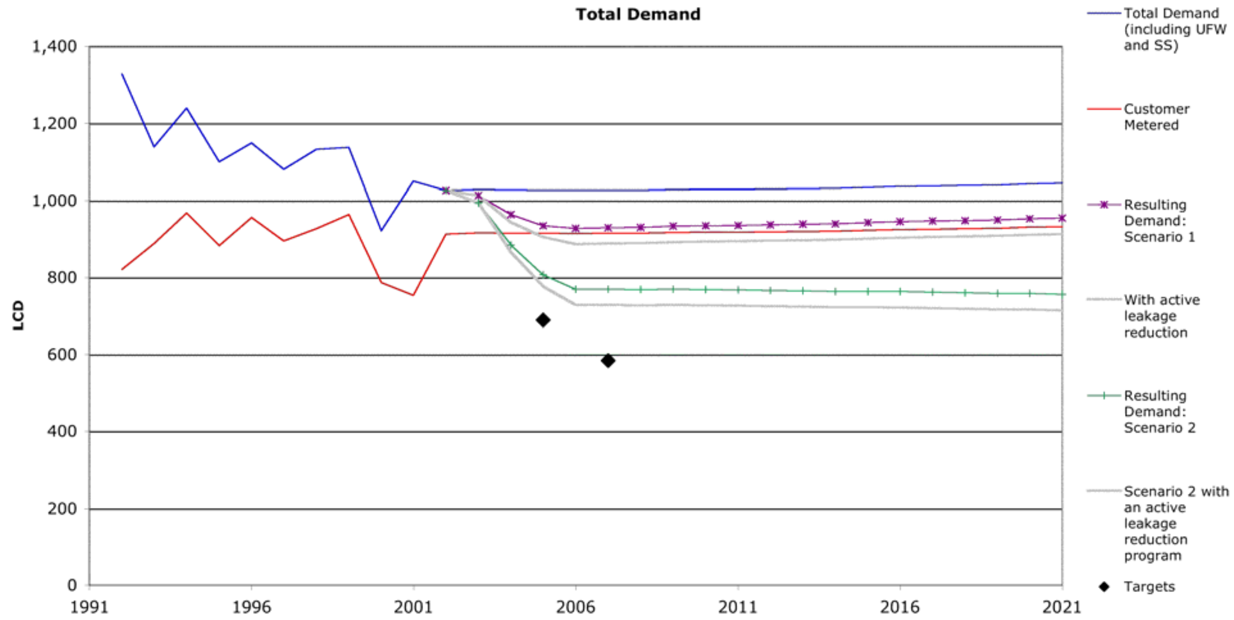


Figure 8-6 Demand Management Water Demand Savings for Scenarios 1 & 2 (LCD)



Whilst neither of these scenarios actually meet the targets, it is important to recognise that neither of the scenarios incorporate the full range of possibilities for demand reduction, as they do not fully utilise the potential contribution of leakage control, source substitution or reuse. These issues will be discussed in Section 8.8 together with why the high scenario for demand management (Scenario 3) has not been developed.

8.6 Comparing the Options and Ranking

Generally once options have been developed they are often compared and ranked in terms of cost and the lowest cost option taken forward for implementation once environmental impacts and social issues have been considered. In the case of demand management options and the use of LCP principles, a suite of options are put forward as a comprehensive program to be taken forward for implementation. These options are developed by designing a demand management program which targets a wide range of sectors, customer types and indoor and outdoor demand. Thus reducing the risk of relying on a single option. Sydney Water Corporation, Rous Water and Kalgoorlie Boulder have all used comprehensive demand management programs similar to the one developed under this Study to reduce the risk of relying on a single option.

The suite of options identified in Section 8.3 (the program) and the scenarios have been developed by considering the unit cost ($/kL saved) and thus high cost options have effectively been screened out during the development process. Hence comparison and ranking of options at this stage is only used as a way of deciding which options should be implemented first (picking the lowest hanging fruit) rather than deciding not to implement a specific option at all.

For each option the interdependency should also be considered (e.g. the Targeted Outdoor Option relies on the Outdoor Foundation Program and Outdoor Water Efficiency Option) as this assists in determining which option should be implemented first irrespective of the unit cost. The success of demand management programs often depends upon a larger number of options being implemented simultaneously as communication measures can reinforce various options during the implementation phase and some demand management options are partially reliant on each other for success. Hence, although costs, and in particular the unit cost of an option, are often used to rank options and prioritise implementation steps, other issues need to inform the prioritisation decision such as interdependency of specific options and other environmental factors that may need to be addressed (e.g. reduction of sewage overflows).

Table 8.3 provides details of the water demand reduction of each option developed in ML/a, the unit cost in $/kL and the total present value cost in $ for the years 2008 and 2021 for Scenario 1. The table has been ranked according to unit cost and shows that the unit cost of the options proposed are fairly consistent across the whole range of options when compared to options such as rainwater tanks which are often a factor of ten higher than the most expensive option (Washing Machine Rebates) proposed under this Study. It should be noted that the lowest cost option (Targeted Outdoor) is reliant on the residential Outdoor Water Efficiency Option, which includes the cost of the Foundation Program. Table 8.4 provides similar details for Scenario 2.

Having concluded that a comprehensive program is desirable such as the suite of options described in Section 8.3, what remains then is to consider the benefits, other than water demand reduction, which could be used to inform prioritisation. The $3.8M demand management program under in Scenario 1 delivers many benefits to the community other than reducing water demand. For example, by reducing indoor demand sewage effluent produced will be reduced and thus effluent overflows to Ilparpa swamp will be reduced (refer to Figure 8.3). Given the issue of sewer overflows to Ilparpa swamp has been an issue for many years, it may be desirable to consider sewage effluent as a higher priority rather than water demand reduction. Another example may be that due to the electricity system supply constraints, a higher priority may be placed on options that provide energy savings such as retrofitting of showerheads. Hence consideration of a number of other benefits needs to be considered even though many of these externalities can not be attributed an economic value.

Table 8.3 shows the other benefits for the years 2008 and 2021 for Scenario 1 in terms of:

- sewage effluent reduction in ML/d;
- energy saved MWh/a;
- greenhouse gas savings (GHG) in tonnes/a; and
- peak day water demand reduction in ML/d.

Table 8-3 Comparing the Options (Scenario 1)

Option Name	Demand Reduction in 2008 ML/a	Unit Cost $/kL	Total Cost (PV)	2008 Sewage Reduction ML/d	2008* Energy Saved MWh/a	2008 GHG savings t/a	2008 Peak Reduction ML/d	Notes
Targeted Outdoor	63	0.05	22,339	0.00	41	3	0.34	1, 5
Town Camps	68	0.14	89,151	0.32	98	54	0.00	
Schools	101	0.18	183,571	0.12	118	65	0.43	2
Hotels	100	0.19	195,653	0.17	121	67	0.37	
Outdoor Water Efficiency	100	0.26	253,698	0.00	107	59	0.53	5
Public Housing	26	0.27	70,499	0.07	33	18	0.07	3, 4
Pine Gap Saving Water	154	0.28	454,692	0.42	198	109	0.42	
Residential DCs	31	0.30	164,919	0.08	39	21	0.09	4
Institutional Buildings	86	0.38	300,693	0.21	109	60	0.24	2
Indoor Retrofit	118	0.53	603,791	0.32	152	84	0.32	
General C/I	107	0.53	520,251	0.26	136	75	0.32	
Non Residential DCs	12	0.55	110,292	0.03	15	8	0.04	4
Hospital	12	0.56	60,645	0.03	15	8	0.03	
Cooling Alice 2	20	1.32	234,165	0.00	22	12	0.11	5
Washing Machine Rebate	3	1.39	49,065	0.01	4	2	0.02	

Notes
1. This options needs to follow the general Outdoor option.
2. These options represent ‘Government leading by example’.
3. This is a useful option to pursue in terms of equity and disadvantaged communities.
4. These options require PW to work with other government departments and therefore require consideration of implementation issues.
5. Outdoor programs in particular require simultaneous evaluation with implementation to allow for adaptive management.

* - Energy savings have taken into consideration the reduction in energy requirements associated with reduced pumping and treatment of water from the borefield. They have not taken into consideration the additional significant benefits that can be obtained from hot water energy savings associated with indoor residential water demand.
DCs – Development controls

Having identified figures on the savings/reduction predicted for specific years it is now possible to put a weighting on the importance of the water demand reduction, the unit cost and the other sewage, energy, GHG and peaking issues savings/reductions identified. By weighting the importance of each of these issues more detailed ranking assessment can be carried out to prioritise which options are taken forward first. Ranking in this way (multi criteria analysis) requires an in depth understanding of the systems being managed and wider community issues that need to be addressed. Hence the ranking process should be carried out by PW and other interested parties such as DIPE and the ASUWMSRG together with the Study Team. Similar details are available for Scenario 2 which again can be used to assist in ranking.

8.7 Reference Case Comparison

Demand management and other reuse and source substitution options are often compared against the reference or business as usual case in terms of deferring of capital and operating expenditure. For example by reducing demand it is often possible to defer the need to augment borefields or expand WWTPs.

Only limited information was available from PW on issues associated with augmentation during the preparation of this report. Hence assumptions have been made where necessary and it is recommended that PW make further investigations during Stage III of the Study with respect to capital and operating costs of running the water, wastewater and electricity systems to assist in clarifying the assumptions made and costs and benefits identified.

8.7.1 Capital and Operating Costs and Benefits

The energy costs of supplying water in Alice Springs are very high due to the depth of the borefields primary aquifer. As the aquifer level continues to fall, both operating and capital costs for pumping will increase over time.

In order to establish future energy pumping costs for the Reference Case and Scenarios 1 and 2, it has been assumed that bore depth and pumping energy use increase linearly with extraction as the aquifer recharge level is low. The associated capital and operating costs have been estimated from PW Asset Management Plan figures for planned rehabilitation, replacement and augmentation of bores (pers comm. P. Heaton) by using the total capital expenditure and total extraction to 2021 to obtain a $/ML investment requirement. This effectively spreads the capital investment out evenly over the 20 year period considered rather than it occurring in lump sums at irregular intervals.

These assumptions need to be investigated in greater detail. It is possible that both operating and particularly capital expenditure costs may increase in a non linear relationship to bore depth. This investigation would ideally be as part of a broader review of the PW Borefield Development Model. It appears that this model utilises a constant consumption growth rate as the basis for calculating capital and operating costs, and augmentation requirements. It would be useful to be able to input demand data that is not linear over time, such as would result from the implementation of a demand management program, in order to compare different scenarios more effectively (refer to Section 3.2).

The present value of the water Reference Case capital and operating expenditure and anticipated present value savings from Scenarios 1 and 2 are provided in Table 8.5.

Table 8-4 Capital & Operating Water Expenditure & Savings

Scenario	Reference Case PV $M	Scenario 1 PV $M	Scenario 1 Savings PV $M	Scenario 2 PV $M	Scenario 2 Savings PV $M
Water					
- capital	5.1*	4.7	Savings proportion unknown	3.9	Savings proportion unknown
- operating	23.7	20	3.8	14.1	9.7

* It should be noted that the present value capital cost for the reference case in this table extracting 12,500 ML/a is virtually the same as the present value cost ($5M) identified in Section 3.2 for the borefield extracting only 10,000 ML/a. This can be attributed to the fact that the reference case in the table uses a linear assumption for capital expenditure over the 20 years considered unlike the reference case calculated in Section 3.2 which assumes distinct times when bores will be replaced. In addition the reference case in the table uses a 7% discount rate and the reference case in Section 3.2 uses a discount rate of 9%.

The anticipated savings can only be attributed to the operating costs at this time as the exact capital expenditure required to drill bores specifically for demand purposes as opposed to refurbishment or replacement associated with bores that are not performing due to issues such as age, are not currently known. As indicated the savings in operating costs are very similar to the investment required for the demand management programs (Scenarios 1 and 2). In the case of Scenario 1 the deferred energy expenditure actually pays for the program. Hence additional capital savings associated with deferring augmentation of the borefield can only contribute further to assisting to pay for the demand management programs.

Note that these savings do not include the benefits from hot water energy savings associated with indoor residential water demand, any deferred augmentation of the sewage and electricity systems or reduced leakage levels, nor do they include savings in greenhouse gas emissions currently valued at around $25 per tonne (White and Campbell, 2002). The water pumping costs also do not allow for the fact that the borefield is located approximately 15 km from the town at the end of the electricity distribution system, and real electricity supply costs may therefore be higher than those currently charged.

8.7.2 Electricity System Benefits

Other benefits will accrue to the electricity supply from implementing a demand management program. It is understood that a planned augmentation of the electricity system will increase current capacity by 20% (pers comm. R. Earl). Although pumping is generally scheduled at off-peak times to reduce energy costs, some pumping does occur at peak water use times in hot weather when electricity demand is also at its maximum, usually in February (pers comm. T. Horman). Any load that can be shifted away from daytime demand peaks through reduced water consumption will improve the load factor and defer further investment in generation capacity. In addition the existing generation machinery is aging and any reduction in electricity maximum demand will result in lower running hours (or even retirement) of the lowest ranked and least efficient machines, improving supply reliability.

8.7.3 Energy and Greenhouse Gas Savings

Energy used for pumping water under the Reference Case will increase from the current level of around 11,500 MWh/a to approximately 23,000 MWh/a by 2021, due to the drop in the aquifer level from 145 m to approximately 240 m. This would mean an extra 6,300 tonnes/a of GHG emissions at the current emission factor of 0.55 tonnes/MWh (pers comm. T Horman). Scenario 1 would save around 3,800 MWh/a compared to the Reference Case, and Scenario 2 nearly 11,000 MWh/a, equivalent to the current annual pumping energy consumption.

Savings in water heating energy in the Scenario 1 residential options alone would reduce electricity consumption by a further 1,600 MWh in 2021. Hot water savings from the non residential options would increase this further. Some of this energy consumption will be at peak times, contributing to reduction in peak electricity demand, although this could not be quantified for this Study.

8.8 Other Options and Issues to Consider

8.8.1 Leakage, Source Substitution and Reuse Options

It is important to note that a number of options that would normally be considered when carrying out a full options assessment are outside the scope of this Study and thus have not been considered. Leakage reduction, reuse and source substitution are such options.

Despite being outside the project brief, this Report includes some description of these options and, in the case of leakage, includes an additional line item in the savings estimate. This leakage option is indicative only and the savings available from leakage and pressure control should be considered in greater detail as they are likely to be higher than the values shown.

Source substitution and reuse (discussed in Sections 3.0 and 4.0), such as the use of Town Basin supplies, rainwater tanks, stormwater collection, greywater reuse and effluent reuse are also outside the brief of this Study and therefore not included. However, considering the high level of outdoor water demand in Alice Springs these options could prove to be highly effective in reducing potable demand and should therefore be considered further.

Each of these options should be developed and costed in order to compare their unit cost ($/kL of water saved or provided) and associated benefits with the demand management options developed under this Study. Full comparison of these additional options with the demand management options and the reference case using an LCP framework will provide a holistic approach that can be taken forward for implementation. Much of this options development work has already been carried out but has not used consistent population or demand forecasting. Hence the results of this Study (e.g. the reference cases) can be used to assist in providing these consistent assumptions. Only by comparing all the options can the most cost effective solution be determined and the full costs and benefits be clearly identified.

During the development of the demand management options and the two Scenarios considered under this Study it has become apparent that demand management options alone will not achieve the preliminary targets set by PW, DIPE and the ASUWMSRG. The high Scenario (Scenario 3) relying purely on demand management has therefore not been developed as it is considered that other options such as leakage control, source substitution and reuse would provide more cost effective solutions.

It is therefore recommended that Scenario 1 (the minimum efficiency Scenario) is taken forward to Stage III. In parallel to Stage III the other options discussed (leakage reduction, source substitution and reuse) should be investigated further. Hence by the end of Stage III a comprehensive suite of options including the demand management program, leakage reduction, source substitution and reuse should have been considered using the principles of LCP, thus forming the ASUWMS ready for implementation planning similar to that undertaken for the demand management program. In addition the targets should be reviewed and goals identified following consultation with the ASUWMSRG.

8.8.2 Pricing

As indicated in Section 4.3 pricing can be used as a demand management measure. Considering the large proportion of water used for outdoor end uses and the fact that water is effectively subsidised in Alice Springs (due to the NT Governments commitment to a uniform tariff policy across the NT) the current pricing structure will need to be reviewed to ensure the proposed demand management initiatives and alternative options such as source substitution and reuse effectively reduce potable water demand.

The low price of water is currently providing the wrong signal to the customer. Water appears to be relatively cheap and thus customers see no advantage in reducing demand because they will not achieve a significant saving on their current water bill. However, if the price of water is brought in line with the real costs of supply of each additional kL of water then the price of water would be considerably more and water bills would be considerably higher. The customer would then see the benefit of reducing demand because they would be able to reduce their water bill through water efficiency. Hence the price of water should be brought in line with the actual cost of supplying water in Alice Springs and NT cross subsidies should effectively be removed thus conforming with COAG recommendations.

Raising the price of water is often seen as being politically difficult and it is perceived that customers will automatically be opposed to such a restructuring. However, if pricing reform is brought about in conjunction with demand management measures to assist customers to reduce water demand yet provide the same service and customers are consulted during the process so that they understand the reasons behind the pricing reform then such modifications can be brought about relatively smoothly.

Due to the relatively high outdoor water demand in Alice Springs the use of an inclining block tariff should be considered during the pricing reform. Research has shown that the demand associated with garden watering is far more elastic than indoor demand because customers have more control and can more easily change their habits with respect to garden watering than indoor activities and thus the use of inclining block tariffs works best in these situations. Inclining block tariffs generally use a low initial connection charge based on below average consumption of a typical household (say 150 to 250 kL/hh/a for Alice Springs). Subsequent volumes used above this basic threshold are then charged at increasingly higher rates. For example water demand between 250 and 500 kL/hh/a would be set at a specific rate, 500 to 750 kL/hh/a would be set at a higher rate and demand over 750 kL/hh/a would be set at an even higher rate all related to the additional cost of supplying that additional volume of water. Thus providing the incentive to reduce bills by reducing water demand in the higher priced demand brackets. A seasonal tariff within an inclining block tariff structure could also be considered, sending a specific signal to customers to reduce demand during the summer months.

The combination of the use of a revised pricing structure, public consultation and demand management options (such as the Outdoor Water Efficiency Option and Targeted Outdoor Option for high water users) would be highly effective in reducing overall demand from the extremely high levels currently experienced.

It is recommended that the revised pricing structure for both residential and non residential customers is implemented at one time and coordinated carefully with the proposed demand management program. It is also recommended that the price of alternative water sources (e.g. Town Basin and reuse) are revised relative to the costs of supply and ensure incentives are provided for non residential customers to switch to alternative sources of supply where possible.

8.8.3 Other Issues

Research

A number of projects and initiatives are currently being explored in Alice Springs including the ALEC Myers Foundation funded project relating to water issues, Cooling Communities, Desert Knowledge projects and CRC funded initiatives. Alice Springs is therefore in a prime position in Australia to be at the cutting edge of data collection and research related to the desert environment and how synergies between water and energy issues can be found to provide sustainable solutions to living in such a difficult climate. This data and research will be invaluable for Alice Springs but also for other arid areas in Australia and around the world and will enable Alice Springs to share knowledge on arid climate issues with others living in similar climates (e.g. Arizona and the Middle East).

It is essential that the demand management options developed under this Study take advantage of the initiatives identified. Where possible knowledge gained from the existing initiatives should be used in Stage III of this Study and where applicable data collected and knowledge gained under Stage III should be used to inform individual initiatives as part of a long term research plan. For example, the 200 houses identified under the Cool Communities project could be used to survey AAA-rated water efficient showerheads and to assess the associated energy savings. Under the Desert Knowledge project a specific water cell could be set up (‘Water in Alice’) dealing with research gaps related to water quality, a/c and garden watering that could feed into the overall demand management program as research progresses.

Hence it is recommended that prior to the commencement of Stage III that PW/DIPE set up discussions with the organisers of relevant projects/initiatives to discuss specific research being addressed and planned, funding available and synergies that can be coordinated between the various projects/initiatives.

Implementation

A number of issues will need to be addressed specifically during Stage III of this Study such as further research on a/c water demand, hard water relating to water efficient appliances and garden watering as discussed in Section 8.2.5. These implementation issues will need to be considered and fed into the overall research gaps being investigated (as indicated in the previous section).

Issues such as a/c water demand and hard water issues associated with water efficient appliances could be investigated at relatively low cost by using participants of PW, DIPE or other government departments. Individuals prepared to carryout an experiment on their a/c units could be provided with metering equipment and a set experimental procedure to follow similar to that conducted by ALEC during Stage II of this Study, thus providing additional data to verify the assumptions input to the End Use Model. With respect to hard water issues a survey could be sent to individuals in PW, DIPE or other government departments asking specific questions on the kinds of water efficient appliances in the home, length of time owned, performance and maintenance requirements etc., thus providing details on specific appliances and their performance within the home. This data could then be supported by experiments carried out in the Cool Communities houses if deemed necessary. Similar data could be collected with regard to garden watering by conducting surveys with PW and DIPE employees and testing of garden visits could be undertaken with garden specialists to determine the best procedures and communication materials to be used.

Payment

To ensure the success of the demand management program and to ensure that all costs are included it has been assumed that PW will pay for all the required costs identified in Scenario 1 and 2. In a limited number of cases payment could be partly paid by the customers (e.g. in the SWC retrofit the customer pays $22 for the retrofit to instil some form of value into the water efficient equipment being received). In other cases where other government departments are involved it may be deemed appropriate to let that specific department pay for the retrofitting or work involved. For example, it may be possible for the hospital to pay for modifications out of its own budget or Pine Gap management to pay for its own retrofits. However, to ensure that all retrofits and modifications are undertaken and that barriers associated with costs are removed, it is recommended that PW only require customers or other government departments to pay in a limited number of cases if at all especially considering the expenditure for the demand management programs is likely to be reclaimed through avoided expenditure on energy costs alone.

8.9 Recommendations

8a – PW should investigate the capital and operating costs of running the water, wastewater and electricity systems to assist in clarifying the assumptions made and costs and benefits identified under this Study.

8b - PW should commit to Stage III (development of the Implementation Plan) of the Water Efficiency Study and at least the funds necessary for the comprehensive demand management program identified under Scenario 1 ($3.8M).

8c – PW/DIPE should consider investigating personnel who would be suitable to take the positions of the Program Team to allow their involvement where possible during Stage III.

8d – PW/DIPE should consider investigating other options such as leakage reduction, source substitution and reuse (e.g. Town Basin, rain tanks, stormwater and bleed off capture, greywater reuses and effluent reuse) in parallel to Stage III and evaluating these options using an LCP framework together with the demand management options developed. In addition following review of this wider suite of options the targets should be reviewed following consultation with the ASUWMSRG.

8e – PW should consider restructuring their current pricing structure to move away from NT cross subsidies and towards the use of inclining block tariffs. This change in pricing structure should be planned to coincide with community consultation and the demand management program.

8f – PW/DIPE should take advantage of other initiatives/projects in Alice Springs related to water and energy issues in arid climates by liaising with other organisations prior to the commencement of Stage III. Thus allowing projects, funding, research gaps and Stage III pilot studies and surveys to be coordinated more effectively and synergies to be clarified.

8g – PW/DIPE should consider running a number of pilot studies and/or surveys in parallel to Stage III of the Study to assist in verifying specific assumptions used in the End Use Model and testing implementation issues raised by the ASUWMSRG. In addition PW/DIPE should consider using their own or other Government staff to assist in pilot studies/surveys to reduce costs.

8h – PW should consider paying for the whole cost of the demand management program to maximise uptake and success of the program.

9 RECOMMENDATIONS

Throughout this report various recommendations have been made. These recommendations are summarised in the following section for PW/DIPE consideration. The full recommendations can be found in the relevant sections of this report. Individual recommendations from each section have been collated and are included in Appendix J.

PW/DIPE should commit to Stage III of the Study and the implementation of a Demand Management Program by:

- committing all required funds for at least Program Scenario 1 ($3.8M);
- investigating Program Team personnel to be involved in Stage III;
- investigating capital and operating costs of running the water, wastewater and electricity systems to assist in clarifying assumptions and costs/benefits identified;
- committing to pilot studies and surveys to assist in Stage III development; and
- investigating other initiatives/projects related to water and energy issues (e.g. CRC, Desert Knowledge) to liaise and coordinate funding and research gaps/synergies to assist in Stage III and long term research on arid climates.

In parallel to Stage III PW/DIPE should consider:

- restructuring their current pricing structure on water by moving away from an NT uniform tariff policy to a locally based inclining block tariff and a volume based charging system on sewage related to winter water demand similar to the Trade Waste tariffs;
- updating their borefield augmentation model to ensure assumptions are consistent with this Study and to allow fair reference case comparison with other options;
- investigation of leakage reduction, source substitution and reuse options using an LCP framework to determine which other least cost options should be implemented together with the demand management program to form the ASUWMS;
- review of the current preliminary targets together with the ASUWMSRG;
- the implications of the benefits of the demand management program on the investment requirements for other options; and
- evaluate existing initiatives where possible (e.g. Cut the Lawn, audits) to assist in Stage III design and using the climate correction model to check UFW in 2001/02.

PW/DIPE should also consider/investigate:

- using the climate correction model for future evaluation of demand management and other initiatives;
- draft a system management implementation plan/schedule to reduce UFW and move towards best practice management including accurate UFW calculation, the substantial auditing and upgrading of the CIS to allow for ongoing evaluation of customers, use of flow meters at the WWTP, use of outdoor meters to identify outdoor demand, use of meters on individual units of occupancy and use of SIC for individual customers;

- use of demand management on other sources such as the Town Basin and reactivation of additional sources such as the hospital borehole and gaol reuse system;

- obtain more accurate data on the indigenous populations and Pine Gap residents to improve the accuracy of the model and when available incorporate the Trade Waste results and WWTP flow records to assist in calibration of the end use models; and

- steps to advocate appliance water efficiency nationally and ensure local building codes incorporate the synergies of water and energy efficiency as far as possible in both new and modified buildings to minimise the need for demand management retrofitting investment in new developments in the future.

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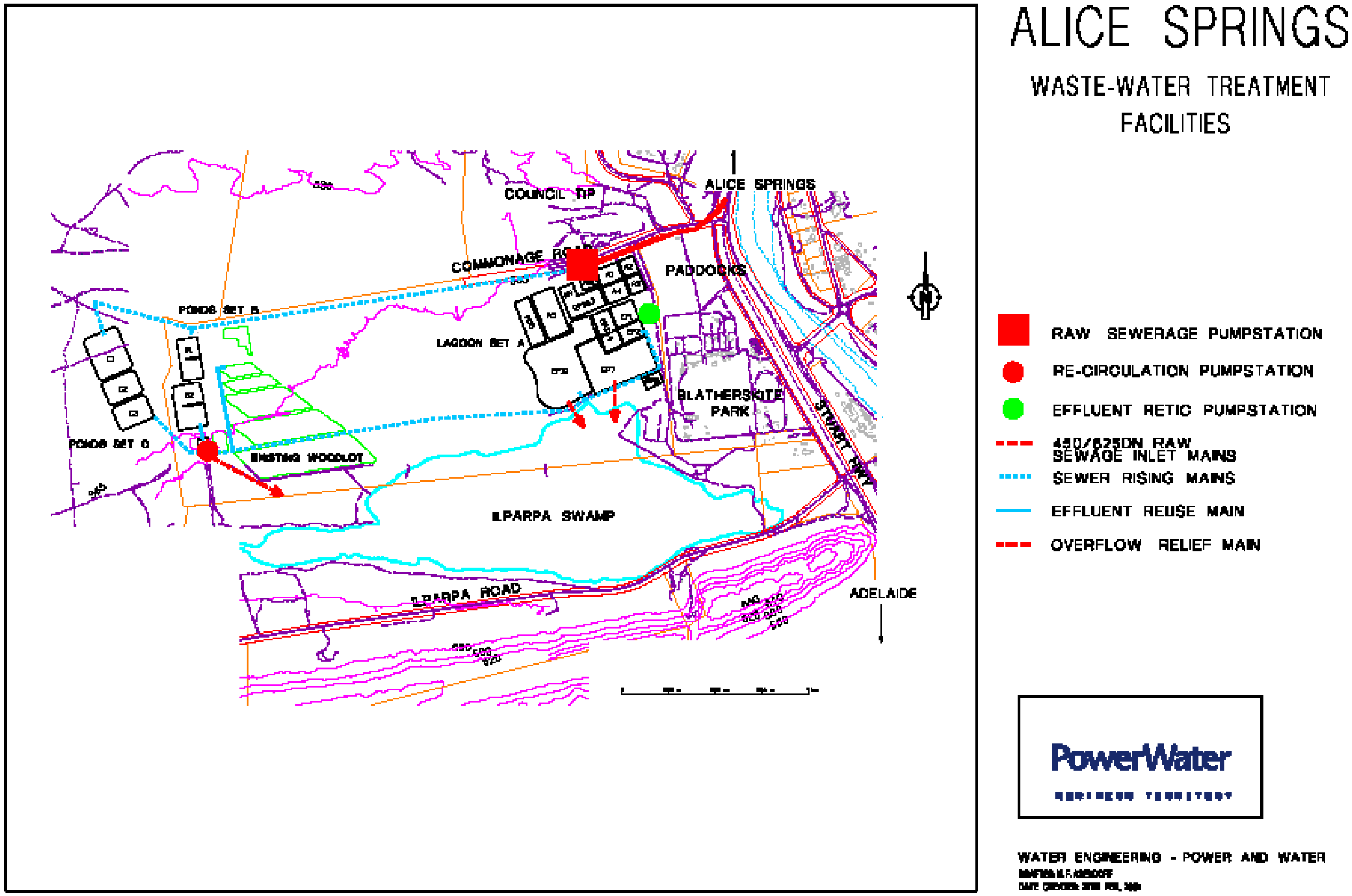
APPENDICES

Appendix A	**Wastewater Treatment Plant Layout**
Appendix B	**Tariffs & Historical PW/DIPE Demand Management/System Management Initiatives**
Appendix C	**Climate Correction Model**
Appendix D	**Customer Type Interviews for Various Sectors (Volume II*)**
Appendix E	**Summary of DPWS Audits**
Appendix F	**End Use Model**
Appendix G	**Specialist Interviews & the Alice Springs Show Survey (part Volume II*)**
Appendix H	**Option Assumptions**
Appendix I	**ASUWMSRG Workshop – 20 March 2003**
Appendix J	**Collated Recommendations**

*A number of interviews have been undertaken as part of this Study. To maintain confidentiality transcripts of these interviews have not been included in this Report but collated and included in a separate volume (Volume II).

APPENDIX A – WASTEWATER TREATMENT PLANT LAYOUT

Figure A1 – Wastewater Treatment Plant Layout



APPENDIX B - HISTORICAL PW/DIPE TARIFFS & DEMAND MANAGEMENT/SYSTEM MANAGEMENT INITIATIVES

Table B1 - Tariffs

WATER TARIFFS

Water Tariff - Domestic & Commercial
01/07/82 – 30/06/84 = $75 + $0.20/kl over 500 kl/a
01/07/84 – 30/06/86 = $90 + $0.25/kl over 500 kl/a
01/07/86 – 01/10/87 = $0.25/kl (<1000 kl/a) + $0.30/kl (>1000 kl/a)
01/07/87 – 01/10/88 = $0.30/kl
01/10/88 – 01/10/89 = $0.32/kl
01/10/89 – 31/03/91 = $0.34/kl
01/04/91 – 30/06/91 = $0.36/kl
01/07/91 – 30/09/92 = $0.38/kl
01/10/92 – 30/06/95 = $0.41/kl
01/07/95 – 31/08/96 = $0.46/kl
01/09/96 – 30/06/98 = $0.53/kl
Two part tariff of fixed daily charge + usage charge introduced on 01/07/98
01/07/98 – 30/06/00 = $0.60 (+$0.25/day fixed daily charge)
01/07/00 – 31/12/01 = $0.63 (+$0.2625/day fixed daily charge)
01/01/02 – 31/12/02 = $0.66 (+$0.2756/day fixed daily charge)
01/01/03 - = $0.6765 (+$0.2825/day fixed daily charge)

Fixed charge for various meter sizes:

	07/98	07/00	01/02	01/03	
Up to 25 mm	0.25	0.2625	0.2756	0.2825	$/day
26 – 40 mm	0.64	0.672	0.7056	0.7232	$/day
41 – 50 mm	1.00	1.05	1.10	1.1275	$/day
51 – 100 mm	4.00	4.20	4.41	4.5203	$/day
101 – 150 mm	9.00	9.45	9.92	10.168	$/day
151 – 200 mm	16.00	16.80	17.64	18.081	$/day

> 200 mm =
(area of connection cross section (mm 2) * $0.2825)/490.87)
Meters >80mm not with <10kl in any one billing period

SEWERAGE TARIFFS

Sewerage Tariffs – Domestic & Commercial
(allows for 2 fixtures for each commercial property)

	extra charges for commercial
01/07/82 – 30/06/83 = $75	$45 per additional fixture
01/07/93 – 30/06/84 = $100	$50 per additional fixture
01/07/84 – 30/06/85 = $100	$50 per additional fixture
01/07/85 – 30/06/86 = $150	$75 per additional fixture
01/07/86 – 30/06/87 = $200	$75 per additional fixture
01/07/87 – 30/06/88 = $215	$112.50 per additional fixture
01/07/88 – 30/06/89 = $220	sliding scale introduced
01/07/89 – 30/06/90 = $227.50	
01/07/90 – 30/06/91 = $235	
01/07/91 – 30/06/92 = $251	
01/07/92 – 30/06/93 = $255.75	
01/07/93 – 30/06/94 = $258.04	
01/07/94 – 30/06/95 = $257	
01/07/95 – 30/06/96 = $278	
01/07/96 – 30/06/97 = $278	
01/07/97 – 30/06/98 = $278	
01/07/98 – 30/06/99 = $285	see below latest sliding scale
01/07/99 – 30/06/00 = $284.22	
01/07/00 – 30/06/01 = $299.25	
01/07/01 – 30/06/02 = $299.25	
01/07/02 – 30/06/03 = $314.20	

Non-domestic
0 - 2 pedestals – fixed annual charge – as above
3 - 24 pedestals – additional charge per pedestal (over 2) of $194
25 - 49 – additional charge per pedestal (over 24) of $182
50 - 99 – additional charge per pedestal (over 49) of $169
100 - 149 – additional charge per pedestal (over 99) of $157
above 149 – additional charge per pedestal (over 149) of $152

WATER TARIFFS	SEWERAGE TARIFFS
Water Tariff - Government 01/09/93 – 30/06/95 = $0.54/kl 01/07/95 – 31/08/96 = $0.61/kl 01/09/96 – 30/06/98 = $0.68/kl 01/07/98 – 30/06/00 = $0.70 (+ $0.25/day fixed daily charge) 01/07/00 – 31/12/01 = $0.70 (+ $0.2625/day fixed daily charge) 01/01/02 – 31/12/02 = $0.70 (+ $0.2756/day fixed daily charge) 01/01/03 - = $0.7175 (+ $0.2825/day fixed daily charge) Government fixed charges on meter size as for domestic/commercial Other Threshold concessions apply to churches, schools, charitable organizations & church properties Pension concessions apply Portable meters do not have a fixed daily charge, rates are $1/kl non construction & $0.80/kl construction meters. Commercial time of use meters have a 12 hour window	

Table B2 – System Demand Management Initiatives

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
SYSTEM MANAGEMENT					
Price/Tariffs	Pre 80s	Volume based tariffs on water and sewage prior to 1980s for all customers. A fixed charge was introduced in addition to the volume based charge in July 1998 effectively adding a minimum of $91.25 to each bill.	Details of tariffs on separate table	Government has always tried to equalise costs/pricing between Darwin & Alice Springs etc. (Alice Springs effectively subsidised) & has no current plans to change.	S Satour e-mails PAWA memo 26/06/98 *Pers comm* M Skinner
Water Meter Accuracy	July 83	Planning Branch – Water Division 300, 20mm domestic meters randomly chosen & tested for accuracy. Used to be 30% UFW, assessed meters showed average 14% of consumption not shown on meters but inaccuracy of meters tested varied widely.	In mid 80s quite a few meters blew out due to frosts (around 1983 PW read –7 deg C at 1 m above ground)		Report on 20mm Water Meter Accuracy, Jul 83, A Whyte *Pers comm*
Meter Replacement Program	92-96	92/93 - 1743 of 6000 20/25mm meters replaced (29.05%) or 1743 of 6201 (28%). 93/94 - 1477 of 6200 (23.82%) or 1477 of 6298 (23%), (Alan Whyte, 1880 replaced). 94/95 - 2113 of 6407 (32.98%). 95/96 - 1310 20mm replaced.	Since around 1996 DK PSM type meters used for replacement which when tested showed accuracy of 2% & reliable after 9999 kl (A Whyte not sure how frost resistant new meters are) In 90s meters replaced around 7000 kl based on 80s testing, new meters allowed to run longer		PAWA file notes
Customer Information System (CIS)	92	CIS system came on line in 92 and used to combine customer meter information for electricity & water.	Metered information pre 92 difficult to obtain		*Pers comm* S Satour
Leakage Detection Report	Aug 93	Night (12 to 6 am) metering investigation by Water Operations Branch on 17 & 26 August 93. Target leakage of 9 l/connection/hr used for assessment. A large no. of the areas examined were close to or over the target limit and were to be re-examined.	A Whtye indicated that study was not undertaken correctly and that people conducting study could hear water. Study had no real conclusions apart from a few valves that needed closing	No action taken	Leakage Detection Report Aug 93, *Pers comm* A Whyte
Fire hydrant Replacement	00	It was found that fire hydrants installed in Alice Springs constructed using galvanised pipes were corroding and leaking and believed by PW staff to be responsible for a considerable proportion of UFW. In 2000 the replacement program for fire hydrants was dramatically increased and has continued to increase since to about 70 hydrants per year.			J Gibbons e-mail 13/03/03
Water Pressure		Pressure reducing valves (PRV) and system modifications 1990 - Brewer Estate PRV – Reduced pressure in Brewer		Mark Skinner identified in Actions of ASUWMS Meeting of	J Gibbons e-mail 13/03/03

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
SYSTEM MANAGEMENT					
Investigations & Reduction		Estate area from over 800 to 600 kpa. Sept 2002 - Brewer Estate Pumping Station – Further reduction of pressure in Brewer Estate area to about 450 kPa. 1994 – Farms area PRV – Supplies all water south of Heavitree Gap except that which goes through the Brewer Pumping Station and previously through the PRV (the Farms area PRV failed in Dec 2000 and remained inoperable until March 2002). 1997 - Gap area PRV – Reduces pressure on one feed into the Gap, Gillen and CBD areas. Aug 2002 - Ilparpa Pumping Station installation has allowed pressures to the Farms area to be reduced slightly.		May 2002 (to be completed by May 03). Details of actions to be completed unavailable	ASUWMS Actions of Meeting May 02
Customer Meter Replacement Program	02	April/May/June & Oct/Nov 02 intensive meter replacement program (up to 90 meters a day replaced).	Detailed information not available		*Pers comm* M Skinner
Leakage	Mar 02 Feb 03	Leak near Ilparpa swamp found and fixed. Hospital valve (bypassing meter) found to be open.	Data indicates leak could have been running for around a year and may be responsible for substantial proportion of increase in UFW rate over 01/02		*Pers comm* M Skinner, N Decastro & A Turner analysis
Bulk meters		Since at least 1987 the same flow meter location has been used for the bulk meter readings and the same calculation method has been used to determine actual daily consumption (by considering changes in the level in storage tanks) although the presentation of the results has changed slightly. A Dall Short differential pressure device was used (up to 1991) which required regular checking to maintain accuracy. No records of checks/calibration are available except in 1989 when calibration was undertaken and the meter was thought to have an accuracy of around 5%. Bulk meter (Fuji Ultrasonic unit installed in 1991) suffered from loss of signal during the first year which was then rectified. Bulk meter has been checked and recalibrated a number of times although there are no records prior to 1998. In July 01 accuracy checked and found to be 2%. In Feb 03 accuracy checked again and maintained at 2%.			J Gibbons e-mail 13/03/03

Table B3 – General Demand Management Initiatives

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
DEMAND MANAGEMENT					
Mandatory Dual Flush	93	Mandatory dual flush toilets introduced into building code in 93 for all new and modified properties.			*Pers comm* J Childs
PAWA Resource Conservation Program	Since 1992	Aims to reduce water consumption to prolong the life of the Roe Creek borefield. This program has evolved into the ASUWMS.			Mentioned in cut the lawn paperwork (Media Release)
Waterwise	1994	PAWA has been a member of waterwise since around 1994. Water week in Alice Springs since at least 1995 using waterwise concepts.			
Alice Springs Water Action Group	Since 92	AS Water Committee formed in 92 was formed to provide an advisory link between the Alice community & PAWA on water conservation issues. Became AS Water Action Group around 97 & stopped around 98. WAG slightly different focus & less hands-on than original committee. Original purpose of Group was to manage the water demand management program in the Southern Region through community involvement. Functions have included provision of advice & monitoring of water conservation strategies, long term goal of adopting a water conservation education program for AS community & schools, sponsorship & participation of various PAWA funded projects with a water conservation theme, sponsorship of courses for plumbers to assist them perform water audits, on going development & publication of various information booklets to influence water use habits in the arid zone.	Achievements/involvement identified up to 98 Cut the Lawn Project ABC Garden Competition Hotel signage (May 98 Minister Eric Poole launched) (23 of 44 hotels displayed) Oct 98 Water conservation postcards at Honda Masters Game 6 Nov 98 DPWS Water audit workshop (2 days) done on Schools, motels, hospital & govt housing JDFPG won water conservation award 97 ASTC won in 98 (moisture sensing equipment used) 10, 15 second adverts on Imparja TV TV Ads from around 92 to 98 (including Brian Brown) Newspaper adds Water conservation material in packages for new DH&LG tenants (June 98 memo), JDFPG desk, tourist shops, tourist assoc. Approached DH&LG on tenants paying excess water charges (Memo March). Dept has a limit of 500 kL/hh/a above which tenants are charged (20% tenants use excess water) Brochure on Public Gardens Landscaped with Australian Plants (left in PW reception areas)		ASWAG file notes

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
DEMAND MANAGEMENT					
Booklets	1992 1993 1997	ALEC Gardens in the Desert. PAWA Arid Zone Watering. Greening Australia Green Tips for Alice Springs.	Imaginative gardening in Arid Australia A guide to effective irrigation in Central Australia Details on native plants	Booklets very popular and printed several times.	*Pers comm* A Whyte
PAWA Cut the Lawn Program	94 to 98	In 94/95 & 95/96 funded by National Landcare Program & PAWA with individual schools providing some cost and labour etc. Greening Australia also involved conducting educational programs to help students gain a better understanding of arid zone plants, water harvesting, mulching and the benefits of dripper systems. Project designed to reduced lawn area & install appropriate landscapes to minimise water demand.	In 95 & 96 Anzac Hill High School, Nathalie Gorey Pre School, Braitling Primary School and Gillen Primary School involved. In 98 carried out in Ross Park and Sadadeen Primary Schools and Ida Standley Pre School. The Institute for Aboriginal Development expressed interest in the project & was offered financial assistance but did not take up the offer in the end		Water Action Report letters DTW Report 98
JDFPG Dripper Sprinkler Project	July 95	Dripper & sprinkler systems installed & tenants informed on how work.			Memo 14/2/97 from Sam Shah
JDFPG Water Conservation Initiative	Prior to Jan 97	Arid Zone Landscaping (430 or 303 dwellings) including lawn & unsuitable trees & shrubs removed and replaced with PAWA water conservation approved ground cover & shrubs & timer controlled pop up sprinklers & drippers installed. Dual Flush – 290 installed (6L) Washing Machines – 122 installed (AA rated). Dishwashers – 58 (A rated) & 25 (AA rated).	JDFPG won water conservation award in 1997 (ASWAG notes) Auditing – 2 Housing Maintenance plumbers attended PAWA/MPA water audit seminar to evaluate water saving strategies (since parts put on order for trials and other appliances such as flow restrictors on showers have been installed)		Fax from Sam Shah DTW 21/1/97 & *pers comm* J MacManus
ABC Radio Garden Competition	Run since 1989	Various garden categories including garden of the year, best arid, best new, best food producing, best commercial, public, innovative ideas.			PAWA file notes & ASWAG files notes
Water Conservation Model Playground	95 - 98	Greening Australia, Alice Springs Town Council, PAWA. Mobile playground with water conservation messages. Only erected a few times.			Paddy Hall PW memo 10/1/96, *pers comm* A Whyte
Town Basin Non-Potable Reticulation System	1996 May 96	Non-potable water supplied to : Larapinta Park, Ross Park, Anzac Oval, Sturt Park, Baseball & Hockey Ground (Traegar Park), Gillen Park, Newland Park, Prickle Park,	ASTC used to use Town Basin water for areas such as Treagar & Ross Park but then handed system over to PAWA for upgrade and ongoing management		SKM 07/01 Town Basin Aquifer Management

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
DEMAND MANAGEMENT					
	Dec 96 Jan 97 Feb 97 June 97 Sept 97 July 98 Jan 00 Mar 00 Unknown Unknown May 00	Gillen Primary School (meter since Feb 97), Traeger Park Primary School, Alice Springs High School (meter since Apr 97), Traeger & Tunks Rd Standpipes, Ross Park Primary School, ASTC along river from Wills to Stott Terrace, Flynn Park, Bradshaw Primary School (meter since Oct 99), Town Pool & Sadadeen College (High School meter reading May 00), Church Undoolya Rd (Verdi Oval), Minor consumers, OLSH PS2 meter reading since May 00.	Borehole provided to hospital for outdoor water use within the hospital grounds in 1991 but not used (thought to be due to costs). Cooling water from hospital and Power Station is connected into Town Basin system. The pump that feeds the hospital cooling waste water into the Town Basin system is thought to have failandDecision not to repair and reconnect thought to be due in part to pumping costs and other testing costs such as Legionella Power Station cooling water connected since about 1998		Review Report, CIS data J Gibbons e-mail 12/03/03
Town Basin Private Bores	Prior to 1992	Golf Course (additional borehole in 1997), St Phillips, Det 421 (US Air Force operated site), Casino.			P16 SKM Town Basin Aquifer Report J Gibbons e-mail 13/03/03
PAWA Waterwise Audit Course	Sept 96	Plumbers audit course sponsored by PAWA.	One off workshop attended by JDFPG, plumbers *etc…*	One plumber sent team & used stickers *etc.*…but didn't continue to use due to lack of interest by public in water efficiency and lack of government support	Memo 7/6/96 G Marshall plumber interviews
PAWA Water DM Workshop	Oct 96	PAWA Water DM Workshop (organised but cancelled). Aimed at Gov Depts, tourist establishments, schools, Amoonguna, Churches, Turf Club *etc…*			PAWA files
PAWA Showcase Demonstration Garden	Prior to Sept 97	PAWA showcase garden at Power Station – Most of the work relating to setting up and constructing the garden was undertaken on Saturdays and was open to the public to view techniques and to talk to experts doing the work. Schools were taken to see the garden and adults encouraged to visit the garden and a similar water saving garden at the Airport.	PAWA garden still there but in disrepair PAWA sponsored a part of Olive Pink Garden (Botanic Gardens)		McGregor Report p24 *Pers comm* A Whyte J Gibbons e-mail 13/03/03
PAWA grey water experiment	Prior to Sept 97	Mentioned in MacGregor Report PAWA Booklet 'Re-using Grey Water' identified that an experiment was being conducted.	Experiments done in Darwin & Alice Springs. Found that maintenance was too labour intensive so projects not maintained on individual houses, so both projects dropped and Alice Springs system removed when house sold in 98		McGregor Report p25 Grey water booklet *Pers comm* A Whyte
McGregor	Sept 97	(McGregor have been doing PAWA NT assessments	Alice Springs groups included – water		

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
DEMAND MANAGEMENT					
Marketing Focus Group		since 1992). 6 groups of 10 (2 from Darwin) asked to respond to various water efficiency issues & DM initiatives carried out/potential.	conservation residents with garden, non water conservation residents with garden, business owners/managers, trade suppliers		
DPWS Audit Audit Report	Mar 98 Oct 98	Carried out audit on Hospital. Gillen, Braitling & Sadadeen Primary Schools Alice Springs High School & Centralian College. Anthelk Ewlpaye Town Camp. Public Housing – Gap Rd, Liana Court, Northrop Flats, Watts Apts, Wauchope Flats.		Wayne Hoban mentioned irrigation systems checked in multi residential public housing but indoor hardware not modified specifically	DPWS *Pers comm* W Hoban
DPWS Audit Workshop	Nov 98	Aim to discuss findings of the audit. Attended by; PAWA, ASWAG, AS Resort, Hospital, Red Centre Resort, St Mary's, Big Fat Pdtn, JDFPG, Diplomat Hotel, Centralian Advocate, State Projects, MacDonnel Range Holiday Park, ASTC, Centralian College, H&LG.		No further actions known	PAWA Memo
Greywater Reuse Survey	Nov 00	ALEC carried out greywater resuse survey (19 questions) by randomly calling 85 households in urban Alice Springs.			G Marshall 8/2/01
Concept Investigation Report	Aug 00	Tailored Water Supplies For Major Tourist Accommodation Report.	Investigations into high class hotels/motels using softened water Motels surveyed carried out included Lasseters Casino, Rydges Plaza, Alice Springs Vista, Desert Palms Resort, Alice Springs Resort		Arup Report Aug 00

Table B4 – The Alice Springs Urban Water Management Strategy Initiatives

INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
ALICE SPRINGS URBAN WATER MANAGEMENT STRATEGY					
ASUWMS	From around 1995	Aims; To conserve the non-renewable water at Roe Creek, Maximise the use of renewable water supplies,to relieve pressure on the Roe Creek aquifers & to improve ground water quality at the Town Basin aquifer, To make good use of wastewater and to reduce the number of mosquitos in Ilparpa swamp & in the long term to stop overflows and return the swamp to a natural condition, To determine whether aquifer storage and recovery is a feasible alternative to another evaporation or storage pond.	Initiated ASUWMS & set up diverse reference group Origins lie in Alice Springs Water Supply, Sewage Treatment and Infrastructure Development Plan which commenced in 1995 and initiated the DPWS water audits and PW reports (many prepared by SKM)	Targets proposed	ASUWMS Sheet J Childs & J Gibbons E-mail 13/03/03
Roe Creek Borefield Development Analysis	Aug 00	Review of potable water supply.		Water Efficiency Study recommended which now being carried out	SKM Report
Aquifer Storage & Recovery Feasibility	Aug 00	Review of potential aquifer injection & storage sites.		Further investigation needed Community consultation does not favour	SKM Report
Initial Community Consultation	Nov 00	Community Workshop 18&19 Aug 00 with Discussion Papers provided before 234 questionnaires returned (at workshop & from public).	Community Discussion Papers (Aug 00) – No.1 - Water Management in Alice Springs No. 2 - Drinking Water Supply System No. 3 - Sewage Treatment & Effluent Management	Community Newsletter No.1 'Water for the Future' on Workshop results distributed to all houses	SKM Report
Town Basin Aquifer Management Review	July 01	Review of Town Aquifer strategy		Plans to increase usage	SKM Report
ASUWMS Workshop	May 02	Developed targets & actions with ASUWMS Reference Group.	Ave water consumption per prop – current – 1100 kl/yr/prop – future - 600 kl/yr/prop Ave water consumption per residence – current – 530 kl/yr/res – future - 350 kl/yr/res Roe Creek borefield ave demand – current - 30 ML/d – future - 25 ML/d Roe Creek borefield peak demand – current 50 ML/d – future – 40 ML/d Town basin aquifer usage – current – 800 ML/yr – future 1500 to 2000 ML/yr short	Paper produced summarising targets & actions RG to review every 6 months	ASUWMS Paper & notes of meeting

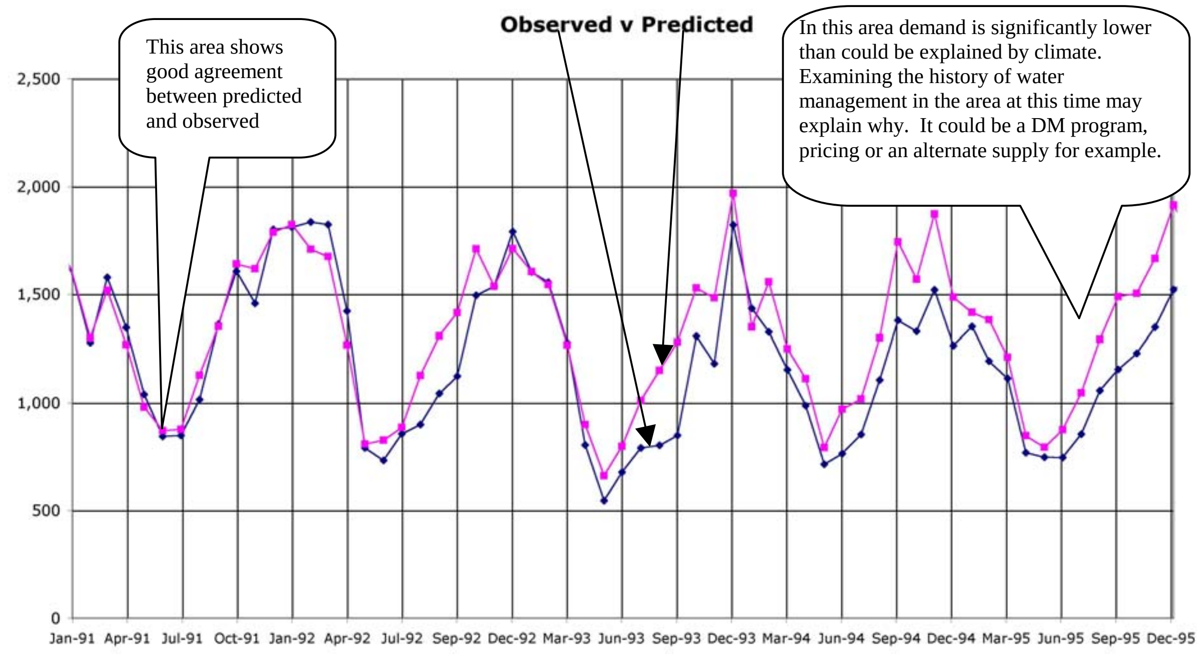
INITIATIVE	DATE	DETAILS	NOTES	FURTHER ACTION	REF
			term only Sewage inflow to waste stabilisation ponds – current 8 ML/d – future – 7 ML/d Discharge from ponds to Ilparpa swamp – current 3 ML/d – future emergency only % volume of effluent available for reuse – current 30% - future 80% Urban water tariff current - $0.69/kl - future – increase Potable water leakage reduction – current – 9% (1000 ML/yr) - future – 5.5% (600 ML/yr)		
Alice Springs Show Survey	July 02	Stall at Alice Springs Show set up with information & top loading washing machine prize. Survey designed to find out more about appliances in residential households.	Over 500 questionnaires collected	Findings incorporated into Water Efficiency Study and used to check assumptions used for end use model and options developed.	A Turner
Water Efficiency Study	July 02	Stages I & II designed to develop end use model and series of demand management options (completed May 2003). Stage III designed to develop implementation plan for preferred options.	ASUWMSRG Workshop undertaken during Study (March 2003) to discuss demand management options developed and implementation issues that need to be considered	Stage III (implementation plan) next phase of Study	A Turner
Waterwise NT Schools Program	03	The program is an accreditation system that encourages schools to meet essential criteria which are designed to meet both educational and 'action' orientated outcomes (e.g. saving water). The criteria also require the school to make an ongoing commitment by developing a school policy statement about water conservation. The program provides information resources, staff support, excursion guide, and links to other educational materials and programs that deal with water.	Grant available is worth $5,000 per year with a max of $1,500 per school/campus	Program will take into consideration in future the schools program being developed under the Water Efficiency Study	Ref *pers comm* R Henderson

APPENDIX C – CLIMATE CORRECTION MODEL

Intent

Climate correction models predict demand based on climatic variables (e.g. temperature, rainfall and evaporation rates). The models indicate what demand is likely to have been based on the influence of the weather alone. However, demand can be influenced by many other factors including price or imposed restrictions. Indeed we use these influences when attempting to manage demand. Differences noted when comparing the demand predicted by a climate model to the actual demand, indicate the impact of other influences as shown in Figure C1.

Figure C1 Extract from Predicted v Observed Demand, Alice Springs



Evaluating the success (or otherwise) of a demand management initiative such as voluntary restrictions can not be done by comparing the consumption in January 2003 to average consumption in January over for example the past five years, as 2002 in Alice Springs is known to have been one of the driest years on record. However, by comparing a predicted demand (based on climate) to the observed demand, we can estimate how much change in the demand is caused by another factor (e.g. restrictions). It is possible that although metered demand may be higher in January 2003 than it was in January 2002, in climate corrected terms, the demand may have decreased and this may be due to restrictions.

Data Used

A number of data sets and information were used to develop the climate correction model including:

- water demand - daily production data (i.e. historic bulk water demand);
- population figures;
- daily climate data (maximum daily temperature, daily pan evaporation rate, daily recorded rainfall);
- any major consumption changes in the commercial/industrial sector (e.g. opening or closing of water using businesses); and
- major restrictions or other events that may disrupt or change consumption patterns.

Climate Data

This data is available from the Bureau of Meteorology[1]. The data is such that rainfall and evaporation are measured at 9am for the previous 24 hours, meaning that the rainfall and evaporation of the previous day are listed against a said date. Maximum temperature is measured on the day.

Events/Dates

A number of demand management events have been implemented in Alice Springs, which are listed in Appendix B. The dates of implementation of these events have been collated to assist in plotting them on a timeline to assess whether these events have assisted in reducing demand.

Method

The model assumes that water demand per person can be predicted as a function of temperature and/or rainfall and/or evaporation. The relationship is unknown but may be represented by the following equation:

$$D = a_0 + a_1 t + a_2 m$$

Where:

D = water demand per person (L/person);
t = temperature (in degree days); and
m = moisture deficit.

This model predicts average daily demand per person in a month. ‘Degree days’ simply means the monthly sum of the maximum daily temperature.

Moisture deficit is a cumulative value determined by considering the rainfall and evaporation that occur on a given day and considering the resulting balance of water. For example, assuming 7mm of rain is received and there is 5mm of evaporation that day. The net moisture in the soil is 2mm. If the reverse occurred, 5mm of rainfall and 7mm of evaporation this is described as a moisture deficit.

Considering the soil as having finite capacity for water storage, then even if 50 mm of rain falls in a day, the 7 mm of evaporation/day will dry the soil in less than seven days. The soil is considered to be capable of holding up to 12.5mm of moisture. Drying conditions mean that negative soil moisture is impossible, since dry soil cannot be dried further.

Therefore there are two boundary conditions for soil moisture balance, a maximum of 12.5mm and a minimum of 0. The moisture deficit calculated is 0 while the moisture balance is greater than 6.25. If the moisture balance falls below 6.25, then the moisture deficit is the difference between the moisture balance and 12.5.

Using a linear regression, calibrated over a 2 year period (June 1986 to 1988) the following equation was developed for the demand in Alice Springs:

$$D = 506 + 5.43m$$

[1] See http://www.bom.gov.au to find the nearest recording station (note the 6 digit number) and order data via e-mail: webclim@bom.gov.au.

The statistical significance of this result has been confirmed with the following statistics:

- An r^2 value[2] of 0.96 was obtained; and
- t statistics[3] of 15.5 and 24.1 were found for the two variables.

In this case, only a constant (intercept) and one co-efficient are given in the output. This is because despite a range of regression attempts, no significant influence of temperature was found in the results and moisture deficit appeared to be much more significant influence and provided a better r^2 value.

This equation is then used to generate predicted demand, which can be plotted against observed demand, as shown in the extract in Figure C1 and also in the body of this report (refer to Section 5.4).

[2] The r^2 value indicates how much agreement there is between the data and the equation, *i.e.* the better the fit the closer the value is to 1 or –1, 0.96 means that the equation explains 96% of the demand.
[3] The t-statistic for significance depends on the degrees of freedom (or pairs of x and y) used in the regression. For large degrees of freedom (> 120) the t-statistic needs to be >1.96 to have significance at the 95% confidence interval.

APPENDIX D - CUSTOMER TYPE INTERVIEWS FOR VARIOUS SECTORS

A series of individual sector customer type interviews have been undertaken as part of the Study. Customer types interviews include:

- Amoonguna Water Use Interview Results.
- Town Camp Water Use Interview Results.
- Pine Gap.Telephone Interview
- Public Housing Telephone Interview.

Transcripts of these interviews have been included in Volume II of this Report to maintain confidentiality.

APPENDIX E - SUMMARY OF DPWS AUDITS

Table E1 – Alice Springs Hospital

End Use	Kl/d	%	Details	DPWS Recommendations
Base Flow	84	24	Leakage source unknown	Measurement & management
Laundry	70	20		Pre sort to minimise dirty wash cycle & replace machines when required
Cooling/boiler/pool	47	13		
Internal (toilets, basins, showers, kitchen, other	68	19	Taps – majority combination hot water ground floor 15–20 l/min, upper floor 6-9 l/min (due to pressure) Toilets – generally wall hung 11 L push button Showers – main building hand held 6-9 l/min, other areas fixed 15-20 l/min Kitchen – Hobart continuous feed dishwasher	Flow control taps (50 units ground floor) & showers (34 units staff accommodation) Kitchen considered water efficient – replace dishwasher with efficient unit when required
Irrigation	85	24	PAWA bore but not used (1998)	Reduce lawn area, put in arid, match moisture requirements, re-activate bore
Total	**354**	**100**	**180 beds, 172 staff accommodation**	**Benchmark should be 0.6-0.8 kl/bed/d excluding irrigation & laundry (AS=1.1kl/bed/d)**

Source DPWS – 1998

Table E2 - Schools

End Use	Kl/d	%		DPWS Recommendations
Centralian College (Sadadeen & Grevillea)				
Base Flow	22	16	Some leaking toilets & urinals	Reduce leakage through management
Evaporative air conditioning	3.2	2	Sadadeen – 1 large evap for gym & 3 smaller ones, main building refrigerative Grevillea – 22 evap air conditioning	
Internal	12	9	Sadadeen 37 (11 L) toilets, 7 urinals, 71 taps (some 15 l/min, not all used), 12 showers (generally not used) Grevillea 32 (11 L) toilets, 17 urinals, 40 taps (15/l/min), 6 showers (generally not used)	Minor tap flow control
Irrigation	101	73	Grevillea have reduced irrigation demand over last 2 years by reducing watering of rear area. Sadadeen - Oval irrigation done by others, bank irrigation done 9.00pm & also dripper irrigation system with 1000 heads Grevillea – Manual systems, pop ups, 100 drippers, subsystem, 25 trees with drippers	
Total	**139**	**100**	**S-406 full time students (179M/227F) G-209 full time students (108/M/101F) 134 staff (65M/69F) 1985 part time students (875M/1110F)**	
Alice Springs High School				
Base Flow	11	42	Found large leak due to air conditioning unit (8 kl/d), leaking toilets (normally fixed)	Maintenance management
Evaporative air conditioning	3.8	15	7 large evap coolers & 6 smaller ones, large variation between units, meters are going to be installed	Bleed settings need to be checked
Internal	5	20	18 (11L) & 12 (9/4.5 L) toilets, 6 urinals, 8 taps (15 L/s), showers never used, thinking of installing lever action taps	
Irrigation	6	23	Majority supplied by non potable water. 23% identified potable supply (pop up sprinklers, night irrigation, some hand held)	
Total	**26**	**100**	**400 (50/50) students & 50 staff**	
Braitling Primary School				
Base Flow	1	2		
Evaporative air conditioning	2.8	5	1 cell deck (?) dumps at end of each day & some individual units	
Internal	7	13	29 toilets (50% dual), 28 taps (15 L/min) 2 showers (20 L/min)	Tap/shower flow control
Irrigation	44	80	Automatic (Toro 640 units)	Reduce
Total	**55**	**100**	**504 (50/50) students, 47 staff**	

End Use	Kl/d	%		DPWS Recommendations
Gillen Primary School				
Base Flow	3	15		Maintenance management
Evaporative air conditioning	0.9	5	2 cell decks (dump at end of day), 1 multiple pad unit, 16 pad unit (bleed at 1.5 l/min), 2 times 3 pad units	
Internal	5	24	24 toilets (50% 11L/ 50% 9/4,5 L), 8 manual urinals (9L), 32 taps (most 18 L/min), 2 shower (not used)	
Irrigation	11	56	Non potable for timed irrigation (53 kl/d not included here) (16 acres) (Toro 640 & other) & potable (11 kl/d as shown here) also used generally hand watering	Reduce
Total	**19**	**100**	**419 (180F/239M) students & 30 staff**	
Sadadeen Primary School				
Base Flow	26	36	Some device being left on as not continuous	Minimise leakage
Evaporative air conditioning	2.2	3	6 (5000), 1 (1500), 1 (4000) & 6 or 7 (5000) units. On at 8am/off at 6.30PM. DPWS comment appears to bleed rapidly	
Internal	7	10	29 (11 L), 4 (9/4.5 L), 3 (6 L kids) toilets, 2 (9 L) urinals, 29 taps (15 to 20 L/min), 5 showers, 2 baths	Flow control on taps
Irrigation	37	51	Potable water with automatic sprinklers	Reduce irrigation
Total	**73**	**100**	**359 (140F/169M/50nursery) students & 25 staff + on same meter 21 children & 17 staff from Acacia Hill (disabled) & flat**	

Source – DPWS Oct 98

APPENDIX F – END USE MODEL DETAILS

The Reference Case

The reference case indicates future demand assuming no significant intervention by PW, or other authorities (e,g. planning departments, regulatory changes). It is based on the analysis work described in Sections 5 and 6 of the report and future anticipated changes. These changes include population size, appliance ownership and housing type, all of which impact upon demand. By clearly defining the future projected demand the reference case can be used to assess how a demand management program can be used to reduce demand from that projected and if possible to such an extent that it defers augmentation requirements of the existing system.

The residential component of this reference case is the output of end use modelling, which considers demand to be based on water services. End use analysis focuses on the factors and technologies that affect water use, including emerging trends, so historical patterns are less relevant. The focus is on what the end users need or want, for example clean clothes or aesthetically pleasing landscapes.

Demand for each residential end use has been calculated based on demographics, ownership of appliances, usage patterns and technologies.

Stock X Usage X Technology = Water use

Total residential demand is the aggregation of the demands of the specific end uses (e.g. toilets, showers, washing machines). The model output for the last 10 years, has been compared, and developed in consultation with, the results of the analysis of metered consumption data to allow calibration of the model.

Non-residential demand is also based on analysis of historic demand in the significant sectors combined with what could be gleaned from the residential and other end use modelling. For each sector a projection has been prepared which is a combination of anticipated growth in that sector combined with an assumption about whether or not the water demand in that sector can be related to population growth.

The outputs of the end use model are shown in Section 7.0.

Seasonal Variation

Alice Springs experiences significant variation in demand between summer and winter seasons. The end use model attributes this difference to variation in outdoor water use. Indoor uses are less discretionary and therefore tend to be more consistent throughout the year. The difference for the SR sector is illustrated in Figures F1 and F2.

Figure F1 - Typical Winter Demand – Single Residential Households Expressed as an Annual Demand

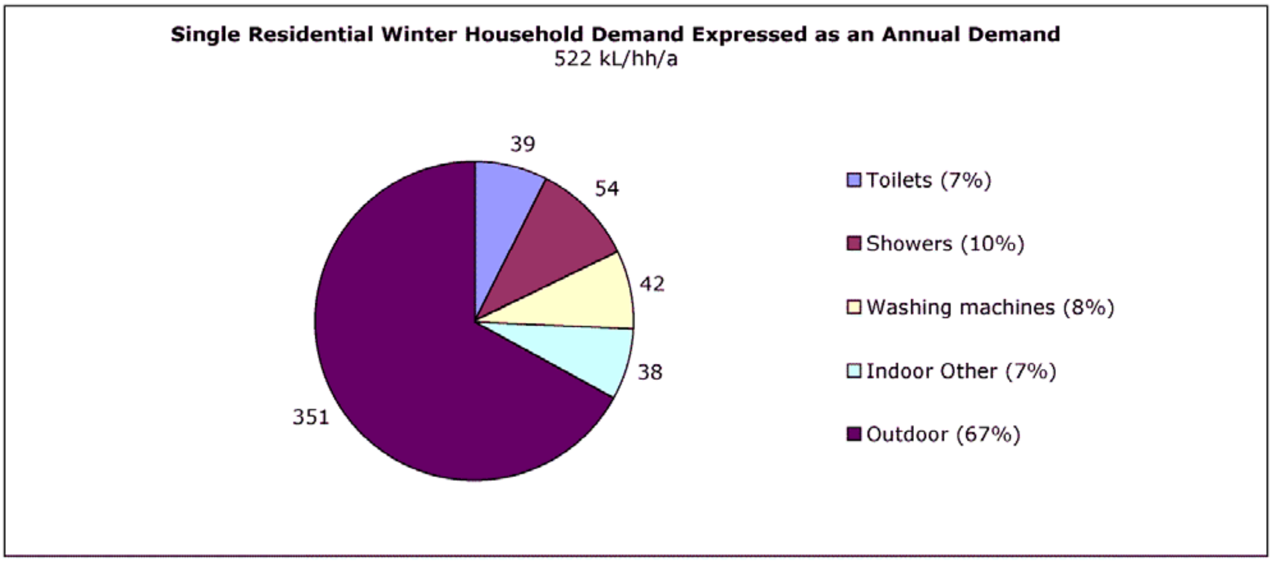
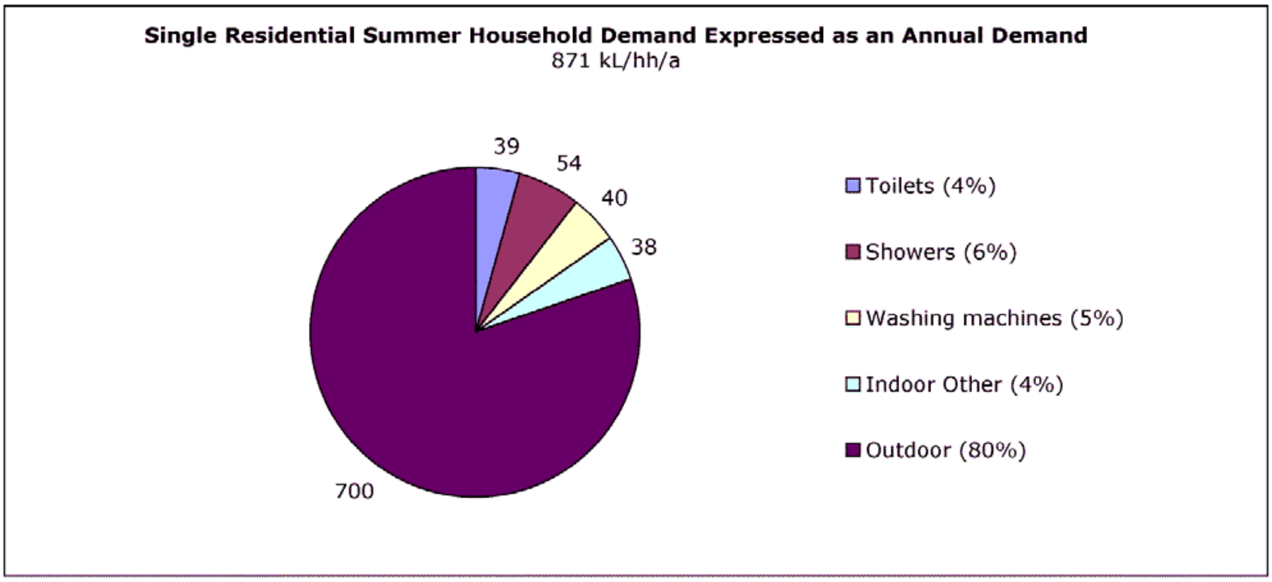


Figure F2 - Typical Summer Demand – Single Residential Households Expressed as an Annual Demand



Residential End Use Modelling

The residential component of this model has separately considered the end uses of:

- Toilets and toilet leakage,
- Showers,
- Baths,
- Taps,
- Washing machines,
- Pools; and

- Air conditioners.

A series of assumptions about each of these end uses, combined with data and projections of population and housing, provides an estimate of demand by end use. Assumptions for each end use in the model are summarised in Table F1 below. Full assumptions and references are contained in the model. These assumptions have been derived based on sources such as the Alice Springs Show Survey, interviews, air conditioning experiments, ABS data and end use figures from other Australian and international studies. Where possible more than one source has been used to derive these assumptions.

Table F1 – Indoor End Use Assumptions

End Use	Assumption		Value	Units
Indoor				
Showers	Lifetime:		13	years
	Flow rate:	'normal' showerhead	8.43	litres/min
		AAA showerhead	6.2	litres/min
	Average duration of shower:		7	minutes
	Frequency :		1	showers/day
	AAA showerhead ownership:	1994	15%	% of hh
		1998	28%	% of hh
		2001	29%	% of hh
		2002	36%	% of hh
	Number of showers per household:	Houses	1.4	shower/house
		Flats	1	shower/flat
	AAA showerhead sales:	1997	30%	% of sales/yr
Toilets	Lifetime:		25	years
	Average water consumption:	11 litre single flush	11	litres/flush
		11/6 litres	7	litres/flush
		9/4.5 litres	5.5	litres/flush
		6/3 litres	4	litres/flush
		Extra water consumption for 2 toilet households	20%	
	Frequency:	1 toilet household	5	flushes per day
		2 toilet household	6	flushes per day
	Ownership of dual flush:	1994	42%	
		1998	63%	
		2001	69%	
		2002	80%	
		6/3 2002	38%	
		9/4.5 2002	14%	
		11/6 2002	4%	
	Toilet Ownership:		1.4	toilets per hh

End Use	Assumption		Value	Units
Clothes Washers	Lifetime:		14	years
	Ownership:	Total (1999)	90%	penetration
		Top loaders (2002)	85%	% ownership
		Front loaders (2002)	12%	% ownership
		Manual (2002)	3%	% ownership
	Water consumption:	Top (2003)	140	litres/wash
		Front (2003)	80	litres/wash
		Twin Tub (2003)	50	litres/wash
	Frequency:		300	washes/year
		Front loader factor	1.1	
		Standard deviation	0.25	
Bath	Water consumption		58	litres
	Frequency		2.8	baths/hh/week
Taps	Water consumption - kitchen		12	LCD
	Water consumption - bathroom		5.9	LCD
	Water consumption - laundry		7.2	kl/hh/a
Dishwashers	Ownership		15%	of hh
	Usage		3.03	times/week
	Water Demand		21	L/load
			63.6	L/hh/week
Toilet Leakage	Leakage rate		2	kl/toilet/a
			10.95	kl/toilet leak/a
	Leaking toilets		3%	of toilets
			0.33	kl/toilet/a
Outdoor				
Air Conditioning	AC Ownership & Use	SR HHs with Evaporative AC	90%	
		MR HHs with Evaporative AC	80%	
	Seasonal Use		8	months/year
			242	days/year
	Daily Use		10	hrs/day
	Total Run Time		2420	hrs/year
	AC Water Demand	Bleed Rate	6	L/hr
		Evaporated Rate	20	L/hr

End Use	Assumption		Value	Units
Pools	Pool Ownership & Use	SR HHs owning pools	18%	
	Average pool surface area		40	m2
	Average pool volume		48	m3
			48000	L
	Season of pool use		7	months
	Pool Water Demand	Draining and refilling every	5	years
	Evaporation	Av evap. rate	7.78	mm/d
		Loss per pool per day	311.09	L/day
	Backwash	No. occurances	30	/year
		Water per backwash	300	L
	Splash		50	L/week
	Leaks	Assumption - in 1% of pools	50	L/day
	Pool Cover Usage	HHs owning pool covers	33%	
		Days pool covered	50%	
		Reduction in Evaporation	95%	
		Evaporation Rate if not covered	1.94	mm/d

APPENDIX G – SPECIALIST INTERVIEWS & SHOW SURVEY DETAILS

A series of specialist interviews have been undertaken as part of the Study. Interviews include:

- Air Conditioning Interview Results
- Additional Air Conditioning Interview Results
- Garden Irrigation Water Use Interview Results
- Plumber Interview Results
- Swimming Pool & Spa Interview Results
- Additional Swimming Pool (Shade) Interview Results

Transcripts of these interviews have been included in Volume II of this Report to maintain confidentiality.

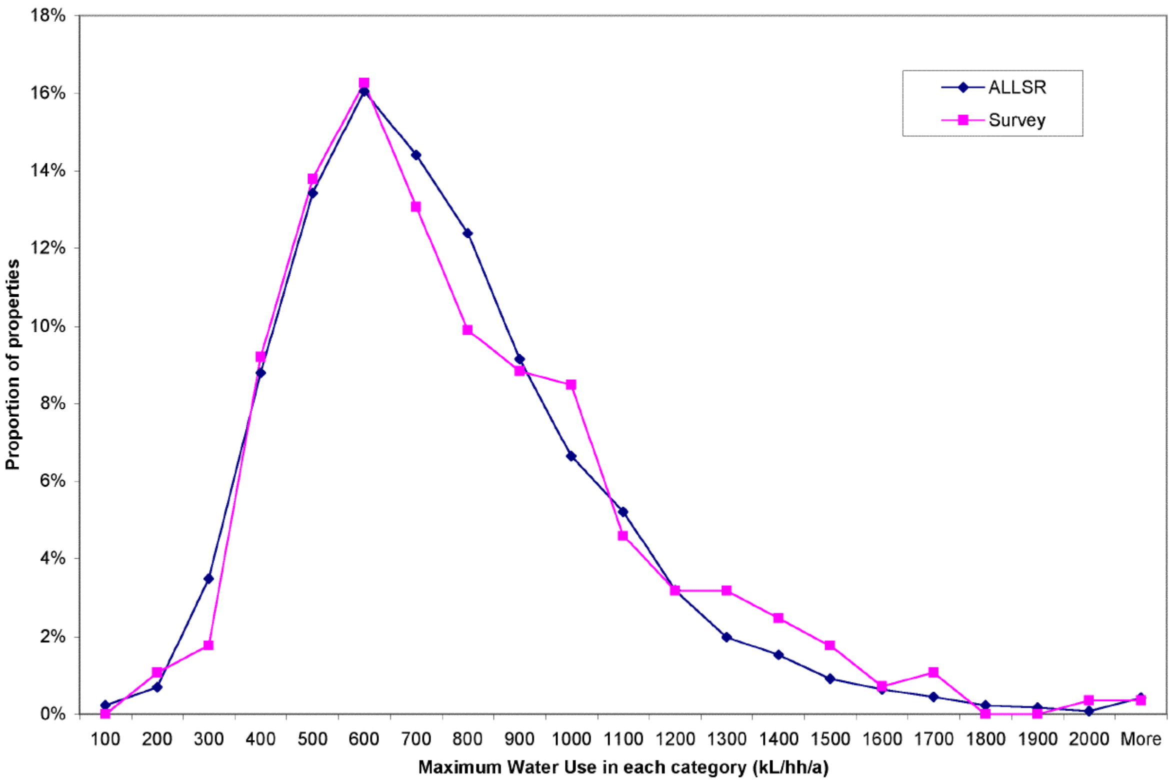
ALICE SPRINGS SHOW SURVEY

This survey, conducted at the Alice Springs Show in July 2002, involved a simple questionnaire (see copy included at the end of this appendix) completed by residents attending the show. The questionnaire was available to people at a stand at the show and they were encouraged to participate because each completed questionnaire entitled the respondent to an entry in the draw to win a water efficient front loading washing machine. Participants answered a range of questions covering topics such as their attitudes to water efficiency and reuse, the appliances they owned and how they used them, water use/water conservation measures they employed and some basic demographic information. The final question on the survey requested permission for the researchers to link the answers provided to the customer's water use data held by PW.

Responses

There were 537 completed surveys and of these 440 respondents (approximately 82%) agreed to have their survey data and water consumption data linked. From these respondents, analysis of a SR sample of 258 households was possible. These were customers who indicated they were in a single detached house and for whom there was sufficient identifying data to enable them to be linked to PW metered data. Stratification of the sample was confirmed by comparing the water use profile of the total SR cohort with the profile of these respondents. A particularly good agreement was found (illustrated in Figure 7-2 in the body of the report and reproduced here as Figure G1) allowing analysis to proceed on the basis that this was a representative sample, despite an over-representation from rental properties compared with the broader Alice Springs demographic.

Figure G1 - Alice Springs Survey



Analysis

Each question has been analysed (See Table G1 below) in terms of the percentage of respondents providing that answer and in terms of the water use of those respondents. The water use data analysed was mainly average annual total consumption and for relevant questions seasonal variation in consumption and is shown, where there is a significant sample size for that response.

Table G1 - Analysis of Responses

Question		Responses		Water Use (kL/hh)	
				Annual	Seasonal Variation
1	Is water use a serious issue?	61%	strongly agree	There is no difference in their average consumption	
		31%	agree		
End Use Appliances - Indoor					
2	Do you have a dual flush toilet?	80%	Yes	730	
		20%	No	699	
3	Do you have a water saving shower rose?	36%	Yes	721	
		60%	No	733	
		4%	Not Sure		
	Both dual flush toilet and water saving shower rose?	*35%*	*Yes*	*742*	
4	What type of hotwater system	60%	storage - solar	765	
		32%	storage - other	688	
		4%	instant		
		1%	other		
		2%	not sure		
5	What sort of washing machine?		none		
		3%	twin		
		12%	front	757	
		85%	top	718	
		1%	other		
		0%	not sure		
6	How many loads/week?	14%	1-2	706	
		41%	3-5	701	
		26%	6-8	756	
		11%	9-11	734	
		7%	12-16		
		2%	>16		
	Combining Q5 and Q6				
	Top loaders…				
	Front Loaders	*6%*	*1-2*		
		44%	*3-5*	*723*	
		25%	*6-8*	*610*	
		19%	*9-11*	*838*	
		6%	*12-16*		
		0%	*>16*		

Question		Responses		Water Use (kL/hh)	
				Annual	Seasonal Variation
Air Conditioning					
7	Do you have an evaporative air				

Question		Responses		Water Use (kL/hh) Annual	Seasonal Variation
	conditioner?	10%	No (1)	723	80
		89%	yes (2)	725	93
7a	Where does the bleed water go?	79%	Garden (1)	716	90
		2%	Street (2)		
		4%	Sewer (3)		
		11%	Not Sure (4)	658	87
Gardening					
8	What sort of garden do you have?	50%	Arid	699	87
		28%	Other	809	108
		65%	Lawns	742	93
					96
		20%	Vegetables	767	
		39%	Fruit trees	782	99
		17%	Palm trees	811	101
		3%	No garden		
9	How did you water the garden last summer?	43%	Fixed - Pop	779	94
		51%	Fixed - Drip	752	97
		24%	Hand hose	761	95
		5%	Soak hose		
		25%	Sprinkler hose	683	92
		3%	Other		
10	How much lawn area do you water?	38%	Small patch	716	89
		29%	Only one yard	735	97
		15%	All around the whole house	792	100
		16%	None	652	77
		1%	Not sure		
11	How often did you water the garden last summer?	1%	Twice a day		
		23%	Daily	755	94
		30%	Every 2nd day	787	96
		22%	Twice a week	659	89
		14%	Weekly	744	94
		7%	Less than once		
12	How long did you usually water?	32%	> 0.5 hrs	719	88
		41%	0.5 - 1	748	99
		14%	1-1.5	700	88
		7%	1.5-2		
		3%	>2		

Question		Responses		Water Use (kL/hh) Annual	Seasonal Variation
13	Do you have a controller on your watering system? What type?	33%	Tap timer on hose	696	93
		34%	Auto irrigation control	826	97
			Moisture sensor		
		27%	No controller	673	89

Question		Responses		Water Use (kL/hh)	
				Annual	Seasonal Variation
14	What time of day did you water?	8%	6-8		
		2%	8-12		
		1%	12-5		
		29%	5-7	696	85
		34%	7-9	657	89
		17%	9pm-6am	885	103

Hypothesising

Does garden type affect duration/frequency of watering?

Note: % are of the people who have that garden type.

	Garden type			
Watering Freq	**Arid Garden**	**Other**	**Lawns**	**Fruit**
Twice a day	1%	1%	2%	1%
Daily	21%	30%	23%	23%
Every 2nd day	29%	36%	33%	29%
Twice a week	24%	23%	22%	30%
Weekly	13%	8%	15%	11%
Less than once	10%	0%	4%	4%
Watering Duration				
> 0.5 hrs	30%	35%	35%	29%
0.5 - 1	40%	48%	42%	50%
1-1.5	15%	6%	13%	8%
1.5-2	6%	4%	5%	8%
>2	5%	5%	3%	3%

Question		Responses		Water Use (kL/hh)	
				Annual	Seasonal Variation
Pools					
15	Do you have a pool?	70%	no	663	83
		29%	yes	860	111
15a	Do you use a pool cover?	10%	yes	760	104
		20%	no	922	113
Other water use					
16	Do you use other water sources for your garden?	8%	rain tank		
		14%	reuse laundry	688	89
		52%	air conditioner bleed	730	94
		9%	water harvesting from roof	687	81
		1%	other		
		34%	no	720	90
17	Do you have any of the following?	13%	rain tank	714	90
		45%	guttering	756	96
		14%	spa	761	97
		33%	dishwasher	810	99
18	Do you own or rent your home?	81%	own	747	96
		18%	rent	633	73
19	Is it a separate house?	100%	separate	725	92
			unit		
20	How many years have you lived in Alice Springs	Max	62		
		Min	0.5		
		Average	16		
		Mode	6		
		(See also histogram)			
21	How many years have you lived at your current address	Max	50		
		Min	0.5		
		Average	9		
		Mode	1		
22	How many people usually live here?	Max	9		
		Min	1		
		Average	3		
		Mode	4		

Question		Responses		Water Use (kL/hh)	
				Annual	Seasonal Variation
23	How many people are usually at home during weekdays?	Max	9		
		Min	0		
		Average	2		

Question	Responses		Water Use (kL/hh)	
			Annual	Seasonal Variation
	Mode	2		

THE WATER WE USE - Alice Springs residents domestic water survey 2002

1. Do you feel high water use is a serious issue in Alice Springs?

☐ Strongly disagree ☐ Disagree ☐ Agree ☐ Strongly agree

WATER IN THE HOME

2. Do you have a dual-flush (two buttons) toilet or single flush (one button) toilet?

☐ Dual-flush ☐ Single flush ☐ Not sure

3. Do you have a water-saving shower rose?

☐  Yes ☐  No ☐ Not sure

4. What type of hot water system do you have (please tick one)

☐ Storage solar hot water ☐ Storage other (electric, gas) ☐ Instantaneous ☐ Other .... ☐ Not sure

5. What sort of washing machine do you use?

☐ None ☐ Twin tub ☐ Front loading ☐ Top loading ☐ Other ☐ Not sure

6. How many loads a week do you usually do in your washing machine?

☐ 1 to 2 ☐ 3 to 5 ☐ 6 to 8 ☐ 9 to 11 ☐ 12 to 16 ☐ over 16

7. Do you have an evaporative air conditioner(uses water cooling)?

☐ No ☐ Yes ⟶ 7a. Where does the bleed water go?

☐ Garden ☐ Street ☐ Sewer ☐ Not sure

WATER IN THE GARDEN

8. What sort of garden do you have? (please tick one or more)

☐ Arid garden ☐ Other garden ☐ Lawns ☐ Vegetables ☐ Fruit trees ☐ Palm trees ☐ No garden

9. How did you water the garden last summer? (please tick one or more)

☐ Fixed watering System (pop-up or spray) ☐ Fixed watering system (drip) ☐ Hand held hose ☐ Soaker hose ☐ Hose end sprinkler ☐ Other

10. How much lawn area do you water?

☐ Small patch ☐ Only one yard ☐ All around the whole house ☐ None ☐ Not sure

11. How often did you water the garden last summer?

☐ Twice a day ☐ Daily ☐ Every 2nd day ☐ Twice a week ☐ Weekly ☐ Less than once a week

Please turn over *Please turn over*

12. How long did you usually water? (please tick one)

☐ Less than half an hour ☐ Half an hour to one hour ☐ One hour to one and a half ☐ An hour and a half to two hours ☐ Over two hours

13. If you have a controller on your watering system, what type of controller do you have?

☐ Tap timer on a hose sprinkler ☐ Automatic irrigation system controller ☐ Moisture sensor or rain sensor ☐ No controller

14. What time of day did you usually do your watering?

☐ 6am-8am ☐ 8am-12pm ☐ 12pm-5pm ☐ 5pm-7pm ☐ 7pm-9pm ☐ 9pm-6am

15. Do you have a pool at home?

☐ No ☐ Yes → If you have a pool, do you use a pool cover? ☐ Yes ☐ No

16. Do you use other water sources for your garden?

☐ Yes, water from a rain tank ☐ Yes, re-using laundry or other wastewater ☐ Yes, air-conditioner bleed water ☐ Yes, water harvesting from roof ☐ Other ………………… ☐ No

17. Do you have any of the following? (tick if yes)

☐ A rainwater tank ☐ Guttering on the roof ☐ A spa bath ☐ A dishwashing machine

A FEW QUICK QUESTIONS ABOUT YOU

18. Do you own or rent your home?

☐ Own ☐ Rent

19. Is it a separate house, unit, other?

☐ Separate house ☐ Unit/duplex ☐ Other……………………………………

20. How many years have you lived in Alice Springs?………………years

21. How many years have you lived at your current address?………………years

22. How many people (including children) usually live at your home?………………people

23. How many people (including children), are usually at home during week days?……………people

Our survey will be greatly assisted if we can analyse recent water metering figures for the surveyed houses using your street address. All these results will be collated together and will be anonymous and confidential. No household will be able to identify in the results at any stage.

24. Do you give permission for PAWA water metering figures for your household to be used?

☐ Yes ☐ No

Name ………………………………………… Street Address …………………………………………

Phone………………………………………… THANK YOU VERY MUCH !!!!

APPENDIX H – OPTION ASSUMPTIONS

Indoor Retrofit

Sector: Residential

Group: All households

Measure: Efficiency

Instrument: Economic Incentive

Option Description: PW would establish a retrofit program where households could contact them requesting a retrofit. A plumber would then visit the house and replace an inefficient showerhead with a AAA showerhead (additional showerheads to be purchased separately), install tap flow regulators, install a toilet displacement device and check for leaks. PW may consider including a single flush toilet retrofit.
The cost of the retrofit would be borne mainly by PW and there would be a small charge to householders.

Savings:	117.73	ML/a water saved in 2008	
	0.32	ML/d in 2008	Sewage volume reduction
	152.00	MWhr/a in 2008	Energy saving
	83.60	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.53	/kL	PV

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	9,419			in 2002
Total customers in target group	9,419			in 2002
Uptake rate	50%		ISF	Experience in SWC retrofit program
Participants	4,709			in 2002
Option duration	2	years		Start late in 2003 and finish in 2005
Demand Reduction				
Water				
Retrofit (without toilet)	25	kL/hh/a	Sarac et al (2002)	Evaluation of retrofit programs in NSW
Toilet retrofit	17.9	kL/hh/a		From model this saving could be as high as 35kL/hh/d
Total with toilet retrofit	42.9	kL/hh/a		
Hotwater (with or without toilet)	20	kL/hh/a		Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	25	kL/hh/a		Since all demand is indoor
Sewage (+toilet retrofit)	42.9	kL/hh/a		Since all demand is indoor
Peak Reduction	0.32	ML/d		In 2008
Peak Reduction (+toilet retrofit)		kL/hh/a		Since demand reduction is consistent over the whole year
Costs				
Capital				
Hardware & Implementation				
Showerhead	$ 50.00	/hh		
Tap flow regulators (3/hh)	$ 9.00	/hh		
Toilet displacement device	$ 3.00	/hh		
Tap Seating (Stainless Steel)	$ 15.00	/hh		
Operating				
Overheads				
Brochure design	$ 5,000			Brochure development at the outset
Marketing and promotion	$ 10,000	p.a		On-going
Plumbers needed	3			
Plumber training	$ 3,000			Course cost to be distributed based on number of plumbers
Plumber visit	$ 40.00	/hh		required for DM program.
On-going				
Admin	$23,547	/a		Possibly an overestimate in the final year of the program - could be used for evaluation/feedback

Washing Machine Rebate

Sector: Residential

Group: All

Measure: Efficiency

Instrument: Economic Incentive

Option Description: This option provides a rebate (credited on the bill or sent via cheque) on the purchase of a new front loading washing machine. The option seeks to increase the sales of front laoding machines.

Savings:	3.49	ML/a water saved in 2008	
	0.01	ML/d in 2008	Sewage volume reduction
	4.49	MWhr/a in 2008	Energy saving
	2.47	T CO_2e/a in 2008	GHG reduction
Unit Cost:	$ 1.39	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	9,520	hhs		in 2003
Total customers in target group	775	sales of washing machines		in 2003
Uptake rate	25%			Given that sales of front loaders are currently 10% of sales, the aim is to increase this rate during the program duration.
Participants	194			in 2003
Option duration	3	years		
Demand Reduction				
Water	18	kL/machine/a		Difference between washing with a front loader and washing with a top loader in the end use model.
Hotwater	0.70	ML/a		20% of water used (and therefore of water saved), AGO, Australian Residential Building Sector
Sewage	18	kL/machine/a		greenhouse Gas Emissions 1990-2010 (1999) Appendix
Peak Reduction	0.02	ML/d in 2008		All flows are to sewage
				Demand reduction is evenly spread
Costs				
Capital				
Hardware & Implementation				
Rebate	$ 150.00	/machine		
Operating				
Overheads				
Promotion	$ 20,000.00			Mostly used to develop marketing campaign, some continued advertising, (50%, 25% 25%)
On-going				
Admin	$ 1,000.00	/year of option		

Pool Cover

Sector: Residential

Group: Swimming Pool Owners

Measure: Efficiency

Instrument: Economic Incentive

Option Description: In this option PW would subsidise the cost of purchase of a pool cover and communicate broadly the advantage of using a cover during summer to reduce evaporation losses.

Savings:	41.74	ML/a water saved in 2008	
	0	ML/a	Sewage volume reduction
	45.00	MWhr	Energy saving
	43.56	T CO_2e	GHG reduction
Unit Cost:	$ 0.63	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	5,733		Demog.xls	All SR home owners in 2003
Total customers in target group	1,032		Pools_Alice.xls	Pool owners
Uptake rate	50%			
Participants	516			in 2002
Option duration	2	year		
Demand Reduction				
Days Pool Covered	75%			
Reduction in evaporation losses on days covered	95%			
Normal Evaporation losses	311	L/day		
Water Saved	296	L/day covered		
	81	kL/pool/a		
Hotwater	0			Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	0			
Peak Reduction	see targeted outdoor			
Costs				
Capital				
Hardware & Implementation				
Pool Covers	$ 500.00	/cover		
Operating				
Overheads				
Information Brochure Development	$ 5,000.00			One of development cost for promotional purposes
On-going				
Admin	$ 3,000.00	/year		
Promotion	$ 3,000.00	/year		
Cost Allocation				
Customer				
Other				
PW				
Other parties	50%			
	$ 250.00			

Public Housing Retrofits

Sector: Residential

Group: Public Housing

Measure: Efficiency

Instrument: Economic Incentive

Option Description: Given that Public Housing is a significant component of housing stock in Alice Springs, and from analysis which has revealed that these properties have a higher than average water demand. A plumber would visit the house and replace an inefficient showerhead with a AAA showerhead (additional showerheads to be purchased separately), install tap flow regulators and stainless steel tap seating, install a toilet displacement device and check for leaks on taps and in toilet. Option includes an annual maintenance check to ensure leaks are detected quickly both indoors and outdoors. SCENARIO 2 includes repairs of any toilet leaks found.

Savings:	25.76	ML/a water saved in 2008	
	0.07	ML/d in 2008	Sewage volume reduction
	33.16	MWhr/a in 2008	Energy saving
	18.24	T CO_2e /a in 200	GHG reduction
Unit Cost:	$ 0.27	/kL	

SCENARIO 2

Savings:	26.07	ML/a water saved in 2008	
	0.07	ML/d in 2008	Sewage volume reduction
	33.65	MWhr/a in 2008	Energy saving
	18.51	T CO_2e/a in 2008	GHG reduction
Unit Cost:	$ 0.28	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	9,520			in 2003
Total customers in target group	1,041			in 2003
Uptake rate	90%			
Participants	937			annually
Option duration	2	year		
Demand Reduction				
Water				
Retrofit (without toilet)	25	kL/hh/a	Sarac et al (2002)	Evaluation of retrofit programs in NSW
Increased savings	10%			Expecting higher savings due to anticipated higher leakage rates and requirement to install stainless steel tap seating.
Toilet leakage savings	0.329	kL/hh/a		Assumes 3% of toilets are leaking at 11kL/hh/year. These would all be repaired resulting in this average/hh saving.
Total Saving per hh	27.5	kL/hh/a		
Hotwater	74%	of savings		Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	27.5	kL/hh/a		Since all demand is indoor
Peak Reduction	0.07	ML/d		Since demand reduction is consistent over the whole year
Costs				
Capital				
Hardware & Implementation				
Showerhead	$ 50.00	/hh		
Tap flow regulators (3/hh)	$ 9.00	/hh		
Toilet displacement device	$ 3.00	/hh		
Tap Seating (Stainless Steel)	$ 15.00	/hh		
Toilet leak repair materials	$ 25.00	/hh		
Operating				
Overheads				
Plumbers needed	3			
Plumber training	$ 3,000			
Plumber visit	$ -	/hh		
Plumber additional cost for toilet repairs	$ 50.00	/hh		
On-going				
Admin				1 off liaison effort required to establish the option with the department

Pine Gap Saving Water

Sector: Residential

Group: Pine Gap Properties - US Dpt. Defence

Measure: Efficiency

Instrument: Economic Incentive

Option Description: Given that Pine Gap is a significant component of the housing stock in Alice Springs, and from analysis which has revealed that these properties have an average water demand which is significantly higher than average, it is suggested that targets be established for these properties and steps be taken to ensure that demand is reduced to be equal to or less than the average demand per property in Alice Springs.

Savings:	153.59	ML/a water saved in 2008	
	0.42	ML/d in 2008	Sewage volume reduction
	197.67	MWhr/a in 2008	Energy saving
	108.72	T CO_2e /a in 200[illegible]	GHG reduction
Unit Cost:	$ 0.28	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	9,520			in 2003
Total customers in target group	520			in 2003
Uptake rate	90%			
Participants	468			annually
Option duration	1	year		
Demand Reduction				
Water				
Existing Demand/property	1034	kL/hh/a	Pine gap analysis	
Average Demand/property in AS	706		AS analysis	
Total Saving per hh	328.2	kL/hh/a		
Hotwater	20	kL/hh/a		
Sewage	98.5	kL/hh/a		
Peak Reduction	0.42	ML/d		
Costs				
Capital				
Hardware & Implementation				
Other changes	$ 1,000.00	/hh		We have assumed a general option without perscribing the steps to be taken.
Operating				
Overheads				
Plumbers needed	2			
Plumber training	$ 2,000			
Plumber visit	$ -	/hh		Assumed to be included in incentive

Outdoor

Sector: Single Residential

Group: All SR (except Public Housing and Pine Gap)

Measure: Efficiency

Instrument: Economic Incentive

Option Description: PW customers would be offered a visit to their home by a water efficiency landscape advisor. The advisor would visit the home and with the owner complete an inspection of their garden. The major points to note would include water system (e.g. Fixed - pop up) and note any water saving devices (e.g. tap timers) where these devices are in place the advisor would confirm with the owner how they currently use the item and together they would carry out routine maintenance including flushing of lines and unclogging of drip lines. Where these are not in place the advisor could provide free devices including tap timers, drip irrigation system components, and rebate vouchers for the purchase of native plants and mulch (up to a mximum value of$50/hh).

In this option PW would also subsidise the cost of purchase of a pool cover where the advisor had identified that there was a pool and a cover was not owned. If a cover was owned the advisor would encourage greater use of the cover to reduce evaporation losses. The advantages of using a cover during summer to reduce evaporation losses would also be communicated broadly in brochure format.
This option would be implemented in Spring and Summer only, over a few years

Savings:	99.65	ML/a water saved in 2008	
	-	ML/d in 2008	Sewage volume reduction
	107.42	MWhr/a in 2008	Energy saving
	59.08	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.26	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	5,733		Demog.xls	All SR home owners in 2003
Target Group	3,730			
	70%			SR Houses owned (ie. Others rented)
Participants				
Take-up rate	30%	of owners		
	1,119	hhs		
Option duration	2	years		Implemented during Spring and Summer
Pool Covers				
% Pool ownership	18%			
Total customers in target group	201		Pools_Alice.xls	Pool owners
Uptake rate	80%			
Participants	161			in 2002
Option duration	2	year		
Demand Reduction				
Estimate current average garden demand	451	kL/hh/a	Total_Alice.xls	Analysis
Percentage reduction	20%	/hh		of garden demand
Decay	5%	p.a		Savings reduce when program is not active after completion
	90	kL/hh/a		from participants
Other reductions (General communications)	5%	/hh		of garden demand in half of the remaining hhs
Pool Covers				
Days Pool Covered	75%			
Reduction in evaporation losses on days covered	95%			
Normal Evaporation losses	311	L/day		
Water Saved	296	L/day covered		
	81	kL/pool/a		
Hotwater	0			Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	0			
Peak Reduction	0.53			
Costs				
Capital				
Landscape Assessors	5			
Training	$ 9,375.00			
Give-away efficiency pack	$ 50.00			
Establish Demonstration Garden	$ 20,000.00			One off cost for design and construction with educational signage and handouts
Operating				
Landscape advisor initial visit	$ 70.00	/hh		
End of summer re-visit	$ 35.00	/hh		
Admin	$ 5,595	/a		
Communications strategy	$ 20,000			3 different brochures developed at $5,000/brochure, printing 9,000 copies of each.
Maintenance demonstration garden	$ 2,000	/a		For four years following construction.
Pool Covers				
Capital				
Hardware & Implementation				
Pool Covers	$ 500.00	/cover		
Operating				
Overheads				
Information Brochure Development	$ 3,000.00			One of development cost for promotional purposes
On-going				
Admin	$ 3,000.00	/year		
Promotion	$ 3,000.00	/year		

Development Controls

Sector: Residential

Group: All new properties

Measure: Efficiency

Instrument: Regulatory

Option Description: A planning control would be developed requiring the installation of efficient water fixtures in all new developments. The development and exhibition phase has been anticipated to take 12 months and 6 months later the control is expected to affect all new properties. The control is likely to include AAA rated showerheads, flow regulators in taps and 6/3 dual flush toilets and mandatory annual air conditioning maintenance by an accredited service agent. In addition the control would require either the installation of a water efficient washing machine (as per Council's requirements, e.g. 4 A Rating) or a minimum efficiency points score attained based on a landscape plan submitted to the regulatory authority.

Compliance with this control is to be secured through the use of bonds, submitted at the time of application for development. The bond will only be returned twelve months later upon inspection of the garden or the installed machine and together with submission of an invoice for inspection and maintenance of any air conditioning device installed on the property.

Savings:	30.77	ML/a water saved in 2008	
	0.08	ML/d in 2008	Sewage volume reduction
	38.94	MWhr/a in 2008	Energy saving
	21.42	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.30	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	9,520			in 2003
Total customers in target group	102			new dwellings in 2003
Uptake rate	100%			
Participants	102			in 2002
Option duration	On-going	year		Development of controls in 2003-2004. Effective from 2005
Demand Reduction				
Water				
AAA showehead	43.40	LCD (AAA)		
Existing expected average	47.07	LCD (mixed)	Showers_Alice.xls	As a result of the current mix
Shower saving	3.67	LCD		Multiplied by occupancy to give hh savings in this model since occupancy predicted to change
Dual flush toilet (6/3)	20.00	LCD		
Existing expected average	33.80	LCD		
Toilet saving	13.80	LCD		
Tap flow regulators	50%	less		than modelled tap water usage
	12.48	LCD		
A/C maintenance	10%	less		than modelled a/c water usage through regular servicing
	6.29	kL/hh/a		
Front-loading washing machine	26.4	kL/hh/a		
Existing expected average	36.66	kL/hh/a		
	10.26	kL/hh/a		
Garden design savings	10.26	kL/hh/a		Point system to be design to so that savings are at least equivalent to the savings from front loading machines
Total Water Demand Reduction	**47.75**	kL/hh/a		
Hotwater	10.32	kL/hh/a		Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	89%			Assumes equally half of participants do either of washing machine or garden
Peak Reduction	0.09			
Costs				
Capital				
Design DCP	$ 50,000			
Consultation & Liaison/Exhibition	$ 50,000			
Operating				
Overheads				
Training assessors	$ 15,000			
On-going				
Admin on bonded deposit	$ 35	/prop		Inspection of property

Hotels

Sector: Hotels

Group: Top 17 hotels (82% of water consumption in this sector)

Measure: Efficiency

Instrument: Economic Incentive

Option Description: PW establishes a combined indoor/outdoor hotels efficiency option which involves establishing management level sign off to an action plan developed in consultation with the hotel. The plan would include aspects of staff training (laundry, cleaning, kitchen practices, leak detection), indoor efficiency retrofits and communication strategies/materials for guests. The $5000 worth of hardware incentives/hotel is to be highlighted in communications materials and liaison with targetted hotels.

A mailout of standard brochures will be sent to all other hotels (33) and they will be invited to send a participant to the the hotel staff training courses run by PW.

PW must identify or install a separate meter which meters outdoor water use (for evaluation purposes) during the visit to the hotel.

Savings:	99.94	ML/a water saved in 2008	
	0.17	ML/d in 2008	Sewage volume reduction
	121.01	MWhr/a in 2008	Energy saving
	66.55	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.19	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	50			in 2003
Total customers in target group	17			in 2003
Uptake rate	80%			
Participants	14			in 2003
Option duration	2	year		
Current demand	30,000	kL/prop/a		Hotels_Alice.xls
Average rms/hotel	70	rms/targetted hotel		
Demand Reduction				
Current water - indoor	20,000	kL/prop/a		
Guest rooms	75%	of total indoor demand		Sydney Water, Hotels Auditing
	15,000	kL/prop/a		
Savings estimate	25%			
	3,750	kL/prop/a		
Laundry	15%	of total indoor demand		
	3,000	kL/prop/a		
Savings estimate	15%			
	450	kL/prop/a		
Kitchen	16%	of total indoor demand		
	3,200	kL/prop/a		
Savings estimate	5%			
	160	kL/prop/a		
Total Indoor Savings	4,360	kL/prop/a		
Non-participants	36	hotels		
Current average demand	3,648	kL/a/hotel		
	5%	demand reduction		
Additional Savings (communications)	6,639	kL/a		
Current water - outdoor	10,000	kL/prop/a		
	25%	garden		
Total Outdoor Savings	2,500	kL/prop/a		
Total Saving/participating hotel	6,860	kL/prop/a		
Hotwater	3,305	kL/prop/a		Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	64%	kL/prop/a		
Peak Reduction	0.37			
Costs				
Capital				
Hardware				
Showerhead	$ 50.00	/rm		
Tap flow regulators (1/rm)	$ 3.00	/rm		
Toilet displacement device	$ 3.00	/rm		
Tap Seating (Stainless Steel: 1/rm	$ 5.00	/rm		
Total/rm	$ 61.00			
Incentive	$ 5,000.00	/hotel		Could take the form of moisture sensors, tap timers and mulch or natives at reduced prices
Operating				
Overheads				
	3	plumbers		
Plumber training (3)	$ 3,000			
Communications	$ 20,000			Design 4 brochures (staff, gardeners, guests, general hotels), Print 60 copies of hotel brochures and 7000 in room documents (would include labels and stickers), Audit offer letter/pack
Hotel Staff training course	$ 40,000			Deisgn course and run twice (30 participants/course)
On-going				
Plumber visit	$ 16.67	/rm		
Gardener specialist	$ 210.00	/hotel		3 hr visit

Schools

Sector: Schools

Group: All

Measure: Efficiency

Instrument: Economic Incentive

Option Description:

PW would establish a relationship with all schools in the area. Firstly retrofits would be carried out on all taps (to install flow regulators) and on any single flush toilet or urinal (install displacement device).

Significant base flow has been indicated in DPWS reports and this will be targetted in schools to demonstrate government leading by example. This may include installation of additional meters on A/C or outdoor enduses to provide greater surveilance to enable early detection of leaks. A thorough audit will be carried out to detect existing leaks and an annual inspection and maintenance visit will occur.

Potable demand for outdoor water use in schools is estimated to be as high as 50%. Additional outdoor water demand is already satisfied by Town Basin supplies. This demonstrates significant demand and illustrates a need for efficient watering practices in particular. PW would offer a garden specialist visit annually to advise on efficient watering practices (duration, timing and frequency). Moisture sensors may be provided and subsidies toward mulch would be offered.

PW may work with local schools to develop a curriculum package so that students at schools can be actively involved both in managing their own water use at school and in developing water efficient practices.

The increased efficiency in outdoor water use could result in non-potable supplies satisfying a greater component of total demand.

Savings:	101.19	ML/a water saved in 2008	
	0.12	ML/d in 2008	Sewage volume reduction
	118.14	MWhr/a in 2008	Energy saving
	64.98	T CO_2e /a in 200!	GHG reduction
Unit Cost:	$ 0.18	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	18			in 2003
Total customers in target group	18			in 2003
Uptake rate	100%			
Participants	18			in 2003
Option duration	3	year		
EP in schools	7000	EP		
Days in use	200	days/year		
Average demand	17	ML/a/school		15% is indoor demand
Demand Reduction				
Water				
Toilets				
Existing demand (SF, 11L)	11	L/toilet/flush		
Stock	75%			
Efficient demand (Dual Flush)	4	L/toilet/flush		
Saving	7	L/toilet/flush		
Flushes/day	3	flushes/p/day		
Total Toilet Saving	22.05	ML/a		
Urinals				
Existing demand	9	L/flush		
Efficient demand	6	L/flush		
	2	flushes/p/day		
Total Urinal Saving	4.2	ML/a		
Taps				
	2%			of the total indoor demand assumed to be taps
	81%	reduction		
Total Tap Saving	0.28	ML/a		
Outdoor				
	50%			
	8.5	ML/a/school		
	25%			
Outdoor Saving	2.125	ML/a/school		
Base Flow				
	22%			
	3.74	ML/a/school		
	50%			
Leakage Reduction	1.87	ML/a/school		
A/C				
	6%			
	1.02	ML/a/school		
	15%			
	0.153	ML/a/school		
Hotwater	None			Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	43%	of total demand		
Peak Reduction	0.43			
Costs				
Capital				
Hardware & Implementation				
Number Required				
Dual Flush - Toilets	572			These stock estimates are based on DPWS audit of 25% of schools in AS
Urinals	160			
Tap flow regulators	776			
Moisture Sensors	36			
Cost/unit				
Dual Flush - Toilets	$ 170.00			
Urinals	$ 3.00			
Tap flow regulators	$ 3.00			
Outdoor incentives	$ 500.00			Includes moisture sensor
Operating				
Overheads				
Plumbers	6			
Training	$ 6,000.00			
Develop Curriculum package	$ 15,000.00			
On-going				
Audit of school	$ 150.00	/school		Three hour visit to organise
Plumber Visit	$ 400.00	/school		
Garden specialist visit	$ 210.00	/school		
A/C specialist visit	$ 100.00	/school		

Commercial/Industrial

Sector: General Commercial/Industrial

Group: High Water Users (Top 40 properties)

Measure: Efficiency

Instrument: Economic Incentive

Option Description: PW conducts an indoor and outdoor audit to identify high water using practices and in consultation with the property manager develops an action plan to reduce water use.

Savings:	107.25	ML/a water saved in 2008	
	0.26	ML/d in 2008	Sewage volume reduction
	135.62	MWhr/a in 2008	Energy saving
	74.59	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.53	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	700		Analysis	in 2003
Total customers in target group	40			in 2003
Uptake rate	90%			
Participants	36			in 2003
Option duration	3	year		
Total demand by this group	429	ML/a		
Demand Reduction				
Estimated savings	25%			
	97	ML/a		
Hotwater	?			Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	90%			
Peak Reduction	0.32			
Costs				
Capital				
Hardware & Implementation	$ 10,000.00	/prop		ISF Literature review of similar programs
				2.68125
				10725
Operating				
Overheads				
Promotional materials or briefing	$ 15,000.00			over 3 years
Training CI auditors	$ 15,000.00			
On-going				
Audit and follow-up	$ 5,000.00	/prop		

Cooling Alice

Sector: Residential

Group: All

Measure: Efficiency

Instrument: Communicative

Option Description:

The 'Cooling Alice' residential option involves a communications campaign to encourage residents to use their air-conditioner in the most efficient (and effective) way possible. The program focusses mainly on evaporative a/c as these are the most common type in Alice Springs.

The communications strategy would involve the development of a brochure detailing maintenance steps for managing your a/c, including simple steps like providing adequate ventilation through opening doors and windows. The brochure would be sent to all households with their pre-summer water bill together with a voucher for a subsidised a/c service (to be redeemed before Christmas). The service technicians would be trained to effectively use the opportunity to communicate with residents about how regular maintenance will save them water (and cool their houses more effectively).

After the first round of services the program should be evaluated (participants and non-participants) to ensure its effectiveness. In the following year the program may be repeated subject to this evaluation.

PW could subsidise the 'Government leading by example' initiative by Public housing to capture A/C bleed water for outdoor water use.

Scenario 2 involves PW targetting MR Public Housing properties and installing tanks to capture A/C bleed water. Evidence indicates this could be as much as 24kL/hh/a which would then be available for reuse on gardens at
This could be designed to install a drip or sub-surface irrigation system direct from air-conditioning bleed water.

Savings:	1.90	ML/a water saved in 2011	
		ML/a	Sewage volume reduction
		kWhr	Energy saving
	0	kg CO_2e	GHG reduction
Unit Cost:	$ 0.51	/kL	

Scenario 2

Savings:	20.29	ML/a water saved in 2008	
	-	ML/d in 2008	Sewage volume reduction
	21.88	MWhr/a in 2008	Energy saving
	12.03	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 1.32	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	9,520			in 2003
Total customers in target group	9,520			in 2003
Uptake rate	10%			
Participants	952			in 2003
Option duration	1	year		
PH MR Air Conditioning				
Number of MR Buildings	45		To be confirmed	
Take-up rate	70%			Assumed to be viable in most properties
Participants	32			
Duration	3	yrs		
Demand Reduction				
Water				
Current usage in A/C	48.60	kL/hh/a		
Estimated Saving	20%			on participants due to visit
	9.72	kL/hh/a		
	5%			on all properties due to communications
	2.43	kL/hh/a		
Savings decay	15%	pa		Savings deteriorate quickly as this behaviour may need to be further encouraged to be repeated
Hotwater	0			Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	0			
Peak Reduction	9.72	kL/hh/a		Likely to be disproprotionately higher in summer
PH MR Air Conditioning				
Current usage	48.60	kL/hh/a		
% bleed	50%			Elevated bleed as a component of usage is supported by anecdotal evidence from Public Housing representatives who annually set bleed to 25L/hr, as required in the operating manual.
Volume bleed	24.30	kL/hh/a		
	145.81	kL/a in a MR block of 6		
Additional Peak reduction				
Total Peak Reduction	0.108343909			
Costs				
Capital				
Hardware & Implementation				
Service technician visit	$ 50.00	/hh		
Operating				
Overheads				
Train A/C technicians	$ 5,000			
Develop brochure	$ 10,000			Technical brochure with details spanning a range of models
Admin	$ 1,000			
Advertising	$ 4,000			
On-going				
Brochure printing	$ 5,000			
PH MR Air Conditioning				
Tank cost	$ 5,000.00			Volume needs to be calculated individually for each block of flats.
Plumbing	$ 1,000.00			

Non-residential Development Controls

Sector: General Commercial/Industrial

Group: All new properties

Measure: Efficiency

Instrument: Regulatory

Option Description: A planning control would be developed requsing a point system to be designed requiring new developments to prove that they have incorporated best practice water efficiency, saving at least 25% of current standard practice. Compliance with this control is to be secured through the use of bonds, submitted at the time of application for development. The bond will only be returned twelve months later upon inspection of the property and submission of an invoice for an annual maintenance/inspection of any air conditioning device installed on the property.

Savings:	11.78	ML/a water saved in 2008	
	0.03	ML/d in 2008	Sewage volume reduction
	14.92	MWhr/a in 2008	Energy saving
	8.20	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.55	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	686			in2002
Total customers in target group	3			new dwellings in 2003
Uptake rate	100%			
Participants	3			in 2002
Option duration	On-going	year		Development of controls in 2003-2004. Effective from 2005
Demand Reduction				
Water				
Existing expected average	1.66	ML/a		
DCP Savings	25%			Point system to be designed requiring new developments to prove that they have incorporated best practice water efficiency, saving at least 25% of current standard practice.
Total Water Demand Reduction	**0.42**	ML/p/a		
Hotwater		kL/hh/a		Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	90%			
Peak Reduction	0.04			
Costs				
Capital				
Design DCP	$ 50,000			
Consultation & Liaison/Exhibition	$ 50,000			
Operating				
Overheads				
Training assessors	$ 5,000			
On-going				
Admin on rebates	$ 140	/prop		

Targetted Outdoor

Sector: Residential

Group: <<High Water Users (Varying top %s)>>

Measure: Efficiency

Instrument: Communicative

Option Description:

This option is similar to the residential outdoor option but it requires PW to specifically target high water using single residential properties. Because of this targetted approach it is reasonable to assume that savings will be significantly higher due to the higher average demand.

Similarly, this option offers a landscape assesor visit however home owners will be targetted and phoned by PW. Their high water bill will be mentioned to indicate the financial savings they could accrue by participating. In this way the option does not rely on participants call PW.

Similar levels of giveaways are likely to contribute to this option, I.e. $50 per paticipating household with pool cover vouchers being issued only where assessors deem this appropriate.

Savings:	63.19	ML/a water saved in 2008	
	-	ML/d in 2008	Sewage volume reduction
	41.08	MWhr/a in 2008	Energy saving
	2.88	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.05	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	5,733		Demog.xls	in 2003
Selected target	10%			
Total customers in target group	283			Reduced by 30% to assume that some participated in
Uptake rate	50%			the initial untargeted program
Participants	141			in 2002
Option duration	2	year		Following on after option broad program
Pool Ownership	18%			
Pool Covers vouchers offered	25			
	50%			
Uptake	13			
Demand Reduction				
Water				
Average demand outdoors	1,666	kL/hh/a		
Percentage reduction	30%	/hh		of garden demand
	500	kL/hh/a		from participants
Decay	5%	p.a		
Pool Covers				
Days Pool Covered	75%			
Reduction in evaporation losses on days covered	95%			
Normal Evaporation losses	311	L/day		
Water Saved	296	L/day covered		
	81	kL/pool/a		
Hotwater				Note Solar hotwater heaters in AS - Assumed 50%
Sewage	0			(DoH property data)
Peak Reduction	0.34	ML/d		
Costs				
Capital				
Give-away efficiency pack	$ 50.00			
No. of Assessors	2			These assessors move on from the initial outdoor program
Operating				so there is no additional training cost
Landscape advisor initial visit	$ 70.00	/hh		
End of summer re-visit	$ 35.00	/hh		
Admin	$ 1,014	/a		
Communications strategy	$ 5,000			Contribution to brochure development costs
Pool Covers				
Capital				
Hardware & Implementation				
Pool Covers	$ 500.00	/cover		
Operating				
Overheads				
Information Brochure Development	$ 1,000.00			Brochure development half of cost of Outdoor_Option6.xls
On-going				
Admin	$ 4,000.00	/year		As for untargetted + additional $1000 for targetting
Promotion	$ -	/year		No promotional costs due to targeting

Town camps

Sector: Town Camps

Group: All

Measure: Efficiency

Instrument: Economic Incentive

Option Description:

This option would see PW liaising with groups already working in the Town Camps surrounding Alice Springs. Given that established relationships exist between advisors and residents in the camps, it is recommended that PW provide funding directly to those groups undertaking the work. The funding should be directly linked to water efficiency measures which may include retrofitting of high quality water efficient devices and may also be used in educational or communicative initiatives as determined by the long term advisors in the area.

PW is not advised to undertaken their own retrofitting or other water efficiency actions in Town Camps as the established relationship already in place is very valuable and not easily replicable.

PW would establish effective metering to be used for evaluation purposes. Continuing funding would be provided with additional PW support if savings were not being achieved.

Savings:	68.39	ML/a water saved in 2008	
	0.32	ML/d in 2008	Sewage volume reduction
	98.33	MWhr/a in 2008	Energy saving
	54.08	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.14	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Option duration	3	years		2004 - 2006
Existing average annual demand	456	ML/a		Based on 2000 and 2001 data
Target group size	3	Property managers		
Uptake	100%			
	3			
Demand Reduction				
Water				
Percentage reduction	5%	/year		of total demand, increasing to a 15% reduction in demand by 2006
	22.80	ML/a		
Hotwater				Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	50%			
Peak Reduction				
Costs				
Capital				
Hardware & Implementation	$ 10,000.00	/year		
Operating				
Overheads				
Submission preparation by Town Camps Management	$ 500.00			
On-going				
Annual Maintenance check	$ 1,200.00	/year		$400/property/year

Institutional Buildings

Sector: Other Institutional

Group: All institutional buildings

Measure: Efficiency

Instrument: Regulatory

Option Description:

The NT government would use this option to demonstrate the 'government leading by example' in this major water efficiency undertaking. Over a period of three years, all institutional buildings in Alice Springs would be retrofitted with efficient appliances including AAA rated showerheads, tap flow regulators and stainless steel tap seating, and dual flush toilets (or displacement devices in single flush toilets).

Integrating changes into management practices.

Savings:		85.97	ML/a water saved in 2008	
		0.21	ML/d in 2008	Sewage volume reduction
		108.83	MWhr/a in 2008	Energy saving
		59.86	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$	0.38	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	97		Institutional	average 1997 to 2001
Total customers in target group	97			in 2002
Uptake rate	100%			
Participants	97			by 2005
Option duration	3	years		2004, 2005, 2006
Annual participants	32			
Demand Reduction				
Water				
Indoor	309	ML/a	Indoor (total) - AS_Sewerage Model	
	3,196	kL/a/prop		
Percentage reduction	25%	/prop		of indoor demand
	799	kL/prop/a		
Average demand outdoors	34	ML/a		
	355	kL/prop/a		
	25%	/prop		
	89	kL/prop/a		
Hotwater				Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	90%			
Peak Reduction	0.24			
Costs				
Capital				
Hardware & Implementation	$4,000	/ML/prop		
	$3,551	/prop		
Operating				
Overheads				
On-going				

Hospital

Sector: Hospital

Group: Hospital

Measure: Efficiency

Instrument: Economic Incentive

Option Description:

The NT government would use this option to demonstrate the 'government leading by example' in this major water efficiency undertaking. Over a period of two years, the hospital in Alice Springs would be made water efficient in accordance with best practice for buildings of this type. This may include being retrofitted with efficient appliances including AAA rated showerheads, tap flow regulators and stainless steel tap seating, and dual flush toilets (or displacement devices in single flush toilets).

This option would take further steps in light of the DPWS audit program. Steps would be determined in consultation with the hospital maintenance staff and management to take account of steps taken since the audit. Importantly, this option takes into account both water use which is structural and that which more operational. This results in an option which includes capital expenditure on efficiency measures and training programs to develop more efficent water using practices as part of the hospital's daily operations. Integrating changes into management practices would be a significant part of this program.

Savings:	11.78	ML/a water saved in 2008	
	0.03	ML/d in 2008	Sewage volume reduction
	14.91	MWhr/a in 2008	Energy saving
	8.20	T CO_2e /a in 2008	GHG reduction
Unit Cost:	$ 0.56	/kL	

Assumption	Value	Units	References	Notes
Option Targetting				
Total customers in Sector	1		Institutional	average 1997 to 2001
Total customers in target group	1			in 2002
Uptake rate	100%			
Participants	1			by 2005
Option duration	2	years		2004-2006
Annual participants	1			
Demand Reduction				
Water				
Indoor	85	ML/a	Indoor (total) - AS_Sewerage Model	
	84,809	kL/a/prop		
Percentage reduction	25%	/prop		of indoor demand
	21,202	kL/prop/a		
Average demand outdoors	9	ML/a		
	9,423	kL/prop/a		
	25%	/prop		
	2,356	kL/prop/a		
Hotwater				Note Solar hotwater heaters in AS - Assumed 50% (DoH property data)
Sewage	90%			
Peak Reduction	0.032	ML/d		
Costs				
Capital				
Hardware & Implementation	$3,000	/ML/prop		Hospitals considered to be at the lower end of the cost spectrum for commercial properties due to the intensive use of equipment.
	$70,674	/prop		
Operating				
Overheads				
Liaison costs	$1,000			
On-going				

APPENDIX I – DRAFT STAGE I & II REPORT WORKSHOP

Alice Springs Water Efficiency Study

Draft Stage I & II Report
Workshop

Thursday 20th March 2003

Introduction

These notes summarise the comments of the Alice Springs Urban Water Management Strategy Reference Group (ASUWMSRG) after presentation of Stages I & II of the Water Efficiency Study and the preliminary options developed. The ASUWMSRG members attending the meeting were requested to split into individual groups and identify the concerns and opportunities of the preliminary options identified by the Study Team and to identify any other additional options/issues that should also be considered.

Group 1

Concerns/Questions

- Calcium blocking flow restrictors and other devices
- Trials of particular types of appliances (*e.g.* showerheads to check impact of hard water)
- Water softeners?

Opportunities/Ideas

- Share marketing with interstate utilities (*e.g.* TV Imparja)
- Cooling water from Power Plant – what happens to it? (PH advised some of it goes into the Town Basin system)
- Alice Springs Town Council street sweepers/flushers currently using potable water? (SS & AT advised some is drawn from special Town Basin access points)
- Alice Springs correction centre has a reuse system which could be reactivated but at a cost (MS advised that there may be health concerns with using that particular system)
- Need branding so that trade allies can buy in clearly recognisable products and customers are more familiar with water efficiency products and the program
- Reverse osmosis units (*e.g.* Desert Park and hospital currently goes to waste?) – how are they being managed (could potentially go to reuse)? (JC believe 95% goes to waste)
- Link demand management programs with community auditing programs (*e.g.* ALEC Myer foundation and Cooling Communities)
- Trade allies (*e.g.* Greening Australia and nurseries)
- Potential in new areas/subdivisions (*e.g.* Larapinta with approximately 70 lots) to do things differently (*e.g.* evaporative air conditioners lower and shaded, reuse or shandying, rainwater tanks which used to be more common)

Group 2

Concerns/Questions

- The level of unaccounted for water seems high.
- Health/cost/operational concerns of using greywater.

Opportunities/Ideas

- Locate evaporative air conditioners in shady low level positions and ensure architects involved in design rather than a badly designed add on unit
- Ensure new building designed properly
- Reuse bleed off from evaporative air conditioners
- Provision of professional advice for water efficiency measures
- Use of effluent as irrigation water
- Dual systems for use in residential areas
- Government legislation to ensure that efficiency locked in
- Extend residential retrofit to hotels
- Spring loaded taps in public locations

Group 3

Options	Concerns	Opportunities
Toilet retrofit	Residents should contribute some of the $ to ensure value retrofit	Could use Japanese style hand basin in cistern
Washing machines	Population turnover (40%) could mean subsidising machines that are moved out of town	More efficient machines use less energy and therefore provide additional benefits of energy and GHG. PW energy system reaching maximum capacity
Education	Long term commitment needed, can't just do in a year and expect results (learn from Kalgoorlie Boulder)	
All	Consistency of approach to ensure everyone involved (equity)	Incentives Recognition on water bill or through awards
Pool covers	Dangerous? Water on top? Need to design correctly	Regulations (pool fences now)? Evaporation inhibitors additives/emulsifiers?
Evaporative air conditioning		Different technology? Use of water softners to reduce salt build up and bleed off Bleed off to toilet (commercial?)
All		More potential for softners which can reduce tap/shower/maintenance/leaks
Irrigation systems	Appropriate design Examples of where they do & don't save water (*e.g.* use patterns of system) Local business training accreditation?	Use of greywater and water harvesting

Options	Concerns	Opportunities
Cooling Alice (Evaporative air conditioning program) & All		Need to market well so that both men and women targeted
Development control		Need to ensure houses designed properly (e.g. better insulation to reduce cooling needs, water efficiency/reuse locked into buildings)
All		Linkage with Desert Knowledge (cool communities)
All		Government (Local & NT) lead the way

Group 4

Pine Gap Details

- In 1994 started desert landscaping of properties
- 1997 award from Water Action Group
- Most US properties have reverse cycle air conditioning but used a lot as power is free
- Putting in ecovalves (10 L/min)
- Most toilets are dual flush 6/3 litre (also mentioned some 40 year old houses which have not been renovated)
- Generally a high turnover (every 3 years) which means properties are looked at around every 3 years and use preventative maintenance/rolling program.
- Garden contractor monitors the outdoor watering systems
- Leaking taps are sorted ASAP
- US households often have large families (*e.g.* 6 resident)

General Ideas

- Some people just don't care about water efficiency or can't afford to do anything about it
- Once arid plants are established they don't need as much water and often don't need any water
- Should use local grasses, which are more resilient and bounce back very quickly when weather changes
- A program centred around cutting lawn area could work as people don't always want a large lawn
- Alice Springs has a very high turnover of residents, therefore may need real estate agencies to help newcomers to Town, on water efficiency issues (education leaflets)
- Should ensure irrigation not carried out during the day (*e.g.* restrictions)
- Perhaps label high water users 'water abuser'
- General education on water efficiency required
- Building regulations on water efficiency required

APPENDIX J – COLLATED RECOMMENDATIONS

Summarised recommendations from Section 9.0:

PW/DIPE should commit to Stage III of the Study and the implementation of a Demand Management Program by:

- committing all required funds for at least Program Scenario 1 ($3.8M);
- investigating Program Team personnel to be involved in Stage III;
- investigating capital and operating costs of running the water, wastewater and electricity systems to assist in clarifying assumptions and costs/benefits identified;
- committing to pilot studies and surveys to assist in Stage III development; and
- investigating other initiatives/projects related to water and energy issues (e.g. CRC, Desert Knowledge) to liaise and coordinate funding and research gaps/synergies to assist in Stage III and long term research on arid climates.

In parallel to Stage III PW/DIPE should consider:

- restructuring their current pricing structure on water by moving away from an NT uniform tariff policy to a locally based inclining block tariff and a volume based charging system on sewage related to winter water demand similar to the Trade Waste tariffs;
- updating their borefield augmentation model to ensure assumptions are consistent with this Study and to allow fair reference case comparison with other options;
- investigation of leakage reduction, source substitution and reuse options using an LCP framework to determine which other least cost options should be implemented together with the demand management program to form the ASUWMS;
- review of the current preliminary targets together with the ASUWMSRG;
- the implications of the benefits of the demand management program on the investment requirements for other options; and
- evaluate existing initiatives where possible (e.g. Cut the Lawn, audits) to assist in Stage III design and using the climate correction model to check UFW in 2001/02.

PW/DIPE should also consider/investigate:

- using the climate correction model for future evaluation of demand management and other initiatives;
- draft a system management implementation plan/schedule to reduce UFW and move towards best practice management including accurate UFW calculation, the substantial auditing and upgrading of the CIS to allow for ongoing evaluation of customers, use of flow meters at the WWTP, use of outdoor meters to identify outdoor demand, use of meters on individual units of occupancy and use of SIC for individual customers;
- use of demand management on other sources such as the Town Basin and reactivation of additional sources such as the hospital borehole and gaol reuse system;
- obtain more accurate data on the indigenous populations and Pine Gap residents to improve the accuracy of the model and when available incorporate the Trade Waste results and WWTP flow records to assist in calibration of the end use models; and
- steps to advocate appliance water efficiency nationally and ensure local building codes incorporate the synergies of water and energy efficiency as far as possible in both new and modified buildings to minimise the need for demand management retrofitting investment in new developments in the future.

Collated recommendations from individual sections:

Table J1 – Collated Recommendations

No.	Details
3a	PW should consider updating their borefield augmentation model to ensure the assumptions associated with population growth and water demand are consistent with those developed as part of this Study. Thus allowing fair comparison of demand management, source substitution and reuse options with augmentation requirements associated with the reference case.
3b	PW should take advantage of the significant opportunities a demand management program would have in reducing/deferring capital costs associated with planned water and wastewater system augmentation and the high energy operational costs associated with potable water extraction.
3c	PW should take advantage of the Town Basin supply and consider increasing extraction to that of the sustainable recharge (1,140 ML/a). PW should ensure that where Town Basin supplies are used that water efficient practices are adopted to maximise the effective use of this limited resource. Maximising extraction, ensuring efficient use of the resource and increasing the number of customers connected to the Town Basin supply will provide significant benefits such as reduced potable demand and reduced infiltration to the WWTP.
3d	PW should consider the proposed investment in the effluent reuse scheme with other available options. The demand management program developed under this study will reduce the volume of effluent passing to the WWTP. Hence any investment or design decisions associated with the reuse project should take into consideration the effects of the demand management program.
4a	PW should obtain more accurate data on the indigenous population and Pine Gap residents and discuss the Alice Springs projection figures with ABS to assist in the accuracy of the End Use Model.
4b	PW/DIPE should take steps to advocate appliance water efficiency nationally and to ensure local building codes incorporate the synergies of water and energy efficiency as far as possible in both new and modified buildings including the location of evaporative air conditioning units.
4c	PW should consider restructuring their current pricing structure for water and reconsidering its decision to keep a uniform tariff structure across the NT.
4d	PW should consider restructuring their current pricing structure for sewage by moving away from pedestal charging and towards more volume based charging systems for wastewater effluent related to water demand (e.g. using winter demand to indicate discharge to sewer) similar to those properties being affected by Trade Waste Agreements.
4e	PW/DIPE should ensure that all demand management initiatives (e.g. Cut the Lawn) are monitored and evaluated in terms of achieving the objective of reducing water demand.

No.	Details
4f	PW should draft a system management implementation plan/schedule to ensure that unaccounted for water is minimised and best practice system management is achieved and maintained.
4g	PW/DIPE should ensure maximising the use of source substitution, greywater, effluent reuse and water quality cascade within new residential and commercial buildings due to both the potential benefits associated with reducing water demand and wastewater production.
5a	PW should ensure that both the bulk water and customer meter reading databases have a demand variance warning system to enable leaks, high demand and slow running meters to be detected quickly and facilitate rapid rectification.
5b	PW should ensure that calculation and reporting of UFW is consistent (e.g. by using the current CARL and UARL calculations) to ensure that losses can be compared accurately between years. In addition care should be taken when comparing bulk and customer metered data to find UFW by considering the time shift between bulk and customer metered data. For example bulk readings are obtained on a daily basis and are accurate to one day within any given month. However, the majority of customer metered readings are only available on a three monthly basis which means that actual use could be displaced by three months when compared with bulk meter readings.
5c	PW should use the climate correction model to evaluate whether the unexpected rise in demand during the period 2001 was associated with the Ilparpa swamp by inputting the latest bulk water supply data readings into the model. If the difference in observed and predicted demand returns to pre 2001 levels then this will verify whether the leak was the primary cause.
5d	PW/DIPE should use the climate correction model to assist in the evaluation of all future demand management, source substitution and reuse initiatives.
6a	PW/DIPE should ensure that the Town Basin resource and any other source substitution adopted in Alice Springs is used efficiently to maximise reduction in demand on the potable supply and that individual initiatives are evaluated to assess their effectiveness in reducing demand.
6b	PW should investigate whether the hospital borehole can be reactivated for hospital outdoor water demand and/or linking in with the PW non potable operated system to assist in reducing demand on the potable supply.
6c	PW should consider auditing the existing CIS data base to check data entry accuracy and consider expanding fields in order to facilitate easy grouping of customer types for evaluation purposes (e.g. use standard industry codes, identify the number of units of occupancy in individual properties and outdoor water demand). PW should also consider using a meter variance option in the database to highlight when meters fail or water consumption is higher than expected which will assist in targeting demand management

No.	Details
6d	measures to high water users. PW should ensure that the proposed new customer information system allows extensive interrogation and manipulation of data to expedite retrieval and evaluation of data. PW should also ensure that all new multi residential properties have individual meters to ensure that the effects of user pays principles are maximised in all future dwellings and that outdoor meters are made compulsory.
7a 7b	PW should use the data obtained as part of the Trade Waste investigations to refine the sewage discharge assumptions contained in the sewage model. In addition when reliable WWTP sewage flows become available these should be used to calibrate the sewage model. PW should ensure that accurate flow meters are installed at the WWTP at various locations such as the inlet, treated outlet and overflow to Ilparpa swamp to assist in future evaluation of demand management options undertaken and to assess requirements for upgrade.
8a 8b 8c 8d 8e 8f	PW should investigate the capital and operating costs of running the water, wastewater and electricity systems to assist in clarifying the assumptions made and costs and benefits identified under this Study. PW should commit to Stage III (development of the Implementation Plan) of the Water Efficiency Study and at least the funds necessary for the comprehensive demand management program identified under Scenario 1 ($3.8M). PW/DIPE should consider investigating personnel who would be suitable to take the positions of the Program Team to allow their involvement where possible during Stage III. PW/DIPE should consider investigating other options such as leakage reduction, source substitution and reuse (e.g. Town Basin, rain tanks, stormwater and bleed off capture, greywater reuses and effluent reuse) in parallel to Stage III and evaluating these options using an LCP framework together with the demand management options developed. In addition following review of this wider suite of options the targets should be reviewed following consultation with the ASUWMSRG. PW should consider restructuring their current pricing structure to move away from NT cross subsidies and towards the use of inclining block tariffs. This change in pricing structure should be planned to coincide with community consultation and the demand management program. PW/DIPE should take advantage of other initiatives/projects in Alice Springs related to water and energy issues in arid climates by liaising with other organisations prior to the commencement of Stage III. Thus allowing projects, funding, research gaps and Stage III pilot studies and surveys to be coordinated more effectively and synergies to be clarified.

No.	Details
8g	PW/DIPE should consider running a number of pilot studies and/or surveys in parallel to Stage III of the Study to assist in verifying specific assumptions used in the End Use Model and testing implementation issues raised by the ASUWMSRG. In addition PW/DIPE should consider using their own or other Government staff to assist in pilot studies/surveys to reduce costs.
8h	PW should consider paying for the whole cost of the demand management program to maximise uptake and success of the program.