Chapter 3

The options

Introduction

3.1 The previous two chapters set the scene by examining the nature of Australia's water cycle; water use across various sectors; and some of the major supply issues that will increasingly impact on planning over the coming decades.

3.2 This chapter focuses on the range of options that are available to deal with these issues. As this chapter demonstrates, while the challenges and problems faced by water managers are significant, there are lots of options to overcome these problems. These include demand management and water efficiency measures to reduce the amount of water our society needs. It also includes adopting a more clever approach to expanding our supply by reusing water, storing rainwater that otherwise goes down the drains, and using new techniques such as Aquifer Storage and Recovery to solve the storage problems that occur from the erratic nature of both supply and demand for water.

3.3 At a more strategic level, the chapter exams the ways in which education at all levels of society, from school children to engineers, will be necessary to effect the culture change that is needed for Australians to become sustainable users of water. The chapter then concludes with consideration of the role of knowledge systems, such as the Cooperative Research Centres, in providing the technical information about ecosystems, water treatment, and public health, that are the crucial foundation to best management practice.

3.4 In covering this range of options, what is clear is that none amount to a complete solution of themselves. Rather, each is a tool, that must be used in collaboration with all the others, to work on each element of the system.

Demand management

3.5 As Chapter 2 showed, increasing water supplies is problematic. An alternative is to reduce people's demand for water. However, the water supply and demand circumstances and the prospects for population growth in the various Australian urban centres are very different. This suggests, therefore, that the need for a uniform demand management solution across Australia does not exist.[1]

3.6 Water managers are using demand management measures to curb water use and to achieve more efficient water use. These measures have so far been successful in reducing urban water consumption. For example, the Queensland EPA told the

1 Water Services Association of Australia, *Submission 55*, p 10.

Committee, that local governments that are implementing significant demand management programs are achieving water savings between 15 and 30 per cent.[2]

3.7 Another example from Melbourne is the drop in annual consumption per household from 256 kL in the early 1990s to around 240 kL at present. Continuing population growth and new housing is expected to result in Melbourne's demand for water growing at around 1 per cent per annum in the foreseeable future. This is lower than the 3 per cent growth rate experienced in the 1980s.[3]

3.8 There are many aspects to demand management and the following list shows some of the measures that can be taken:

- appropriate pricing of water;
- universal customer metering in order to implement the pricing measures;
- customer advisory services, and the use of incentives for installing water efficient equipment and landscapes;
- communication strategies, including community education campaigns designed to reinforce the other aspects of a demand management strategy;
- use of collected rainwater and reclaimed water to reduce the need for fresh water supplies;
- regulation of the efficiency of water-using appliances, especially in new buildings and for garden watering;
- operational measures, such as reducing leaks in the water supply system, reducing pressure, and reducing water use by the water utility; and
- regulations and water use restrictions, either on a temporary or permanent basis.[4]

3.9 Foley and Daniell distinguish between water conservation programmes instigated in response to drought, and programs targeting sustainable water use. While water conservation programs have been successful, once the crisis passes, water demand starts to increase again. They suggest that by targeting sustainable water use, there would be a long-term change in water use patterns.[5]

3.10 Water consumption in Perth reduced significantly in the mid to late 1970s because of several drought years and the imposition of severe restrictions. However, groundwater use increased as a proportion of supply, including a major increase of

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2 Mr Wiskar, *Proof Committee Hansard*, Brisbane, 4 April 2002, p 146.

3 Melbourne Water, *Submission 46*, p 4.

4 Water Services Association of Australia, Wise Water Management, A Demand Management Manual for Water Utilities, p 1.

5 Centre for Applied Modelling in Water Engineering, *Submission 30*, Attachment, p 8.

self-supplied groundwater for outdoor use. About 25 per cent of Perth's houses have private wells.[6]

3.11 The range of water conservation measures implemented in Perth includes the following:[7]

- a permanent ban on daytime use of sprinklers;
- promotion of water efficient household devices and water efficient garden design;
- introduction of charges for water in 1993/94, including higher charges for water use in excess of 350 kL;
- a meter replacement program which upgrades 20,000 units each year; and
- a leakage reduction program, which has reduced leakage from Perth's supply system to between 2 per cent and 4 per cent of the water supplied; and
- a regulatory requirement for dual flush toilets in new dwellings.

3.12 Other water conservation initiatives for Western Australia more generally include:

- development of a leak detection program for regional urban centres;
- building relationships and partnerships with major users;
- Kwinana Water Reuse Project, where up to 20 gigalitres of treated wastewater may be reused by industry;
- reuse of treated wastewater to irrigate local government ovals / parks in over 30 towns;
- integrating water-related learning into the school curriculum with schools endorsed as "Waterwise" after they have met an agreed set of criteria; and
- recycling of wastewater at major wastewater treatment plants (replacing potable water or groundwater for process use).

Pricing

3.13 The Water Services Association of Australia says that the key measures introduced to curb urban demand for water were the introduction of consumption based pricing and full cost recovery.[8] Consumption based pricing was followed by progressively increasing the reliance on the consumption part of the two part tariff. The combination of pricing, technological change and education campaigns have successfully reduced growth in urban water use.

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6 Water Corporation of Western Australia, *Submission 49*, pp 10 and 12.

7 Water Corporation of Western Australia, *Submission 49*, p 12.

8 Water Services Association of Australia, *Submission 55*, p ii. For a detailed discussion of pricing issues, see Chapter 7.

Consumer behaviour

3.14 Demand management programs were being instigated in most of the jurisdictions on which the Committee took evidence, although with varying degrees of success. The CSIRO suggests that the limited progress towards more conservative water use in urban areas may have been caused by a myriad of factors, but it has not been the result of people's lack of concern about water conservation. Its submission provides the results of a large-scale domestic water use study in 1981/82 and 1999 from Perth that shows the number of people stating that they were undertaking conserving activities has risen.[9]

3.15 The study reveals that there is inadequate feedback as to how much water is actually being used. For example, households with timed reticulation systems presumably bought for convenience and to save water have been shown to use more water for garden watering than comparable other families. There is also quite a poor relationship between household water consumption and reported savings behaviours. This could be due in part, to it being socially desirable to present a 'conserving' image, especially during drought periods.

3.16 There appears to be a relatively limited advance in terms of comprehensive demand management programs and reductions in individual household use. Certainly there is steady public support for careful use of water. In fact about 30 per cent of Perth consumers can be labelled as predominantly conservation minded. Nevertheless there is a quarter of the population (including the population outside Perth) who regard water supply as purely a service that should be provided like other utilities, 20 per cent who are indifferent to water issues, and about the same number who consider it as important to lifestyle.

3.17 The requirement for utilities to mount strong demand management programs therefore needs to be tempered against the perceived consumption needs of their customers. There is a justifiable need to balance water conservation against the social benefits obtained from using water through low density housing, gardening as a recreation and the lifestyle benefits of showers and other water uses making hot summers bearable.

3.18 The Committee was told on several occasions that knowledge of consumer behaviour is incomplete and this fact could explain why demand management programs do not always deliver the gains anticipated:

> As I said earlier, we have the theoretical savings that you can make through shower roses. The actual saving that you achieve is different, and we are in the process of modelling that now in order to insert that across our long-term planning horizons.[10]

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9 CSIRO, *Submission 47*, pp 63-64.

10 Mr Woolley, *Committee Hansard*, Brisbane, 4 April 2002, pp 601-602.

3.19 The CSIRO notes that there has been little systematic research as to the significance of water, despite its central and ubiquitous contribution to the Australian wellbeing and psyche on an everyday basis.[11]

Water saving devices[12]

3.20 Much of day to day water use involves appliances such as showers, washing machines etc. Many of these are very wasteful users of water. Sustaining reduced per capita consumption in the longer term is heavily dependent on water efficient appliances and fittings becoming the accepted norm in the marketplace.[13] It was generally felt that installing a few basic, well-proven devices in residential developments is the most cost effective and practical means for reducing mains water use.[14]

3.21 Some water service providers have used incentives to encourage retrofitting of existing sanitary and plumbing fittings. Such incentives have included subsidies for the installation of showerheads and rainwater tanks as well as water efficiency ratings of houses with recommendations for improvements. These programs can be effective in achieving reductions in water usage. However they are expensive and the Water Services Association of Australia recommends that their overall resource efficiency needs to be considered.[15]

Dual flush toilets

3.22 Flush toilets typically use 50 kilolitres of water per household per year, or approximately 16 per cent of residential water use. Older single flush toilets use between 11 and 13 litres of water per flush. In 1984 dual flush 11 litre/6 litre cistern units were introduced (that is, they used 11 litres of water for a full flush and 6 litres for a reduced flush), followed in 1987 by 9/4.5 litre cisterns, and in 1993 6/3 litre cisterns. The latter need to be used with an appropriate toilet pan in order to be effective and they will contribute approximately a 67 per cent reduction in water use compared with single flush models. The Committee was told that work is currently taking place on microflush systems that use only a litre of water.[16]

3.23 There are considerable water savings to be made from upgrading toilets and most major water authorities require the use of dual flush toilets in all new and replacement installations. Despite the fact that their use was not universally

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11 CSIRO, *Submission 47*, p 64.

12 Much of the information in this section is taken from Wise Water Management, A demand mangement manual for water utilities, Water Services Association of Australia, pp 87-94.

13 Sydney Water, *Submission 45*, Additional Attachment, *Water Conservation and Recycling Report*, August 2000, p 19.

14 Government of South Australia, *Submission 51*, p 23.

15 Water Services Association of Australia, *Submission 55*, p 14.

16 Mr Woolley, *Committee Hansard*, Brisbane, 4 April 2002, p 599.

mandated, the requirement from a critical mass of authorities was sufficient to encourage their manufacture to the extent that they forced out single flush toilets. The Committee heard evidence from the Queensland EPA that it is now difficult if not impossible to buy single flush toilets in the Australian market.[17] Additionally, Melbourne Water told the Committee:

> If you went back to 1975, only about eight or 10 per cent of properties in Melbourne had dual-flush toilets. Because they were made compulsory, we are now up to a penetration rate of about 75 per cent. The impact of that on water consumption is quite profound. Particularly the new toilets are down to flushes of about four litres and seven litres. The reason I raise that is that the power of one here is very important. A few little incremental steps at the start may not seem much, but multiply them over the years and in 20 or 30 years time you look back and you are starting to make a real impact. The point I am trying to make is that you have to start somewhere.[18]

Showerheads

3.24 Showers use on average 50 kilolitres of water per household per year. The average flow rate of a shower can be more than 15 litres of water per minute, with Australians enjoying on average a 7-8 minute shower. A triple A rated showerhead uses less than 9 litres per minute so there are considerable water savings that can be made from their installation.

3.25 Flow rate, or water efficiency of a showerhead is one important criterion in its use, but the user-comfort of a particular showerhead and water pressure combination is also important, as are the personal preferences of the user. Water efficient showerheads vary in spray pattern from those that provide a misty spray to a needle-like spray, while others have a pulsating, massaging flow. Factors that affect the comfort of a shower are:

- the speed of the spray;
- the evenness of the rings of water jets; and
- the temperature differences of the water from the top to the bottom of the spray.

3.26 Some water efficient showerheads incorporate a flow regulator that maintains a constant and predetermined flow rate over a range of water pressures. This is in contrast with the standard design where a flow restrictor limits the flow regardless of the pressure.

3.27 In considering the effectiveness of low flow showerheads as part of a demand management strategy, it is also apparent that they are not suitable for installing in low pressure areas or with flow restricted instantaneous hot water systems, and there is

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17 Mr Wiskar, *Proof Committee Hansard*, Brisbane, 4 April 2002, p 135.

18 Mr Young, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 331.

some indication that customer dissatisfaction with water efficient showerheads has occurred because of their inappropriate installation in these situations.[19]

3.28 The Committee heard evidence that the actual water savings from installing water efficient showerheads are often different to the anticipated theoretical savings. This may be because users change their behaviour after the devices are installed - for example they may take longer showers or turn the tap on harder when using the devices.[20] There are other scenarios, where the amount of anticipated savings are not achieved because the original estimate of water used is overstated, for example most people operate showers at less than the maximum flow rate and so they may not be using the potential maximum amount of water.[21]

3.29 However, Sydney Water did not think that people who participated in its retrofit program were taking longer showers. Around 180,000 households have taken part in its residential audit and retrofit program and its customer surveys indicate that more than 95 per cent of these people have retain their efficient showerheads, indicating that this number of people are content with the quality of the shower. Analysis of water consumption data before and after retrofitting showed that on average 20,000 litres of water per household was saved, although savings in the order of 23,000 litres per household had been expected.[22]

Flow regulators

3.30 Flow regulators are devices that can be fitted into shower arms and taps to alter the flow of water. They include flow restrictors that can be placed in the shower arm connection or in taps. Most water efficient showerheads rely upon these to reduce the flow of water, but it is usually in combination with a shower head design that improves the spray pattern for user comfort. Their use without an appropriate shower head, whilst providing a relatively cheap device to reduce water use, may be counterproductive as the user may remove them and become resistant to other water reduction measures because of the inferior quality of the shower.[23]

3.31 Flow regulators can be used in taps, but the type chosen will depend on the major use for which the tap is required: taps will be either used for water flow or for volume. An example of a flow situation is where a tap is predominantly used for

19 Water Services Association of Australia, Wise Water Management, A demand management manual for water utilities, Research report no. 86, November 1998, p 91.

20 Mr Woolley, *Committee Hansard*, Brisbane, 4 April 2002, pp 599 and 601-602.

21 Water Services Association of Australia, Wise Water Management, A demand management manual for water utilities, Research report no. 86, November 1998, p 90.

22 Ms Howe, *Proof Committee Hansard*, Sydney, 18 April 2002, p 177; Sydney Water, *Submission 45A*; and Sydney Water Corporation, *Submission on the Independent Pricing and Regulatory Tribunal of New South Wales mid-term review of our operating licence*, April 2002, p 38.

23 Water Services Association of Australia, Wise Water Management, A demand management manual for water utilities, Research report no. 86, November 1998, p 91.

washing hands, such as a vanity tap; the flow rate is not a major consideration and may be restricted without loss of convenience. In this situation a tap aerator that mixes air with the water stream, can be incorporated in the tap spout and will reduce water use without affecting the quality of the service.

3.32 Other taps, such as bath taps, are required to deliver a volume of water as quickly as possible and installation of a flow regulator would not be appropriate.

3.33 Some companies, for example hotels, hospitals or other commercial or industrial complexes, install flow regulators in all their water outlets, primarily to balance the pressure and flow rate in the outlets, but there can also be substantial water and energy savings from doing so.

Taps

3.34 In public places, slow release push button taps or centre-return taps can help reduce water wastage that occurs when taps are left on. Knees, elbows and feet can also activate certain types of taps and these types of taps can overcome any usage difficulties in centre-return taps, as well as providing improved hygiene.

3.35 Ceramic or quarter-turn taps provide rapid shut-off and excellent wearing properties. They can be useful for people, such as arthritis sufferers, who have difficulty turning taps on and off.

3.36 Thermostatic mixing valves are available that reduce the water wastage that occurs while temperatures are being adjusted. Electronic taps and electronic mixing valves with preset temperatures can also be used to reduce water use and have potential for water savings in hotels, hospitals and similar places.

Urinals

3.37 Depending on their operation, urinals can be extremely high users of water. For example cyclic flush urinals, although banned by many authorities, can use as much as 2 megalitres of water per annum and can be the largest single water consuming device in a commercial organisation. There are various types of controllers and sensor-operated systems that can be installed to reduce water useage and the water efficiency ratings specify a water usage of 2 litres or less per single stall. Waterless urinals have now been developed but their use to date is rare.

Washing machines

3.38 The water efficiency of washing machines is expressed in terms of the volume of water required to wash and rinse a dry kilogram of clothes. There is large variability in the amount of water used by washing machines. They range between using about 10 litres of water per kilogram of clothes to about 35 litres per kilogram.[24]

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24 Australian Consumers Association, CHOICE January/February 2002, pp 40-41.

3.39 Generally, twin tub machines use less water than other types and are cheaper to buy. Front loading machines are considerably more efficient than are top loaders, but unlike Europeans, Australians favour top loading machines with ownership of these outnumbering front-loaders by 10 to 1. The price of front loading machines is initially greater, but running costs in terms of power and water, are lower.

Dishwashers

3.40 In 1998 dishwasher ownership was approximately 25 per cent of households and is expected to rise to more than 40 per cent by 2010. Water consumption in dishwashers varies between 1.6 litres and 4.8 litres per place setting. Machines that use less water have a more efficient spray pattern during the wash and rinse cycle. Average water use of dishwashers has improved significantly, falling from 29 litres per cycle in 1993 to 22 litres in 1996, with an efficient model able to use 13 litres or less.

3.41 There is some evidence to suggest that in certain cases dishwashers can use less water than washing up by hand, but this will vary greatly between households and dishwasher models.

Management of leaks and other losses

3.42 Managing leaks is an important part of demand management. At the household level, large amounts of water can be wasted from leaking cisterns - up to 50 kL per annum can be lost. Even small unnoticeable leaks can result in losses up to 10 kL per annum. Leakage checks need to be part of any assessment and retrofit program.[25]

3.43 One category of water use is unaccounted-for water or non-revenue water. Included in this category are leaks, unmetered and illegal water use, system flushing, and also water used for firefighting.

3.44 Leakage in a water supply system occurs from a few large leaks and a large number of small leaks, mostly in the pipe network. Burst pipes and moderate leaks are usually repaired within a few days because of the high visibility factor or through detection technology. Therefore, though large volumes are lost during burst events, the total volume lost on an annual basis is small. In contrast, small leaks continue 24 hours a day throughout the year, without detection, especially in sandy soils where even large leaks can go unnoticed. They can be difficult to locate and it becomes impractical and uneconomic to eliminate them all.[26] In well maintained and monitored water reticulation systems, water losses can be reduced to about 5 per cent,

25 Water Services Association of Australia, Wise Water Management, A demand management manual for water utilities, Research report no. 86, November 1998, p 88.

26 CSIRO, *Submission 47*, p 65.

but some systems lose as much as 60 per cent of their water. The average range of total unaccounted-for water is between 5 and 25 per cent.[27]

3.45 WSAAFacts shows the weighted average amount of urban system water losses per property in 2000/01 was 41.63 kilolitres per property.[28] As a proportion of the total volume of water supplied, the weighted average system water losses was 9.6 per cent. This ranged from 3.3 per cent in Western Australia to 26.8 per cent in the Central Gippsland area.[29] One estimate of water loss to illegal connections in Melbourne is 4,000 megalitres each year, worth more than $3 million.[30] The Australian Water Association told the Committee in relation to leakage management:

> if you can get down to five per cent loss in your urban system, you are doing quite well. Places like Kazakhstan lose 95 per cent. Places like Malaysia might lose 60 per cent. The UK until a few years ago used to lose about 50 per cent.[31]

3.46 The economic balance of searching for and repairing leakage, and of controlling it to an acceptable level, is a complex issue. Typically a leakage percentage below 10 per cent or even 15 per cent may not be economic to pursue, purely from the value of water lost. In other words the effect of hunting down, identifying and repairing the leakage costs more than the value of water saved.

3.47 To address leakage reduction beyond pressure management, suppliers need to adopt either a passive policy or an active policy for repair and remedial work. The passive method of leak control where only visible or reported leaks are repaired has most commonly been adopted in Australia.

3.48 Although leakage increases operating costs because of the need to pump and treat water that subsequently goes to waste, the major cost arises from the need to augment water supplies at an earlier date than would otherwise be the case. Additionally, there would be large costs in constructing works of a greater capacity than necessary to meet water demand. Therefore, the cost of leakage control has been found to be worthwhile only if augmentation is imminent and leakage control is able to delay that augmentation of supply.

3.49 The Committee took evidence in relation to significant gains in reducing system losses. For example in Melbourne over the last five years since the disaggregation of the Melbourne water industry into one wholesaler and three

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27 Australian Water Association, *We all use water … A users' guide to water and wastewater management*, pp 115-116.

28 The Australian Urban Water Industry, 2001 WSAA*facts*, Water Services Association of Australia, p 25.

29 The Australian Urban Water Industry, 2001 WSAA*facts*, Water Services Association of Australia, p 68.

30 Herald Sun, *Our water rats*, Saturday 29 June 2002, p 3.

31 Mr Davis, *Proof Committee Hansard*, Sydney, 18 April 2002, p 231.

retailers, there has been an approximate 50 per cent reduction in system losses. The retail companies have been doing a lot of work in relation to leak detection and have achieved quicker response times to such things as burst mains.[32]

3.50 Water pressure plays an important role in leakage management. It determines how much water will be lost from the system. Managing the water supply network at the lowest permissible operating pressure is the most convenient and least expensive option for leakage control. For example, research has shown that about a third of operational costs on water main repairs can be saved with slight pressure reductions - there will be fewer bursts and water supplies can be maintained for longer.[33]

3.51 Pressure modulation is achieved by using pressure reducing valves (PRVs), several types of which are available, ranging from the simple fixed outlet PRV to the flow modulated PRV.[34] The latter controls the pressure downstream of the PRV in accordance with the demand. During peak demand periods, the minimum pressure (to service demand at the critical point) will be provided. At low demand periods the pressure will be reduced to minimise excess pressure and the associated leakage. The PRVs need to be adjusted at regular intervals because the leaks gradually increase. The cycle of night flow analysis and PRV adjustment has to be repeated at regular intervals to prolong the usable life of a deteriorating pipe network, at the expense of water leaking into the soil.

3.52 Apart from gravity fed systems, generation of pressure almost always costs money, hence reducing pressure by PRVs is intrinsically inefficient. Therefore other options, such as re-zoning the supply head in an area to match topography or matching pump supply curves to distribution demands should be explored before heading down the path of expensive PRV technology.

3.53 Mr Tim Waldron, Chief Executive Officer, Wide Bay Water, has had significant experience in managing system water loss. He contends that in relation to demand management actions, water companies tend to focus on water pricing and metering, but little is done in water pressure control:

> As far as system water loss management is concerned, some cities lose up to about one-third of their water supply that they produce and measure though underground leaks because of ageing systems or through fractured systems because of badly controlled water pressures. The auditing of this is not done well generally in the water industry. Even the benchmark measurements that are taken in the water industry need to change to reflect perhaps something that may well give people comfort zones at the moment. Often

32 Mr Rose, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 328.

33 Mr Waldron, *Proof Committee Hansard*, Sydney, 18 April 2002, p 208.

34 CSIRO, *Submission 47*, p 65.

> we talk in terms of percentages, but a percentage can vary according to seasonal variations, but losses are usually continual.[35]

3.54 Mr Waldron says that there are some water suppliers who do not have meters on the outlets of their reservoirs and so they have no way of monitoring how much water they supply, and lose to leaks in the system.

3.55 Although he did not advocate their use in Australia, Mr Waldron drew the Committee’s attention to the fact that mandatory targets for leak reduction have been introduced in Europe in response to the last severe drought. He suggests that because of the extra costs incurred by water companies to fix leaks and because the leaks usually occur unobserved underground, the incentives to fix them are not strong. What is required is for the water industry to treat water as a resource that is becoming more scarce and audit its use with this philosophy in mind.[36]

3.56 Sydney Water has found that although its demand management program has not yielded the anticipated water savings it will still reach its targets because of greater than anticipated gains made in leakage reduction. Its leakage reduction programs has been its most successful demand management program to date because it is the only program that is completely under its own control.[37]

3.57 The Queensland EPA has prepared a series of booklets, *Case studies in water loss management*, and seminars for urban water managers on leakage and loss. It told the Committee that in addition to leak management being more cost effective and potentially saving money in infrastructure development, it can also provide jobs at a local level.[38]

Watering systems

3.58 Watering systems at both the domestic and institutional level are often very wasteful of water, but sometimes they are part of the solution and can contribute to substantial reductions in water use by utilising soil moisture sensors and climate data systems to improve water efficiency.[39]

3.59 The Committee was told that Sydney Water sponsors homes in the GreenSmart Village at Kellyville for which it has also provided water sensitive landscaping utilising plantings of Australian native grasses and native species. One of

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35 Mr Waldron, *Proof Committee Hansard*, Sydney, 18 April 2002, p 200.

36 Mr Waldron, *Proof Committee Hansard*, Sydney, 18 April 2002, p 201.

37 Sydney Water Corporation, *Submission on the Independent Pricing and Regulatory Tribunal of New South Wales mid-term review of our operating licence*, April 2002, p 51.

38 Mr Wiskar, *Proof Committee Hansard*, Brisbane, 4 April 2002, p 142.

39 Government of South Australia, *Submission 51*, p 24.

the houses is smart wired and has water sensors in the garden areas so that the computer system can inform the occupant when the garden needs watering.[40]

3.60 During its site visit to Catani Gardens, St Kilda, Melbourne, the Committee was shown the Council's irrigation system that controls the irrigation in the gardens.

3.61 Under this system, a computer regulates the irrigation and receives data from sensors concerning the moisture levels in the soil. Importantly, the device shuts off watering when it is raining. The Committee was told that some 25 per cent of water used in irrigating the park has been saved. Overall, the Council has saved about $10,000 on its monthly summer water bills by watering the 20 parks and gardens using the system. The Council is in the process of converting all of its irrigation systems.[41]

Water efficient gardens

3.62 Because a large proportion of domestic water use occurs on gardens, there is a lot of scope to improve water efficiency in this area. This can be done through mulching garden beds to prevent water loss, selecting plants that require less water, and by removing lawns or at least allowing them to brown off in summer.

3.63 According to the Water Services Association of Australia, the problem with outdoor water usage is that it is not amenable to easy general fixes for water efficiency. The answers lie in garden designs, paving rather than lawns, appropriate plants, responsible watering, urban planning, swimming pool covers etc. The solutions in this area are mostly individual and the only obvious broad tool for management is to ensure that consumers pay for the water they use.

3.64 However, changing the public's perception of the value of water, and enhanced public education in regard to garden watering, will greatly assist in improving water efficiency. Free mulches and native plants can be used as part of incentive schemes, and there is scope for developing a water rating system for all plants and turf, and for irrigation systems. For public gardens, authorities can promote low water using gardens, drip irrigation and the use of indigenous plants. Developers can also be encouraged in low garden water use practices.[42]

3.65 The Committee believes that management of public spaces can play a role in encouraging improved gardening practices. When authorities lavish quantities of water on maintaining lush, European-style gardens during summer the community is sent conflicting messages about water conservation.

3.66 The Committee took evidence from Mr Paul Totterdell, a horticulturist who creates landscapes that control and direct water and nutrient flow to growing areas in

40 Mr Gersbach, *Proof Committee Hansard*, Sydney, 18 April 2002, pp 255-256.

41 City of Port Phillip, *Submission 71*, p 5.

42 Government of South Australia, *Submission 51*, p 23.

gardens by using subsurface drains to retain water on-site. He uses nutrient holding strategies, and wastewater and stormwater recycling as tools to create a 'biofilter' that holds back, filters and recycles excess water, nutrients, organic wastes and pollutants that are produced from the site.[43]

Flora for Fauna

3.67 The Flora for Fauna programme is an initiative of the nursery and garden industry and supported by the Federal Government through the Natural Heritage Trust. It encourages people to plant local species in their gardens in order to provide habitat for native fauna. A corollary to this is the lower water requirements of native plants as compared with exotic species.

ActewAGL Xeriscape Gardens Demonstration Project

3.68 ActewAGL, together with the Canberra Institute of Technology (CIT) and the ACT Department of Urban Services, has established a Xeriscape garden to encourage water conservation. The garden features a range of Australian native and exotic plants, paving, and lawn, to demonstrate water conservation ideas. It also demonstrates water treatment and reuse through the Domestic Wastewater Reuse Research Project which includes a composting toilet, rainwater use and reed beds to cleanse used water.

Case study: Sydney Water's Demand Management Strategy

3.69 Sydney Water's Demand Management Strategy provides an interesting case study of a demand management program in practice. It has been praised for its ambitious targets, the range of measures that it utilises and its success to date in reducing water consumption. The corporation itself considers it to be 'one of the most comprehensive water conservation programs ever undertaken by an Australian water services provider'.[44]

3.70 However, there is evidence that some of the gains foreshadowed from the strategy are not going to be realised and total water demand has continued to rise over the last two years, although the corporation maintains that better than expected results with certain measures will offset less successful outcomes so that the overall targets will be met.[45]

3.71 Sydney Water's Demand Management Strategy uses a mix of water efficiency, water recycling and leakage reduction measures and adopts a 'plan, do, check, act' cycle. It is being delivered through the 'Every Drop Counts' and 'Water Recycling' programs. Sydney Water anticipates that ongoing reductions in per capita

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43 Mr Totterdell, *Submission 31*.

44 Sydney Water, *Submission 45*, p 9.

45 Sydney Water Corporation, *Submission on the Independent Pricing and Regulatory Tribunal of New South Wales mid-term review of our operating licence*, April 2002, p 44.

consumption will allow an additional 700,000 people to be accommodated in Sydney over the next 20 years, as total water demand will stay at current levels.[46]

3.72 The aim of the strategy is to meet per capita water consumption targets of:

- 364 litres/capita/day in 2004/05; and
- 329 litres/capita/day in 2010/11.

3.73 Consumption for 1999/2000, was 414 litres per capita per day. If the above targets are met, a 35 per cent reduction on 1990/91 levels of per capita withdrawals from storages will be the outcome. Sydney Water predicts that more than $50 million will be spent on water efficiency, water recycling and leakage reduction measures during the first five years of its strategy.

3.74 Sydney Water's demand management strategy was developed using least-cost planning whereby it determined the options that would provide its customers with the water-related services that they demand at the lowest cost to the community. This approach is also followed in other jurisdictions such as with the Brisbane City Council.[47] It recognises that customers do not necessarily want more water, but they want the services that water provides, such as clean hands, dishes and clothes and pleasing landscapes. Thus there is scope for satisfying demand for these services by improving the efficiency of water-using products and by replacing grassed areas with paving or using plant species with lower water requirements.

3.75 Sydney Water considered more than 40 different options to reduce demand (such as water efficiency, water recycling and leakage reduction). These options covered all water use sectors (residential, commercial, industrial, institutional, unaccounted for and non-metered water) and all end-uses (toilets, showers, taps, washing machines, and garden use). The options also covered the range of possible means of implementing water efficiency and water recycling measures, including regulation, pricing, education and advisory services, loans, incentives and retrofitting.

3.76 The options were modelled by estimating the potential demand reduction that would be achieved for different levels of investment for each option. In most cases the estimate includes a range of assumptions regarding levels of incentive and adoption rate. Options were selected using the following criteria, in approximate order of importance:

- cost to the community to implement the option;
- ability to provide timely reductions in demand;
- certainty about costs and benefits;
- balance across customer sectors;

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46 Ms Howe, *Proof Committee Hansard*, Sydney, 18 April 2002, p 184.

47 Mr Woolley, *Committee Hansard*, Brisbane, 4 April 2002, p 601.

- equity; and
- balance across option type (pricing, education, incentives, and regulation).

3.77 Sydney Water's strategy is considered in its various components below. Whilst this strategy has been cited as a successful implementation of demand management, it clearly shows the importance on ongoing evaluation of results against goals and the necessity of refining programs as required.

3.78 While gains have been made with this strategy, it highlights the importance of the assumptions that are made in relation to consumer behaviour, existing equipment etc when designing the programs and anticipating savings.

Pricing reform[48]

3.79 Sydney Water hoped to increase the price of water from 90 cents per kilolitre in 2000 to $1 per kilolitre in 2002, in conjunction with a communication strategy and promotion. It was anticipated that this would produce a 2 per cent decline in water use. This proposal was not included in the Independent Pricing and Regulatory Tribunal (IPART) price path in October 2000 and so in real terms water prices will fall and no reductions in water use have been gained from pricing reform.

Smart showerhead rebate program

3.80 This program was run jointly with the Sustainable Energy Development Authority (SEDA) and other energy authorities. Households received vouchers that provided a $10 discount on the purchase of an approved AAA-rated showerhead from a participating retail outlet. 8,907 showerheads were sold under the program and an estimated water saving of 0.1 lpcpd[49] was achieved as compared with the strategy estimate of 0.2 lpcpd. The reason that the take-up of vouchers was less than expected is attributed to retailers not being prepared to provide a discount at the point of sale. Customers were required to return the voucher for a refund rather than when they bought the showerhead and this would have been a deterrent to some.

Residential audit and retrofit

3.81 This program offered householders in targeted local government areas a water 'tune-up' of their premises by a trained plumber. A free shower head, tap flow regulators, cistern displacement device or flush arrestor for single flush cisterns, repair of simple leaks in toilets or taps, and advice regarding other water efficiency

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48 The information that follows is taken from Sydney Water, Demand Management Strategy, December 1999; and Sydney Water Corporation, *Submission on the Independent Pricing and Regulatory Tribunal of New South Wales mid-term review of our operating licence*, April 2002.

49 Sydney Water's operating licence sets requirements in relation to water conservation and demand management. Among other things, these requirements include specific aims to reduce consumption in per capita terms. Many of the goals in the strategy are framed in terms of anticipated reductions in litres of water per capita per day (lpcpd).

improvements were included in the tune-up. The service was worth between $100 and $130 but most participants would only pay $20-$22 or it would be free for low-income participants.

3.82 The program assumed that 170,000 households would participate and the estimated average saving per property would be 27 kL/year. By 31 December 2001, 150,000 households had participated and average savings of 20 kL/year have been achieved. Sydney Water attributes the lower than projected savings to:

- many of the participating households were probably already relatively conservation aware and so their original water use could have been lower than average;
- water usage of the replaced showerheads could have been lower than projected;
- households with more than one shower may not have replaced all showerheads;
- lower take-up of showers as part of the total retrofit package; and
- the relatively high proportion of participants from low income and low water using households.

Outdoor water use conditions

3.83 This program proposed to introduce permanent low-level restrictions for outdoor water use during 2000/01 to provide projected savings of 1.2 lpcpd by 2004/05. These restrictions were to apply to the hosing of pathways and garden watering times and were to be accompanied by a substantial communication strategy. Water authorities in Brisbane and Perth have successfully implemented similar restrictions.

3.84 Although the Sydney Water regulations were amended in 2000 to allow the Minister to impose water restrictions in the public interest, water usage conditions have not been introduced as proposed under the original program.

Outdoor programs voucher mailout

3.85 A reply-paid mail-out was sent to residents to register interest in the provision of water saving offers. Customers could obtain a gardening guide and a discount voucher booklet with offers provided by participating manufacturers and suppliers of approved outdoor water conserving products and services. It was estimated that 80,000 households would participate over 2 years generating savings of around 8 kL/year per household generated.

3.86 The program ran until 30 June 2001 and by April 2002, actual savings had not been analysed, although Sydney Water believes that additional demand generated by the Olympics and dry weather over the program period is likely to have outweighed the savings directly attributable to the program.

Showerhead and washing machine performance standards

3.87 Showerheads and washing machines account respectively for an estimated 23 per cent and 16 per cent of average residential consumption. Sydney Water anticipated savings of 2.6 lpcpd by 2004/05 for the introduction of minimum performance standards for showerheads and this could grow to 12.1 lpcpd by 2010/11 with standards also placed on washing machines.

3.88 Water consumption of showerheads is more than 15 litres per minute. The proposal is for only AAA showers to be available after 2003. These use less than nine litres per minute and the proposal anticipates savings of up to 25 kL/year.

3.89 Washing machines currently use more than 34 litres per dry kilogram of clothes.[50] The proposal is for a minimum energy performance standard of 100 litres per 5 kg load (20 litres per kilogram) after 2005. Typical household savings are anticipated at 15 kL/year.

3.90 No savings have yet been achieved from this initiative as negotiations are continuing with State and Commonwealth regulators in relation to standards for showerheads.

Every Drop Counts business program

3.91 This program targeted customers in the industrial, commercial and government sectors that use about 30 per cent of all water drawn from storages. Initially it involved Sydney Water providing free water audits to selected business customers to identify water conservation initiatives. The program assumed a 30 per cent adoption rate and after retrofitting, water use by the participants would fall by 20 per cent which would provide estimated savings of 3.1 lpcpd.

3.92 Limited success was achieved from the free audit model with few businesses committing to implement the findings even when the potential gains were clear.

3.93 One of the findings from these audits was that despite there being considerable water savings, and therefore cost savings that could be made, other factors such as budgetary constraints or operating conditions precluded businesses from taking steps to achieve these savings. The instability of markets in which companies trade can be an issue as companies may be reluctant to invest considerable sums up-front because market volatility may curtail their operations.[51]

3.94 The business program has been completely revised with a strong emphasis on gaining senior management commitment through a water management diagnostic, the development of an improvement plan and the provision of a range of services that can

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50 Water Services Association of Australia, Wise Water Management, A demand management manual for water utilities, Research report no. 86, November 1998, p 86.

51 Ms Howe, *Proof Committee Hansard*, Sydney, 18 April 2002, p 183.

help companies to overcome barriers to improving their water management performance.

> We revised the program based on the energy 1 to 5 program. It is completely revamped to where we now go in with top management and get these water efficiency, water recycling, evaluations put right into the processes from board executive level down so that they happen. That has been a fundamental progression in the program that has been very positive. Now we are seeing these programs getting taken up by the industries and implemented. Although you could prove the savings before, you could not get them to make the move to implement; now we are getting them to implement by changing the way that we introduce them.[52]

3.95 By April 2002 there were more than 70 companies involved in the program, with memoranda of understanding about implementation requirements signed with 50 participants.

Hospitality audits program

3.96 In anticipation of increased water use because of the 2000 Olympic Games in Sydney, the hospitality industry was the target of a water efficiency audit program that aimed to reduce demand for water in the tourism sector by an amount equivalent to the impact of the Olympic-induced tourism. This program was merged with the Every Drop Counts business program.

Leakage reduction program

3.97 The major contribution (28 per cent of total program savings) in water savings was projected to come from a sustained reduction in the leakage in the water distribution system. Estimated potential savings from leakage reduction were 28.8 ML/day (7.2 lpcpd) by 2004/5.

3.98 Prior to this program, Sydney Water had no active leakage program in place and so there was an extensive data collection phase and pilot program that delayed implementation of the major program until 2001. However, once implemented, the program resulted in significantly higher leakage reduction per kilometre of main at lower cost than originally estimated. The estimates of water savings resulting from the program were consequently increased to a target of 50 ML/day which is equivalent to an additional 5 lpcpd saving.

3.99 Sydney Water acknowledges that this program is its most successful demand management program to date. The reason it gives is that it is the only program that is completely under Sydney Water's control and particularly, it is not dependent on the acceptance of customers to adopt new behaviour or technologies. This fact highlights

52 Ms Howe, *Proof Committee Hansard*, Sydney, 18 April 2002, p 183.

the significant challenges associated with any community-wide social change program – it takes time to achieve results.[53]

Revising the strategy

3.100 Although the strategy still has some time to run, Sydney Water has identified some of the reasons why more progress has not been made in conserving water. These reasons include:

- Sydney's population may be higher than current projections;
- during and since the 2000 Olympic Games, Sydney has experienced extended periods of weather that is warmer and drier than average;
- changes in the housing mix with rapid growth in luxury medium and high density have contributed to higher than expected average demand for this sector;
- above average economic growth over the past two years, with strong customer spending and construction activity contributed to strong per capita demand; and
- demand forecasts in the 1999 Strategy were based on a year when demand levels were abnormally low.

3.101 Sydney Water notes that meeting the 2005 targets in its operating licence to reduce the per capita quantity of water drawn from all sources will be challenging and will most likely require additional strategies and resources to improve demand management performance. These strategies may include:

- expanding leakage reduction and business programs;
- refining the residential program to target high water users;
- adding new programs targeting residential outdoor demand;
- retrofitting Department of Housing properties;
- providing incentives to increase sales of water efficient appliances; and
- exploring alternative pricing structures.

3.102 Sydney Water's experience to date indicates that the achievement of sustained behavioural change in the long-term is not just dependent on rolling out large-scale education campaigns. It will be far more effective if programs are targeted, to meet the needs of customers and engage the support of key industry, supplier and regulatory stakeholders to achieve a transformation in the specific target market.[54]

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53 Sydney Water Corporation, *Submission on the Independent Pricing and Regulatory Tribunal of New South Wales mid-term review of our operating licence*, April 2002, p 51.

54 Sydney Water Corporation, *Submission on the Independent Pricing and Regulatory Tribunal of New South Wales mid-term review of our operating licence*, April 2002, p 52.

Conclusions

3.103 Domestic users are accounting for a growing percentage of water use and overall demand for water is still creeping up. However, there is still considerable scope to contain water use and achieve efficiencies. Water using appliances demonstrate great variability in their water efficiency and there is potential to improve this as well as to encourage greater uptake of efficient appliances.

3.104 Variability in water usage patterns and geographic conditions means that no one demand management strategy will be appropriate for all places, as demonstrated by the Sydney Water case study. Balancing costs and benefits is integral to deciding how to implement a demand management strategy and while the least cost basis is appropriate for initially choosing between demand management alternatives, achieving ecologically sustainable water use may require more aggressive adoption of demand management tools.

3.105 While the Committee was impressed with the many positive and innovative efforts being made in the area of demand management, it remains mindful of the comments of Mr Tim Waldron from Wide Bay Water:

> … I do not want to appear to knock some good quality water managers that there are in the industry, and certainly some companies are addressing these problems. I have been asked to quite a few of them to give lectures or workshops for them. There are some parts of the industry doing things, but I would say there is about 80 per cent of the water industry not doing anything.[55]

Water reuse and recycling

3.106 One way of easing the pressures on water supplies and of reducing the discharge of contaminants to natural environments is to get more use out of effluent. The natural water cycle is the ultimate example of water reuse as water circles the globe in continual renewal. As discussed in Chapter 2, water treatment plants can now produce high quality water suitable for many purposes.

3.107 In general, water treated to drinking water standard is available for all uses in urban areas, even though less than one per cent is actually consumed by people. Many submissions consider that this level of treatment for all water is wasteful and that water quality should be better matched with the purpose for which the water is to be used.[56] At the same time, tougher environmental standards for discharging effluent into some waterways have led to improvements in the quality of that water to the point where those standards are on a par with or better than the quality of water required for many industrial, domestic and irrigation applications.

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55 Mr Waldron, *Proof Committee Hansard*, Sydney, 18 April 2002, p 207.

56 See for example: CRC for Catchment Hydrology, *Submission 25*; and Australian Water Association, *Submission 41*, p 2.

3.108 It is possible to treat what is currently considered wastewater to any required standard, regardless of the pollutants present. However, the treated water can be more costly than comparable potable supplies. Recycled water is at present used for irrigating city parks, verges, ovals, golf courses, for industrial purposes, for agriculture and horticulture, for cooling water, toilet flushing and for environmental purposes; although currently it only comprises a small proportion of total water use.

3.109 Recycling water needs to be part of the whole system of water management. Dr Essery from the NSW Department of Land and Water Conservation emphasised these points:

> … what is important to us is that in dealing with urban water issues there has been a tendency in the past to separate demand management and effluent reuse and discharge recycling. What I would suggest to you more than anything else as a part of our submission is that that separation is a fallacy. Both are heavily integrated and dependent on each other and therefore any approach to urban water issues must not only integrate demand management of water supply but also demand management, treatment of and use of effluent as part of the total water cycle as you would do in any balancing exercise.[57]

3.110 The CSIRO estimates that Australia currently reuses only 14 per cent of its effluent from sewage plants.[58] Although growing, this is a small proportion when compared with water reuse overseas. In Florida around 34 per cent, and in California 63 per cent of treated effluent produced within those states is used for agricultural irrigation.

3.111 It is worth noting that indirect recycling takes place wherever sewage effluent is discharged into a waterway upstream from a town using the same waterway for its water supply. For example, Canberra's effluent is discharged into the Molonglo River which eventually becomes part of the drinking water supply for Adelaide (and other towns along the way). Sewage can also infiltrate groundwater which can subsequently be extracted and used.

3.112 This chapter looks at reusing treated sewage effluent and greywater, and the use of stormwater is considered in Chapter 4. The terms 'reused water', 'recycled water' and 'reclaimed water' will be used interchangeably.

Risks of reusing water

3.113 The major risks associated with the use of sewage effluent are environmental, human and stock health, safety of produce and legal liability (discussed in Chapter 6).

3.114 Health risks can include the spread of infectious diseases by bacteria (typhoid fever, dysentery, tetanus), virus infection (meningitis, hepatitis, respiratory diseases)

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57 Dr Essery, *Proof Committee Hansard*, Sydney, 18 April 2002, p 185.

58 CSIRO, *Submission 47*, p 55.

and worm infection (roundworm, whipworm, tapeworm). These risks can be managed with appropriate effluent treatment and use in accordance with recommendations and guidelines and there have not been any cases of disease outbreaks in Australia attributable to the use of reclaimed water.

3.115 The survival of pathogenic micro-organisms in soils depends on factors such as soil moisture, temperature, pH, nutrients, organic matter and the presence of some organisms and toxins. Sunlight and desiccation destroy micro-organisms remaining on exposed surfaces. Therefore, water containing these contaminants may be used in irrigation of public recreation areas provided a period of time is allowed before access is permitted. Buffer distances between residential areas and reclaimed water irrigation may be designated to prevent risks from airborne pollutants.

3.116 The relative degree of risk will depend on the nature of the reuse scheme, whether it is urban or rural, its size, the degree of treatment given to the reclaimed water, and the efficacy of the overall environmental management plan. Reclaimed water from sewage treatment facilities is required to meet prescribed microbiological health standards.

3.117 Effluent can be quite salty and so it is generally not appropriately used in areas with salinity problems:

> Most treatment systems are designed to reduce pathogen concentrations to safe levels whilst minimising nutrient and other contaminant concentrations in the water. They will not remove the dissolved salts in the effluent and in some processes will increase them slightly. Most treated effluents in Australia will have dissolved salt concentrations just below the threshold where their use for unrestricted irrigation would be limited.[59]

3.118 Dr Peter Fisher raised a cautionary note in relation to reclaimed water use because treatment plants do not currently remove pharmaceuticals and endocrine disruptors from the effluent (see Chapter 5). Greater use of reclaimed water will lead to the wider dissemination of these chemicals. The CSIRO also shares Dr Fisher's concern about the potential of reuse schemes to recycle contaminants around the urban environment.

3.119 The CSIRO points out that reuse schemes will divert contaminants away from natural environments to which effluent is currently discharged to either sludge or onto rural or urban environments and care needs to be taken to ensure that these environments are able to handle the contaminant loads.[60]

3.120 In effect, by increasing the amount of recycling, the environmental risk of effluent discharge is being transferred from outfalls to land applications.

59 CSIRO, *Submission 47*, p 57.

60 CSIRO, *Submission 47*, p 50.

3.121 Both Dr Fisher and the CSIRO advocate that more research be done on filtration and the impact on natural systems, before treated effluent is taken up for widespread use.[61] Additionally, the CSIRO suggests that the impact of these substances can be reduced by higher levels of treatment or by reduction at source (for example by legislating against the use of such contaminants in household products).[62]

Reclaimed water quality guidelines

3.122 Reclaimed water use may be governed by State and Territory legislation with specific statutory obligations imposed under health, environmental, agricultural or food legislation or all four, or it may be a condition of land development. To counter the risks involved in reuse, guidelines, health standards and recommendations for levels of treatment for various uses have been developed.[63]

3.123 The principle source of standards in Australia is the guideline for the use of reclaimed water.[64] It is part of the National Water Quality Management Strategy and was developed by Commonwealth and State agencies, industries and the general community and claims to foster the use of reclaimed water from municipal sewage plants in a way that protects both the public health and the environment. Whilst it provides guidance for a national approach for reclaimed water use, State governments develop their own complementary guidelines as appropriate to underpin the Commonwealth documents, thus allowing for regional and local conditions. For example, there is cause for greater care in relation to hookworm in tropical regions.

3.124 Food hygiene concerns are not addressed in the guideline and individual industries need to address food safety issues relating to the use of reclaimed water.

3.125 The use of reclaimed water is classified in the guideline into a number of specific applications, each with its own requirements for:

- type of reuse;
- level of treatment;
- reclaimed water quality;
- reclaimed water monitoring; and
- controls.

3.126 Reclaimed water is divided into several classes in State guidelines, on the basis of the treatment level applied to the effluent and the uses to which it can be put. For example, Victoria specifies four classes of reclaimed water. Secondary treatment

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61 Dr Fisher, *Proof Committee Hansard*, Melbourne, 23 April 2002, pp 366 and 372.

62 CSIRO, *Submission 47*, p 57.

63 P Thomas and R Croome. *The use of reclaimed water for irrigation: some issues,* September 2001, p 53.

64 National Water Quality Management Strategy, Guidelines for sewerage systems, Use of Reclaimed Water, November 2000.

produces Class D reclaimed water, and pathogen reduction and further treatment (tertiary) can be applied to produce Classes C to Class A as shown in the following table:

Table 1

Classes of reclaimed water and corresponding standards for biological treatment and pathogen reduction[65]

Class	***Water quality objectives - medians unless specified***[1]	***Treatment processes***[a]	***Range of uses – uses include all lower class uses***
A	Indicative objectives • < 10 E.coli org/100 mL • Turbidity < 2 NTU[2] • < 10 / 5 mg/L BOD / SS • pH 6 – 9[3] • 1 mg/L Cl2 residual (or equivalent disinfection)[4]	Tertiary and pathogen reduction[5] with sufficient log reductions to achieve: <10 *E.coli* per 100 mL; <1 helminth per litre; < 1 protozoa per 50 litres; and < 1 virus per 50 litres	Urban (non-potable): with uncontrolled public access Agricultural: eg human food crops consumed raw Industrial: open systems with worker exposure potential
B	• <100 *E.coli* org/100 mL • pH 6 – 9[3] • < 20 / 30 mg/L BOD / SS[6]	Secondary and pathogen (including helminth reduction for cattle grazing) reduction[5]	Agricultural: eg dairy cattle grazing Industrial: eg washdown water
C	• <1000 *E.coli* org/100 mL • pH 6 – 9[3] • < 20 / 30 mg/L BOD / SS[6]	Secondary and pathogen reduction (including helminth reduction for cattle grazing use schemes)	Urban (non- potable) with controlled public access Agricultural: eg human food crops cooked/processed, grazing/fodder for livestock Industrial: systems with no potential worker exposure

65 EPA Victoria, *Guidelines for environmental management: Use of reclaimed water*, Publication 464.1, September 2002, pp 21 and 22, viewed on 4 October 2002, at: http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/716543f3e369a021ca256aa7001e5635/64c2a15969d75e184a2569a00025de63/$FILE/464.1.pdf

Class	***Water quality objectives - medians unless specified***[1]	***Treatment processes***[a]	***Range of uses – uses include all lower class uses***
D	• <10000 *E.coli* org/100 mL • pH 6 – 9[3] • < 20 / 30 mg/L BOD / SS 8	Secondary	<u>Agricultural</u>: non-food crops including instant turf, woodlots, flowers

Notes to Table 1

1. Medians to be determined over a 12-month period.

2. Turbidity limit is a 24-hour median value measured pre-disinfection. The maximum value is five NTU.

3. pH range is 90th percentile. A higher upper pH limit for lagoon-based systems with algal growth may be appropriate, provided it will not be detrimental to receiving soils and disinfection efficacy is maintained.

4. Chlorine residual limit of greater than one milligram per litre after 30 minutes (or equivalent pathogen reduction level) is suggested where there is a significant risk of human contact or where reclaimed water will be within distribution systems for prolonged periods. A chlorine residual of less than one milligram per litre applies at the point of use.

5. Helminth reduction is either detention in a pondage system for greater than or equal to 30 days, or by an NRE and EPA Victoria approved disinfection system (for example, sand or membrane filtration).

6. Where Class C or D is via treatment lagoons, although design limits of 20 milligrams per litre BOD and 30 milligrams per litre SS apply, only BOD is used for ongoing confirmation of plant performance. A correlation between process performance and BOD / filtered BOD should be established and in the event of an algal bloom, the filtered BOD should be less than 20 milligrams per litre.

a Where schemes pose a significant risk of direct off-site movement of reclaimed water, nutrient reductions to nominally five milligrams per litre total nitrogen and 0.5 milligrams per litre total phosphorous will be required.

3.127 Class A reclaimed water is the highest quality and can be utilised in the urban context for non-potable use without restrictions on public access to the area where the water is being used. In the agricultural area, Class A water is suitable for irrigating raw human food crops and may be used for industrial uses that have the potential for worker exposure. The following tables give more detail of acceptable uses for the various classes of reclaimed water:

Table 2

Classes of reclaimed water and the associated acceptable uses (typically subject to site controls)[66]

Reclaimed Water Class	Agricultural Uses					Urban (non potable) and Industrial Uses	
	Raw human food crops exposed to reclaimed water	Dairy cattle[1] grazing/fodder, livestock drinking (not pigs)	Cooked/processed human food crops, or selected crops not directly exposed to reclaimed water	Grazing/fodder for cattle, sheep, horses, goats, etc	Non- food crops, woodlots, turf, flowers	Residential, unrestricted public access, open industrial systems	Restricted public access, closed industrial systems
A	✓	✓	✓	✓	✓	✓	✓
B	**X**	✓	✓	✓	✓	**X**	✓
C	**X**	**X**	✓	✓	✓	**X**	✓
D	**X**	**X**	**X**	**X**	✓	**X**	**X**

Notes to Table 2

1. Dairy cattle grazing with Class C reclaimed water are also allowed subject to a five-day withholding period after irrigation.

✓ reclaimed water of this quality is generally acceptable for the corresponding uses, however, management controls may apply.

X reclaimed water of this quality will generally not be acceptable under these guidelines for the corresponding uses.

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66 EPA Victoria, *Guidelines for environmental management: Use of reclaimed water*, Publication 464.1, September 2002, p 29, viewed on 4 October 2002 at: http://epanote2.epa.vic.gov.au/EPA/Publications.nsf/716543f3e369a021ca256aa7001e5635/64c2a15969d75e184a2569a00025de63/$FILE/464.1.pdf

Table 3

Acceptable agricultural uses - livestock access and food safety controls for specific irrigation methods

Reuse category	**Minimum water Class**	**Irrigation method**	**Key management controls for use eg withholding period**
Raw human food crops exposed to reclaimed water			
Crops grown close to the ground and consumed raw (eg. celery, cabbage)	Class A	Unrestricted	Produce should not be wet from reclaimed water irrigation when harvested
Root crops consumed raw (eg. carrots, onions, radish)	Class A	Unrestricted	Produce should not be wet from reclaimed water irrigation when harvested
Human food crops cooked (>70°C for 2 minutes) or processed before human consumption, or consumed raw but with edible parts not exposed to reclaimed water			
Crops grown over 1 metre above the ground and eaten raw (eg. apples, pears, apricots, table grapes, olives)	Class A Class C	Unrestricted Flood, furrow, drip, sub-surface	Produce should not be wet from reclaimed water irrigation when harvested Dropped produce not to be harvested
Crops which are skinned, peeled or shelled before consumption (eg. lemons, limes, nuts, watermelons, rockmelons)	Class A Class C	Unrestricted Flood, furrow, drip, sub-surface	Produce should not be wet from reclaimed water irrigation when harvested Produce should not be wet from reclaimed water irrigation when harvested Dropped produce not to be harvested
Crops to be cooked (>70℃ for 2 minutes) or processed before sale to consumers* (eg. wheat, wine grapes)	Class C	Unrestricted	Produce should not be wet from reclaimed water irrigation when harvested

Reuse category	Minimum water Class	Irrigation method	Key management controls for use eg withholding period
Non food crops			
Crops not for consumption (eg. woodlots, turf growing, flowers)	Class D	Unrestricted	Restrict public access to application area Harvested products not to be wet from reclaimed water when sold
Livestock (excluding pigs)			
Irrigation of pasture and fodder for dairy animals	Class B (including helminth reduction)	Unrestricted	Withholding period of 4 hours before pasture use, dry or ensile fodder Washdown water not to be used for milking machinery Controls to ensure pigs are not exposed to pasture or fodder
	Class C (including helminth reduction)	Unrestricted	Withholding period of 5 days before pasture use, dry or ensile fodder Controls to ensure pigs are not exposed to pasture or fodder
Irrigation of pasture and fodder for beef cattle	Class C (including helminth reduction)	Unrestricted	Withholding period of 4 hours before pasture use, dry or ensile fodder Controls to ensure pigs are not exposed to pasture or fodder
Irrigation of pasture and fodder for sheep, goats, horses, etc	Class C (no helminth reduction necessary)	Unrestricted	Withholding period of 4 hours before pasture use, dry or ensile fodder Controls to ensure pigs are not exposed to pasture or fodder

Reuse category	Minimum water Class	Irrigation method	Key management controls for use eg withholding period
Livestock drinking water or washdown water for dairy sheds	Class B	—	Washdown water not to be used for milking machinery. Reclaimed water with a blue green algae bloom not suitable for stock drinking Pigs not to come into contact with reclaimed water

* Crops that are cooked prior to consumption can be sold uncooked to consumers provided the safety of the practice (such as considering the irrigation steps, preparation prior to sale and domestic cooking) can be demonstrated to the satisfaction of relevant Government agencies, EPA Victoria and DHS for example.

Note: The health risks associated with hydroponics have not been adequately assessed, therefore hydroponic crops consumed raw must currently use Class A water.

Reuse opportunities

3.128 Opportunities for reuse of water from sewage treatment plants have grown rapidly in recent years in all states. Despite the fact that the community has not yet accepted the concept of using reclaimed water for drinking, cooking and bathing purposes, opportunities for using reclaimed water exist in nearly all areas where water is used.

3.129 Some examples include:

- agricultural uses — irrigation of pasture, crops (for example, fruit, vegetables, cotton and sugarcane); hydroponics; and pasture production and turf farms;
- horticultural uses — plant nurseries, vineyards and cut flowers;
- forestry;
- industrial uses — using internal and external sources of recycled water; particularly in electricity generation and to meet cooling and wash down requirements in other heavy industries;
- residential and community (non-potable) uses — irrigation of open spaces; dual reticulation in residential and industrial developments; and
- environmental uses — wetlands, ornamental lakes and environmental flows.

3.130 In general, there is a higher percentage of reuse in regional areas than in metropolitan areas because reuse opportunities depend on their proximity to treatment plants. The further away from the treatment plant, the greater the costs in terms of pipes and pumping of water to where it is required. Usually there is more available land close to treatment plants in regional areas, and there are therefore more opportunities for tree plantations for example, that can use the water.[67]

3.131 Although the greatest volumes of effluent are found in cities, they are often in low lying areas and require pumping to deliver the water to where it is needed. This can add significantly to the costs involved in reusing the water to the point where reuse schemes cannot compete economically with the use of potable water.

3.132 Sydney Water adopts the strategy of looking for reuse opportunities within an approximate 3 kilometre radius of its sewage treatment plants, concentrating on its inland plants which generally treat sewage to a higher standard than do the coastal plants because they must discharge into waterways. Outside this 3 kilometre distance, the costs of transporting recycled water become prohibitive.[68]

3.133 Mr Harvey from VicWater suggests that one option to overcome the expense of transporting water would be for strategic pipeline systems to be built from treatment plants to areas of economic activity. This would allow people to access and

67 Mr Harvey, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 281.

68 Mr Gellibrand, *Proof Committee Hansard*, Sydney, 18 April 2002, p 181.

tap into the pipeline to avail themselves of treated water as a viable, economic option to their business, rather than taking it from the potable supply.[69] Another idea is for water using industries to be located in proximity to sewage treatment plants, although this would have limited feasibility in developed areas where there is no available land. However, introducing smaller scale sewage treatment plants, as discussed in Chapter 5, may create reuse opportunities along these lines.

3.134 There are many opportunities within sewage treatment plants themselves to reuse water in operational activities such as cleaning screens, washing down work areas, cooling, flushing pipes and irrigating landscaped areas. In fact, much of the current urban usage of recycled water occurs in wastewater treatment plants.

3.135 The CSIRO summarises the opportunities and constraints for water reuse as follows:

69 Mr Harvey, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 282.

Table 4 **Summary of Reuse Opportunities and Constraints**

Opportunity	***Implementation to date***	***Barriers to further implementation***
Reuse of sewage effluent for agriculture	Widespread in rural locations and there is a large scheme in Adelaide. 28% of water use occurs in the agricultural industries.	• distance required to pump reuse water • storage requirements • land availability in dedicated reuse schemes • requirement to licence even if discharge to receiving environment is spasmodic • salinity problems • nitrogen removal at small scales
Reuse by industry	32% of water reuse occurs in the mining industry, 5% in the electricity and gas industry, 3% in the metals industry and 3% in other industries.	• distance required to pump reuse water • storage requirements • economics of treating and transporting reuse water compared to the cost of potable water
Dual reticulation (potable water and non potable water supplies)	Limited to a few demonstration sites. May find application at greenfield sites on the fringe of cities.	• economics unfavourable for sites that are already developed • redirects contaminant flows to local streams and household gardens
Potable reuse	Not practiced. Indirect potable reuse was planned in Caboolture Shire but the public did not accept it.	• public acceptance is the major issue • there are risks to human health but these can be managed • economics will probably force the price of water up, but given the low price of water this might be inevitable

Opportunity	*Implementation to date*	*Barriers to further implementation*
Greywater reuse (Household scale)	Practiced by people during drought. Legislation requires this to be done using sub-surface irrigation.	• long term watering with greywater would need to be assessed for its environmental sustainability (ie salt loads, etc) • treatment of greywater would be required before surface irrigation or other water uses could be approved • more work needs to be performed on the human health and environmental outcomes of different levels of treated greywater. These outcomes may affect the economics and the public acceptance (maintenance of system by householder) of household greywater reuse
Greywater reuse (cluster or estate scale)	Requires separation of blackwater and greywater at source, and separate treatment systems for each stream. Practiced overseas at Lubeck, where greywater is treated in wetlands and reused for non-potable uses. Also being considered for Melbourne's green suburb in the North East corridor.	• requires blackwater and greywater separation, and separate blackwater treatment – blackwater collection through reticulated sewage pipes is difficult because of the high solids content, which means the pipes may be prone to blockage. The Lubeck development uses vacuum sewers over short distances (300-400 houses) to minimise these problems, but is still at demonstration stage. Larger water flows to transport blackwater can lead to treatment difficulties at the other end, as the quantity of sewage requiring treatment becomes expensive for anaerobic digestion – Sweden overcomes blackwater separation problems by using hydrocyclones to remove the solids from toilet water and composting the solids on site or for a cluster of houses

Opportunity	*Implementation to date*	*Barriers to further implementation*
		– could be used with on-site treatment of blackwater eg cesspits/composting toilets etc • the requirements for treating greywater are not well understood, and the treatment plant design is assumed to be similar to that of combined sewage. Thus any gains in treating a lower strength waste are not incorporated into the economic analysis. Demonstration sites treating greywater are required for the industry to gain operating experience in handling greywater
Rainwater tanks	Used in parts of Australia where there is no reticulated potable water supply or areas prone to restrictions.	• economics based on cost of potable water versus cost of tanks favour the use of reticulated potable water (full cost of potable water not included in the price). • not permitted by some local councils as they are viewed as unsightly • the traditional designs have taken up room in the back yard and this has produced a negative response from the community, however new designs may overcome these potential obstacles (eg use the eaves as storage) • water quality has not met the NHMRC guidelines for drinking water quality, and therefore there is a general move towards not wanting to use them for potable water uses. Appropriate technology (treatment and tank) may overcome some of these drawbacks • the tanks require maintenance (cleaning of gutters and tank) to maintain water quality. Householders are often

Opportunity	Implementation to date	Barriers to further implementation
		viewed as being unreliable when it comes to maintenance issues, and this adds to the water quality issues surrounding rainwater tanks
Stormwater reuse (cluster estate scale)	To be used in Mawson Lakes, Adelaide in conjunction with aquifer storage and recovery, and in some fringe areas of cities where the infrastructure costs are high.	• if for residential use, then the cost of extra piping may make it too expensive • residential demand is seasonal and occurs when there is no rain. Hence large storage capacity is required and this is often not available or developers of greenfield sites do not wish to lose land that might otherwise be developed. ASR technology may help in some cases • treatment of stormwater would be required before reuse, and in particular disinfection • industry has little experience with these schemes • the pricing of second grade water is difficult, as the cost of potable water is very low and this decreases the incentive to use second grade water
Aquifer recharge and recovery	Planned for Adelaide as part of the Virginia Pipeline scheme and as part of the Mawson Lakes development.	• relies on the local geology for it to be economic • untried technology and so the SA experience will be closely monitored to see what difficulties it might have • potential to pollute ground waters if the water is not treated sufficiently before injection and if the demand for water is lower than anticipated

Social issues

3.136 Public acceptance for projects involving public contact with reclaimed water is an important part of achieving success for these projects and the guidelines for the use of reclaimed water acknowledge the importance of a high level of community involvement in any reuse scheme that is likely to have an impact on it.

3.137 Public opinion towards reclaimed water use is determined by:

- cost/price;
- availability of other sources of water;
- level of human contact;
- health;
- environment;
- treatment;
- distribution;
- conservation; and
- community expectations.[70]

3.138 Environment and community groups argued for a significant increase in water recycling, to reduce the amount of effluent discharged to waterways. The CSIRO notes that in general, people think recycling is a good idea but this support tends to lessen as the recycled water is used in applications that come closer to personal contact. The CSIRO's study in Perth shows that more than 90 per cent of people would accept recycling of treated wastewater to public open spaces; 50 per cent for laundry use but only 10 per cent would accept it as a substitute for potable mains supply for drinking purposes.[71] Sydney Water suggests that community support for recycling has decreased since 1995.[72]

3.139 The CSIRO puts the order of decreasing public acceptance of water reuse as follows:

- watering of golf courses etc
- gardening/toilet flushing
- laundry
- shower/bath
- drinking.

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70 National Water Quality Management Strategy, Guidelines for sewerage systems, Use of Reclaimed Water, November 2000, p 4.

71 CSIRO, *Submission 47*, p 56.

72 Sydney Water, Water Recycling Strategy, p 3.

3.140 Resistance to water reuse can also stem from a lack of knowledge about water quality and treatment and witnesses suggest that this will only be overcome by better educating and consulting with the community – an issue that is discussed further in this Chapter.

3.141 There is also a general acceptance by the community of the use of roof run-off (rainwater tanks) as a source of potable water, and many consumers in rural areas practice this. However, people become more reluctant to use water that 'originated' from dirtier sources, and the order of public acceptance for alternative water sources is:

- potable water supply;
- roof runoff (rainwater tanks);
- stormwater;
- greywater (non-toilet water); and
- wastewater.

3.142 Taste and odour are major determinants in the public's confidence in water quality.

Recycling strategies

3.143 As part of their plans to move towards more sustainable urban water management, all states visited by the Committee are adopting recycling strategies and establishing demonstration projects to confirm the feasibility of using more reclaimed water and help change community perceptions.

Domestic reuse

3.144 Water recycling for domestic or urban use can be done in three ways: centralised treatment of wastewater, which is piped back to individual houses (dual reticulation); onsite treatment and reuse systems; and direct greywater reuse.

3.145 Onsite systems are discussed in Chapter 5. However, in relation to recycling water from these onsite treatment plants, while viable and efficient systems are available, they are prone to many of the problems experienced with septic tank systems, including relatively high failure rates, and a reluctance of many residents to properly maintain them. Given the severe health implications of failures of these systems, it is unlikely they will achieve widespread use in the near future.

Dual reticulation systems

3.146 Treated effluent can be used in domestic premises by dual reticulation. That is, installing two separate pipelines – one supplying potable water and the other supplying recycled water. The latter is connected to taps for garden watering and/or cisterns for toilet flushing and the reclaimed water is treated to a suitable standard and sent to the premises from the treatment plant.

3.147 The obvious drawback to the these systems is the high cost involved in laying a second water main to each property plus duplicating elements of the plumbing. This means that dual reticulation is really only practical for new developments. However it should also be recognised that in such new developments, these capital costs can be mitigated by the fact that smaller pipes are required for both water supply and wastewater, since the recycled water reduces both demand loads and the amount of effluent leaving the site.

3.148 Professor Mein from the CRC for Catchment Hydrology suggests that these dual reticulation systems should be being laid now during development of all new suburbs in anticipation of future opportunities to recycle water. The fact that in general this is not being done, he sees as a major wasted opportunity:

> On the outskirts of Melbourne, for example, we are building vast numbers of new suburbs, with each one that goes in being a missed opportunity to fit it up for more efficient water use in the future. I believe that we should put two pipes in the water supply trench and run two pipes into each house: one pipe would run to the kitchen sink, the shower and so on and the other one would run to the toilet and the garden. For a while, potable water would go on as before to do those things, but it would leave an easy option later on to run water reuse or recycled water to each house.[73]

3.149 Two practical demonstrations in New South Wales of operational dual reticulation systems are the suburbs of Newington, part of the Sydney Olympic Park site, and those in the Rouse Hill development area. They are discussed below.

Newington and the Sydney Olympic Park Site

3.150 The Committee visited Sydney Olympic Park at Homebush Bay where the Water Reclamation and Management Scheme (WRAMS) provides a practical demonstration of the use of recycled water. It is a good example of a complete system for water management of a discrete area and is the first urban water reuse scheme of its type in Australia. It aims to be a practical demonstration of managing urban water holistically by using conventional technology, but embracing all water elements in an integrated way.

3.151 The key elements of WRAMS include:

- a water reclamation plant that removes water from sewage sourced from the neighbouring residential suburb of Newington and from major venues and facilities at Homebush Bay. Approximately 2.2 million litres is treated per day. Advanced biological treatment processes remove pollutants and nutrients, leaving high quality effluent that is disinfected by ultraviolet light and then pumped to the water treatment plant for final processing;
- a water storage reservoir in the lower levels of the north-western corner of the Homebush Bay brickpit store stormwater and excess treated effluent, to provide

73 Professor Mein, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 273.

extra water for final treatment when demand is high. The brickpit also provides an environment for the endangered green and golden bell frog;

- a water treatment plant to filter and disinfect water from the water reclamation plant and from the brickpit storage. This plant uses two treatment processes:
  - continuous micro-filtration, to remove all particles larger than 0.2 microns;[74]
  - reverse osmosis, to reduce salinity. Chlorine is also used to disinfect the water; and
- a separate dedicated supply system to pipe water from the treatment plant through Sydney Olympic Park venues, parks and Newington, which has approximately 1,400 properties connected to the reclaimed water supply.[75]

3.152 The recycled water is delivered to homes and facilities by dual reticulation and costs customers 78.35 cents/kilolitre which is 15 cents less than the price of drinking water. It is clear and odourless and is intended for use where drinking water is not required such as for firefighting, toilet flushing, irrigation, washing cars and other household and garden uses, but not for drinking, swimming, washing clothes or for pets.

3.153 Overall, by reusing water from sewage and stormwater, the scheme:

- reduces potable water demand by over 50 per cent;
- reduces sewage discharge by 850 megalitres per year;
- reduces stormwater pollution by 70-90 per cent compared with untreated stormwater runoff;
- reduces stormwater run-off, peak flows and flood damage;
- integrates stormwater into the landscape and the reuse scheme;
- implements a stormwater source control policy across the entire development; and
- instigates mandatory use of water saving devices.[76]

3.154 In terms of duplicating the success of WRAMs, several issues need to be considered.

3.155 The NSW Government subsidised the costs of the construction and the WRAMS operation and while this is appropriate for a demonstrator project, more

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74 A micron is one millionth of a metre.

75 Sydney Olympic Park Authority, *Submission 48*; and *Recycled water at Sydney Olympic Park, Winning with water*, pamphlet.

76 *Recycled Water System for Future Urban Development*, Andrzej Listowski, Sydney Olympic Park Authority, e20651a, paper presented at the International Water Association World Water Congress, Melbourne Australia, 7-12 April 2002.

widespread use of the WRAMS techniques will depend on cost reductions in the technology and/or changes in pricing policy.

3.156 The price at which recycled water in NSW is sold to customers is currently set at 78 cents per kilolitre - 15 cents below the standard drinking water price of approximately 93 cents per kilolitre - as determined by the Independent Pricing and Regulatory Tribunal. This compares with the Sydney Olympic Park Authority's operating cost of $1.40 per kilolitre for recycled water.

3.157 Part of the problem is that, despite the fact that the WRAMS scheme reduces the load on water supply, sewerage and stormwater infrastructure, Sydney Water continues to charge its standard rates for properties served by WRAMS on the basis that it needs to maintain back-up systems in case of a system failure by WRAMS.

3.158 Furthermore, WRAMS is disadvantaged because its competition, Sydney Water, does not have to pay for any environmental cost for dumping primary treated effluent into the nearby ocean.

Rouse Hill Estate

3.159 Sydney Water's largest recycled water scheme is at Rouse Hill to the north west of Sydney and it provides recycled effluent from the Rouse Hill Sewage Treatment Plant to residential areas that have dual reticulation. The recycled water is cheaper than drinking water, with a quarterly connection charge of $5.75 for residential properties and a usage charge of 27 cents per kilolitre. This compares with a charge of approximately 93 cents per kilolitre for potable water.

3.160 Health and safety measures in the development included:

- colour coded meters, pipes and fittings for the recycled water system to ensure easy identification;
- removable taps that require a reverse thread hose connection; and
- all recycled water taps are fitted with a yellow and black 'not for drinking' warning sign.

3.161 Suburbs have been receiving recycled water since 31 August 2001 and currently approximately 5,000 homes are now being supplied. Another 6,000 homes are soon to be included in the scheme which will ultimately supply 8 megalitres a day of reclaimed water to 100,000 homes.

Greywater

3.162 Greywater, sometimes referred to as sullage, is used water from a household that does not include water from the toilet (blackwater). Greywater recycling is less complex than recycling sewage as there are fewer health issues (less pathogens) and less treatment is required.

3.163 Greywater is usually discharged from the bathroom, laundry and kitchen to the sewer but, especially in times of drought, some households intercept it for garden watering, although little is known about how widespread this practice is. A number of witnesses wanted more to be done to encourage the use of this under utilised water resource both in the garden and for toilet flushing.

3.164 Widespread greywater reuse could have implications for operating the sewerage system which relies on greywater to keep sewage flowing. Any major reduction of greywater flow into sewers could lead to blockages and reduce the effectiveness of the system. Significant reductions in greywater flow would also increase concentrations of waste matter in the sewage which could have a detrimental effect on existing treatment plants.[77]

3.165 However, there are ways around these difficulties. In Lubeck, Germany, they have developed a process that separates blackwater and greywater, treating the latter in wetlands and using it for non-potable purposes, and using vacuum sewers over short distances (comprising about 300-400 houses) to minimise the problems of reduced flows.[78] Sweden overcomes blackwater separation problems by using hydrocyclones to remove the solids from toilet water and then composting the solids on site for a cluster of houses.[79]

3.166 Since no two sewerage systems share quite the same design, the impacts of removing greywater flows will vary. For example, Perth's sewerage system needs a high densitiy of pumps to move the sewage along as a consequence of low gradiants in the area. Also, minimal surface drainage enters the system to add to flows. Given these features, the Perth sewerage system is likely to be affected by removing greywater flows, however, there would need to be approximately a 50 per cent reduction of greywater to create such an adverse impact on the system.[80]

3.167 In summary, while widespread greywater reuse can have an impact on sewerage systems, there is much scope to increase the practice before these impacts will become evident.

Greywater quality

3.168 Many people erroneously believe that water from the laundry and shower is free of contaminants but laundry water contains soil from dirty clothes, phosphates from detergents and sometimes pathogens; shower water contains body soil, soap and sometimes pathogens; and kitchen water contains solid vegetable and animal matter and grease. It is generally recommended that kitchen washing up water not be reused because of its high grease and fat content.

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77 Water Corporation of Western Australia, *Submission 49*, p 28. *See also* CSIRO, *Submission 47*, p 60.

78 CSIRO, *Submission 47*, p 60.

79 CSIRO, *Submission 47*, p 60.

80 Dr Humphries, *Proof Committee Hansard*, Perth, 29 April 2002, p 422.

3.169 The quality of the greywater very much depends on the health, composition and habits of residents in each household. For example, although greywater typically does not contain faecal contamination, if a baby's nappies are being washed, the laundry water will be contaminated; or if a member of the household suffers from incontinence, the bath/shower water may be contaminated. Other issues such as the type and amount of washing powder used in the laundry will determine the levels of phosphorous and other chemicals.

3.170 There can be environmental and aesthetic problems associated with greywater use. Its application to the garden in a haphazard manner may lead to runoff that contaminates surface waters or groundwater and causes a build-up of nutrients and it is difficult for the average householder or body corporate to know if contamination is occurring.

3.171 Greywater may also cause an unsightly grey-green slime over the discharge area, due to soap, detergent and grease in the water. Sodium sulphate and other sodium salts are used as fillers in powder detergents and the elevated levels of sodium salts in greywater can lead to the destruction of the structure and stability of soil and reduce nutrient availability.

Greywater use and regulation

3.172 These health and quality issues lie behind the mixed responses of many regulatory authorities to the use of greywater. The Committee was told that regulations relating to greywater use vary across States, and authoritative advice about greywater use is generally difficult to come by:

> Greywater, in one sense, is grey in the other sense—often councils do not know, or they are not sure whether we can or we cannot [establish greywater reuse systems]. The danger is there that, if people start taking these things on board and going ahead with them without that legislation being in place or without those guidelines being in place, you could end up with someone being hurt via a system that does bring people into contact with some water that they should not be touching.
>
> That is the biggest concern of the whole issue—the public health one; that people should not be allowed to just put these things in without some sort of licensing, I suppose you would call it. But at the moment we are just dealing with that on a case-by-case basis. We will approach the council and they will apply their state laws as they stand.[81]

3.173 Because of the varying quality of greywater, authorities recognise the water savings that can be made from its reuse, but they generally prefer for it to remain a part of the sewage stream and undergo treatment with the resultant effluent made available for use. However, the CSIRO suggests that using greywater for garden watering will probably be more economic when performed at the household rather

81 Mr Totterdell, *Proof Committee Hansard*, Canberra, 22 March 2002, p 51.

than at the regional scale[82] and conservation-minded households may question the benefits of repurchasing water that has already passed through their property and been sent to the sewage treatment plant. The dilemma is summarised by Dr Johnstone from Bayside City Council:

> My understanding is that, clearly, for public health reasons, there are very good reasons for collecting greywater and putting it through the sewerage system, and discouraging grey water reuse. On the other hand it also seems to be a fairly useful resource which is often therefore going to waste, and could be better used.[83]

3.174 It is difficult for authorities to provide comprehensive advice about greywater use because its quality varies between households. Even with a greywater stream relatively free of pathogens, the increased contact risk at the domestic scale raises the probability of human health problems.[84] Another consideration is that greywater systems need to be context-specific, depending on: the level of treatment; whether it will be a new construction or a retrofit; soil and climate conditions; and legal and planning considerations.

3.175 However, the environmental and health issues can be avoided if greywater reuse systems are carefully designed, installed and managed. Sufficient land needs to be available so that the water can be absorbed on site and it is prevented from flowing to neighbouring land. It must not be allowed to form puddles or be sprayed because of the risks of human contact.

3.176 Despite the fact that many people use greywater to water lawns, untreated greywater is generally only suitable for subsurface irrigation where organisms in healthy soils can break down contaminants. Underground systems also remove the risks associated with human contact and the CSIRO suggests that legislation is required to ensure that this occurs.[85] Additionally, long term watering with greywater needs to be assessed for its environmental sustainability (for example, salt loads).

3.177 Using greywater in unsewered rural communities is a widespread practice that, because of lower concentrations of sources, does not apparently cause health problems but it can have environmental consequences. However the impediments that are placed in the way of greywater use are more significant with respect to health issues than for environmental ones.[86]

3.178 Greywater requires treatment before surface irrigation or other water uses can be approved and the CSIRO recommends that more work needs to be performed on the human health and environmental outcomes of different levels of treated greywater.

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82 CSIRO, *Submission 47*, p 57.

83 Dr Johnstone, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 306.

84 CSIRO, *Submission 47*, p 58.

85 CSIRO, *Submission 47*, p 59.

86 Mr McRae, *Proof Committee Hansard*, Sydney, 18 April 2002, p 230.

These outcomes may affect the economics and the public acceptance (maintenance of the system by the householder) of household greywater reuse.

3.179 Although Mr Totterdell reported that because of the nutrients in greywater he had experienced improved plant growth from its use,[87] the main advantage of greywater use is water conservation. A household can save money on potable water costs, but much of this saving is likely to be required for ongoing maintenance of the treatment system. The cost of a reuse system that includes sub-surface drip irrigation is more than $1000[88] although the Committee received evidence that systems can cost far more than this. At $1000, the system would need to be in use for more than twenty years before it paid for itself.

3.180 Added to the expense of household greywater treatment systems is the requirement for ongoing maintenance and commitment. One of the reasons that greywater reuse is often not permitted in sewered areas is because authorities say the community has a poor record for maintenance when it comes to 'doing its own thing'. For example, a study of the performance of on-site systems in areas where households are not connected to sewers referred to in 'We all use water', found the following deficiencies:

- 39 per cent of absorption trenches had significant problems resulting in poor performance or seepage;
- 65 per cent of septic tanks were not performing adequately, resulting in solids being carried over into absorption trenches, or they needed to be pumped out;
- 54 per cent of grease traps needed cleaning out;
- 48 per cent of household sewage treatment plants did not comply with accepted pathogen standards, due to poor performance and low chlorine levels; and
- 90 per cent of houses with dishwashers were connected to grease traps that were undersized.[89]

3.181 It has been suggested that if further use of greywater is to be considered, there needs to be widespread monitoring and policing of the system.

3.182 In most jurisdictions, there is no prohibition against transfering water from the bath to the garden by bucket. However, once the householder decides to pipe the water to the garden, the system is classified as a septic tank system and requires treatment and a planning permit. Witnesses pointed to the inconsistency in this approach but Mr McCarthy from the Eastern Metropolitan Regional Council pointed

87 Mr Totterdell, *Proof Committee Hansard*, Canberra, 22 March 2002, pp 49-50.

88 Australian Water Association, *We all use water … A users' guide to water and wastewater management*, p 203.

89 Australian Water Association, *We all use water … A users' guide to water and wastewater management*, p 203.

out that it was because of the risk of pipes accumulating bacteria and becoming a health hazard.[90]

3.183 One area where there seems to be less concern with untreated greywater use, is a closed system that uses greywater for toilet flushing.[91] Bath and shower water can be diverted to a holding tank and sent to cisterns. This minimises the risk of human contact with the water and can achieve considerable savings of potable water. Because there is about two to three times as much greywater generated per day per household than that required for toilet flushing no potable water would need to be used for flushing.[92]

3.184 However, in relation to the holding tank for the water, one of the tenets of good greywater management is that untreated greywater is not stored for longer than 24 hours. This is because it will very quickly become blackwater when stored, as pathogens multiply and unpleasant smells can be emitted. This problem can be overcome in relation to toilet flushing by a timing device on the holding tank that automatically sends unused water through an overflow pipe back to the sewer every 24 hours.[93]

3.185 Greywater reuse seems to intuitively appeal to people who are interested in conserving water because it is water under their control and regardless of regulation they will take matters into their own hands, especially when they observe the volumes that are being wasted. Witnesses complained that accurate information is not always readily available to make people aware of the potential health and environmental risks so they can take precautions to minimise or eliminate those risks.

3.186 The Committee was told that the key to overcoming barriers to greywater reuse is for health departments to formulate guidelines for safe usage.[94] Local governments are reluctant to act autonomously, especially where risks to public health are involved, and they require a higher authority to advise them.[95] There is a role for the Commonwealth to coordinate a process where agreement is reached between the various health and environment departments on how best greywater reuse can be managed.[96] Unless this is done, the current state of uncertainty about what constitutes acceptable greywater reuse will continue and a valuable resource will continue to be wasted.

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90 Mr McCarthy, *Proof Committee Hansard*, Perth, 29 April 2002, p 407.

91 Dr Humphries, *Proof Committee Hansard*, Perth, 29 April 2002, pp 420-421; Dr Johnstone, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 306.

92 Professor Wong, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 278.

93 Mr Bartley, *Proof Committee Hansard*, Melbourne, 23 April 2002, p 314.

94 Mr McCarthy, *Proof Committee Hansard*, Perth, 29 April 2002, p 407

95 Mr McRae, *Proof Committee Hansard*, Sydney, 18 April 2002, pp 230-231.

96 Mr Head, *Proof Committee Hansard*, Canberra, 22 March 2002, p 38.

3.187 The Committee visited two properties that included greywater recycling in their operation. One was Michael Mobbs' sustainable house in Chippendale, Sydney that recycled the combined blackwater and greywater flows from a single household (see Chapter 5 for more detail), and the other was the Inkerman Oasis development, outlined below.

Inkerman Oasis, St Kilda, Melbourne

3.188 The Inkerman Oasis housing project in Inkerman Street, St Kilda, is a multi-unit residential development that will combine domestic greywater and stormwater recycling when it is completed in 2003.

3.189 Greywater from 50 per cent of the units' bathroom basins, baths and showers will undergo primary treatment in an activated sludge (aeration) tank, before passing through a 400 square metre wetland and sand filter using sub-ground filtration and absorption. First flush roof and ground flow stormwater will also be captured and cleaned through the wetlands and sand filter.

3.190 The treated water will be used for both below ground garden irrigation and toilet flushing across the development. The water for toilet flushing will receive tertiary treatment through a microfiltration and ultraviolet disinfection unit.

3.191 Potable water requirements for the development will be reduced by up to 45 per cent, sewer loadings will be reduced through the reuse of greywater and nutrients from the greywater will prevent the need for fertiliser applications and also avoid such their presence in stormwater run-off from the site.

Agricultural and horticultural reuse

3.192 The use of recycled water for agriculture is probably the one at the forefront of public consciousness. It seems to solve two problems at once: how to sustain irrigation dependent agriculture; and what to do with nutrient rich wastewater.

3.193 The major advantage of this approach is that by using these water waters, it saves money that would otherwise be spent on upgrading a wastewater treatment plant to comply with requirements for reduced nutrient discharges into receiving waters. Using the effluent for agriculture puts the nutrients onto the land where they can be taken up by plants, simultaneously reducing or eliminating the need for fertiliser inputs.

3.194 Agricultural reuse of sewage effluent is already widespread in rural locations, with 28 per cent of total water reuse occurring in the agricultural industries. However, there are several key issues in relation to implementing such schemes:[97]

- the proximity of the water supply to crops;

97 CSIRO, *Submission 47*, p 59.