CSIRO Land and Water

Exploring the Institutional Impediments to Conservation and Water Reuse - National Issues

Darla Hatton MacDonald and Brenda Dyack

Policy and Economic Research Unit

REPORT for the Australian Water Conservation and Reuse Research Program

March 2004

ISBN 0643091882

Folio No: S//04/221

Exploring the Institutional Impediments to Conservation and Water Reuse - National Issues

Darla Hatton MacDonald and Brenda Dyack
Policy and Economic Research Unit

CSIRO Land and Water

CSIRO Land and Water Client Report

March 2004

Copyright and Disclaimer

Cover Photographs:

From CSIRO Land and Water Image Gallery: www.clw.csiro.au/ImageGallery/

ASA_VGS001_020.jpg Lettuce crop at Virginia, SA. This crop was grown on recycled effluent water from the Bolivar Treatment Plant nearby. 2002.

ASA_WTT001_016.jpg Bolivar Recycled Water Treatment Plant pumping station. Purified recycled water from holding dam in background will be used for market garden irrigation at nearby Virginia, SA. 2002.

This is a report of the Australian Water Conservation and Reuse Research Program, a joint initiative of CSIRO and AWA.
Stakeholders of the Program, who supported this research are :

Victorian Smart Water Fund
United Water International
Australian Water Association
Water Corporation WA
Queensland Department of Natural Resources and Mines
Northern Adelaide Barossa Catchment Water Management Board
Patawalonga Catchment Water Management Board
City of Albury NSW
Brighton City Council Tas
City of Mount Gambier SA
City of Mitcham SA
Queensland EPA
Albury City Council
Western Water
Beaudesert Shire Council
Wide Bay Water Corporation
Ipswich Water
Narrandera Shire Council

EXECUTIVE SUMMARY

The way in which water of varying qualities is available and allocated using the current set of formal and informal rules may have the capacity to limit economic development and environmental integrity[1] in some regions of Australia. In order to address this concern this paper explores the institutional impediments to water conservation and reuse from a national perspective.

The overarching institutional impediment to conservation and reuse is a lack of coordination of both policies and regulations that govern water conservation and reuse. This problem is endemic to many areas of natural resource policy where local governments, regional authorities, States and the Commonwealth all have roles to play, responsibilities and overlapping concerns. Complicating the challenge to coordinate policy and regulation is the problem of how best to facilitate flows of information to ensure that policy, regulation and practice change with the evolving state of knowledge.

This report explores the range of institutional impediments that result from the coordination complexity and the need for better information. The main impediments covered in this paper include the following:

Consumer Perceptions and Economics of the Reuse Market

- The "yuck" factor can limit the types of reuse schemes that communities will accept.
- Although hard evidence is hard to come by, the cost of producing reuse water appears to be large relative to willingness to pay in most regions. Information from the supply and demand side of the market is thin.
- Pricing structures currently used for urban potable water do not reflect the full cost of providing that water.

Property Rights

- Defining property rights along the full length of the hydrological cycle reduces uncertainty for private investors.
- The reuse of stormwater and sewage, as an economically viable alternative to current water supplies, is likely to be ultimately limited.

Governance

- In some States, water, wastewater, stormwater and the role of reuse and conservation are affected by regulations and policies initiated by multiple arms of government. In other States such as Queensland and Tasmania, the advantage of streamlined chains of responsibility becomes apparent.

[1] 'Integrity' is used here to refer to an environmental state that is on balance nondegrading. The distinction is made with an environmental state that is in an original or pristine state.

Health and Safety

- Australian approaches to the health risk associated with reclaiming and re-using rainwater, stormwater, greywater and wastewater generally have been very conservative and cautious.
- There are a number of recent technological and management innovations for managing water quality risks that can contribute to a broader and safer application of reuse water.

Environmental Protection Guidelines

- Water quality protection policies in States are focussed on maintaining environmental integrity with respect to aquifers, wetlands, water courses, etc. However, current guidelines may unnecessarily impede legitimate reuse and conservation goals.
- There is a need to create efficient processes for routine proposals as well as a need to investment in the greater in-house knowledge and scientific expertise to evaluate projects.

Research and Development

- Over the last decade research efforts may not have been as coordinated as they could have been across water conservation and reuse researchers. Some might argue that this has resulted in inadequate policy, regulation, and technology verification support for the substantial commercial innovation that is occurring at an increasing pace.

The many issues discussed in this report suggest changes that would reduce the barriers to water conservation and reuse. However, these changes will take time.

In the long term, better coordination of regulation and policy is required. Also required is an improvement of the vehicles for disseminating information and knowledge that cannot be neglected if we are to use water wisely.

Risk can be managed but not regulated away. A proactive approach involves a strong commitment to research, as demonstrated by investments in the base of technical and scientific knowledge. This investment in research is required to manage the health and environmental risk associated with reuse.

Acknowledgements

This research was supported under Stage 1 of the Australian Water Conservation and Reuse Research Program. The collegial support and the technical advice of Mike Young, John Radcliffe, Jeff Connor, Jim McColl and David Ellis are gratefully acknowledged. Thanks also to Murni Po, June Marks, Megan Dyson, Grace Mitchell, and Paul Pavelic for the work they have been doing in the area. While we benefited from their collective work and advice, any mistakes and omissions are the responsibility of the authors.

TABLE OF CONTENTS

1 INTRODUCTION

As a final study in a series of studies commissioned for the Australian Water Conservation and Reuse Research Program, this paper explores some of the institutional impediments that are thought to hinder the development of water conservation and reuse in Australia.[2]

Most of the analysis views the situation from an incentives perspective. This perspective includes incentives for individuals and organisations to invest, incentives for these people to trial new innovative solutions and incentives for those who manage water to make different decisions. The institutional arrangements that exist now among States and Territories vary across jurisdictions according to the distinctive needs of each area.

Natural resource use is shaped by the institutional relationships between resource users and the owner(s) of the natural resource. The institutional relationships include all the formal and informal rules including enforcement. As these rules and arrangements evolve over time periodic reviews, such as this one, of institutional relationships, are required to determine if the rules are still appropriate as measured against the original intentions of the rule versus current goals and objectives.

The institutional arrangements that govern water and wastewater have evolved over time in response to needs that have arisen that required a solution. Most arrangements have evolved in an environment characterised by relatively cheap access to water from ground and surface sources and concerns about preventing contamination from pathogens.

Increasingly, rules have been put in place to protect human health, manage water resources through the hydrological cycle and to protect fragile ecosystems. Working with any set of rules imposes a series of costs on households and firms. Discovering the rules, complying with these rules, or even changing the set of rules can be summarised as a series of transactions costs. Some transactions costs can be safely acknowledged as part of the normal costs of doing business or participating in society. It is when these costs become large, that transactions costs begin to act as an impediment hindering new project development or entrench outdated and inefficient practices and preclude worthwhile innovations.

Institutional impediments in this context are the established practices and requirements which either impose unintended costs or are no longer optimal given changes in objectives, technologies, social acceptability, etc. The costs of these impediments include lost opportunities and delayed development of innovative solutions. For example, given that water scarcity has the potential to limit economic development and environmental integrity in a number of regions

[2] In this paper, we use the term "reuse" rather than "recycling" except where the term recycling is part of a name of a project, program or initiative. Institutional arrangements are defined to include both administrative arrangements *and* the way rules that regulate water use and reuse are defined. Impediments to developing and maintaining both rural and urban reuse projects are considered in this paper.

of Australia, these costs need to be managed. For example, environmental flows in the River Murray, Hawkesbury-Nepean, Shoalhaven Rivers and Yarra River have been identified as being inadequate. Continued draw-down of groundwater in Perth may prove detrimental to the environment.

Many of the institutional impediments relate to uncertainty on the part of government agencies attempting to manage overall human health and safety and to maintain environmental quality. Because they are dealing with risk and uncertainty related to health, safety and environmental costs, agencies may require long lead times to update procedures and to review proposals and technologies.

Legislation, policies and guidelines will continue to evolve. This evolution can occur in a planned way or lurch forward reacting to political crises and political pressures for change in the face of unreasonable transaction costs. Of the options, planned evolution is preferable as it can be used to encourage investment and experimentation. For example, with changing membrane technology, health regulations preventing the use of reuse water in some situations may prove inappropriate. Careful re-examination of the institutional arrangements from time to time can reduce lost opportunities. Reuse water is not the same product as it once was and policies are likely to be lagging behind recent product quality and quantity changes.

This paper documents the current state of play. The actual and perceived institutional impediments to water reuse are discussed in the context of significant technological change and in a political and social climate where, for example, there is increasing pressure to value water at full cost.

This overview is presented as a survey of the set of institutional arrangements and the potential institutional impediments to water reuse. Areas such as property rights, environmental protection and governance arrangements would all benefit from a detailed investigation. Policy recommendations for removing these impediments must be the topic of future, on-going analysis that evaluates the specific situations that have arisen regionally, and even locally, in Australia, building on the review of AATSE (2004).

Clearly the situation is changing. The costs of securing additional water as well as its storage and delivery are rising. Moreover, water reuse and water treatment technologies are improving. Increasingly, the rationale used to justify existing institutional arrangements no longer applies.

It needs to be remembered that impediments can also be perceived as opportunities. The removal of an impediment, by definition, creates opportunities for those with an interest in water use and water reuse to gain by changing what they do. This review takes this perspective that the current institutional impediments can give way to beneficial opportunities.

2 OVERVIEW OF LEGISLATION AND GUIDELINES

The Australian constitution at section 100 states "The Commonwealth shall not, by any law or regulation of trade or commerce, abridge the right of a State or of the residents therein to the reasonable use of the waters of rivers for conservation or irrigation." As a result, principally the States manages water arrangements. As in the case of many other arrangements associated with business and commerce are assigned to the Commonwealth, in practice, responsibility is shared. Nevertheless, the ability of the Commonwealth government to enact legislation that focuses on water is limited. Most responsibility resides with the States and Local governments.

The following provides a summary of the more important pieces of legislation, guidelines and policy commitments according to Kennedy (2004), Fisher (2000) and AATSE (2004).

Commonwealth Government

- Coastal Waters Acts.
- Environment Protection and Biodiversity Conservation Act 1999.

Guidelines by ANZECC and ARMCANZ

- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000).
- Australian Guidelines for Water Quality Monitoring and Reporting (2000).
- National Water Quality Management Strategy (NWQMS).

CoAG

- The 1994 National Competition Policy puts in place a strategic framework designed to create an economically efficient and ecologically sustainable water industry, including pricing reform, structural separation of institutional arrangements, water allocations and trading, and integrated catchment management and water quality guidelines.
- The 2003 National Water Initiative (August 2003 CoAG Communiqué), among other aspects, commits States and Territories to address improvements in urban water use efficiency through measures including water pricing, catchment planning, demand management, and the increased reuse and recycling of wastewater and more efficient management of stormwater.

State Government Law

As the NWQMS was agreed to at a Ministerial level, States are obligated to adopt the basic approach in the NWQMS. In addition, the following categories of State legislation, guidelines, policies and codes are relevant to the development of a reuse project.

- Water resource management laws.
- Environmental protection laws.
- Planning and local government law.
- Health law.
- Food law.
- Consumer protection law.

Significant Specific State Policies

Victoria

- Victoria issued a Water Recycling Action Plan in 2002.
- Victoria is committed to reusing 20% of Melbourne's wastewater by 2010 according to the Green Paper, *Securing our Water Future*. Melbourne is facing population growth, combined with limited new sources of potable water.

New South Wales

- NSW seeks to reduce per capital water consumption by 35% and has issued the NSW Water Conservation Strategy which encourages reuse in order to reduce demand on existing water supplies and to encourage substitution of lower quality water whenever practicable.
- The potential site of Sydney's next dam has been declared a nature reserve suggesting that a dam will not be built in the foreseeable future.

Queensland

- Queensland introduced the Queensland Water Recycling Strategy which encouraged the change of existing laws to allow for a consistent approach from government to water reuse in Queensland.
- Water reuse is being strongly encouraged through partnerships with financial and non-financial assistance being available.

Western Australia

- The Western Australian State Water Strategy is aiming to increase reuse by 20% by 2012.

South Australia

- South Australia is currently reviewing strategies as part of a government review of options to Water-Proof Adelaide.
- State and local government reviews of urban stormwater management are underway.

Tasmania

- A Wastewater Reuse Coordinating Group has been established to encourage a consistent approach by the government to water reuse.

Australian Capital Territory

- The ACT has been developing a number of water resource strategies which outline the future directions and targets for the community with an objective of achieving 20% recycling by 2013.

Northern Territory

- The Northern Territory complies with the NWQMS and where the policy does not cover a particular issue, policies and guidelines in other States are used for guidance in best practice.

3 CONSUMER PERCEPTIONS AND ECONOMICS OF THE REUSE MARKET

The two primary impediments to water reuse are consumer perceptions and the fundamental economics. A clear distinction also needs to be made between reuse involving sewage water and reuse involving stormwater.

3.1 Consumer preferences

Po, *et al.* (2003) classified the major psychological barriers including:

- disgust or "Yuck Factor" where consumers are resistant to water reuse due to perceptions associated with raw sewage before treatment; and
- perceptions of health risk, especially relating to any potential risk presented for children.

The disgust associated with sewage water and the perceptions of health risks appear to be altered by a series of factors including:

- risk and disgust increase with proximity to human contact of reuse water including ingestion; and
- water shortages may dampen disgust and perceived risk (but not always).

Overall acceptance of reuse has been shaped by:

- trust in authorities and scientific information;
- positive attitudes towards the environment and environmental stewardship; and
- seeing that the decision making process as fair.

Research on consumer acceptance in Western Australia, indicates that acceptance tends to be greater for stormwater which requires less treatment than sewage water (Syme, 2002). In fact, this appears to be the case even though the sewage water may have lower concentrations of some contaminants than stormwater.

3.2 Economic considerations

Hatton MacDonald (2004) provides a financial snapshot of reuse projects in Australia. The difference between the price water is sold for and the cost of producing each KL can be quite large. Examples include the following.

- The Rouse Hill, NSW reuse project is a stark example where the cost of producing reuse water is in the order of $3 to $4 per KL and the selling price of the water is 28 cents per KL (de Rooy & Engelbrecht, 2003 and AATSE, 2004).
- The gap may be closing with some of the newer projects that are being planned and undertaken.

In order to gain acceptance of water reuse, suppliers tend to offer reuse water at concession prices. At present there seems to be low willingness to pay though published evidence is thin. The primary reasons include the following ones.

- The lack of full cost pricing for "new" water in a way that reflects the value of externalities associated with water use.
- Residential market - consumers perceive the product to be of inferior quality and as a result are willing to pay only a fraction of the price of current potable water supplies.
- Industrial users - the market for reuse water holds potential. However, there must be some advantage for the firm to justify switching to reuse as there are learning and capital costs with alternative sources. In some new industrial parks, there may be potential for introducing reuse as part of occupancy requirements or conditions.
- Agricultural and forestry purposes - willingness to pay is quite low with the exception of some premium products such as wine grapes.[3] The relatively cheap irrigation water from ground and surface water sources at current prices will limit the market for reuse in agricultural production. Utilities in the Sydney and Melbourne areas have been using agricultural reuse not as a means of reducing demands on the potable water supply but for reducing the volume of wastewater that would otherwise require disposal.

There are very few reuse projects that do not involve a direct or indirect subsidy. An exception is the Southern Vales reuse project operated by the Willunga Basin Water Company for a group of grape growers in the McLaren Vale, SA. In this case, there was a strong demand for water for growing grapes in an area where a water licence to take water from groundwater sources is extremely valuable. Anticipated land revaluation based on access to irrigation underpinned the capital to develop the project.

Indications are that the gap between willingness to pay and the operating costs should close over time due to increasing demand for reuse water and increasing supply.

The demand for reuse is likely to increase over time

- if consumer acceptance of the product improves;
- if the availability of irrigation water contracts; and
- if the price of potable water increases and wastewater disposal costs increase with externality charges.

The supply side for reuse water is likely to change over time

- if technologies improve i.e. removing pathogens; and
- if reuse systems become more energy efficient.

[3] This assertion is based on experience in South Australia with the vegetable growers of the Adelaide Plains and the grape growers of the McLaren Vale.

Key Economic Factors

- Critical to the long term success of water reuse will be the question of how the transition from a demonstration or pilot project to widespread use is managed.
- Stormwater reuse, as part of a water sensitive greenfield design, is becoming increasingly cost effective. This is where the institutional impediments are likely to impose the more serious barriers.
- Because infrastructure costs of dedicated piping are high, the fact that the infrastructure for potable water is already in place, means that potable water will likely remain the cheapest option for many existing industrial, agricultural and residential uses.
- The cost of desalinisation, but more importantly, the transportation of desalinated water to users, represents an upper bound on price. There are small-scale projects in Australia such as Penneshaw, SA.

4 PROPERTY RIGHTS

4.1 Property Rights

Property rights include the whole set of working rules, both formal and informal, that define how a resource may be accessed (Kaufman, 2003). The formal rules are defined by legislation, regulation and the common law. As stated in the overview, the Constitution of Australia does not specifically address water except as a limited reference to section 100 and as a result legislative responsibility for water use and reuse is largely left to the State and Territory governments (Fisher, 2000; Kennedy, 2004). Each State has developed legislation to manage water resources.

Formal rules are the Acts of Parliament and regulations established by Executive Councils of respective Commonwealth, State and Territorial Governments. The informal rules define the intricate relationships between governments, corporatised arms of government, statutory authorities, etc., which are involved in shaping policies and the wider spectrum of entities involved in economic and political activity surrounding resource utilisation. This report highlights the important impediments that can emerge when organisations have very different objectives in mind when setting out the rules.

4.2 Who owns the right to "use" water?

When the water is flowing down a river or sitting in an aquifer[4], water rights are vested in the State. If the watercourse is subject to restrictions (water allocation plans), irrigators and bulk suppliers of irrigation water require an entitlement or an access right to extract water.

Ownership of all water is vested in the State. Water is a public good. Access to a watercourse or to groundwater, are often allocated by the State to specific individuals and organisations. How this is done depends on where the water is located in the hydrological cycle and the degree of investment associated with water use. Typically, but not always, as the amount of investment or investment risk increases, access rights become more secure. As water becomes scarcer, often priority is assigned and it is this priority in the access queue that gives water a market value. In practice, it is access priority and access reliability that is being valued not the water itself. However, water is valued for the services it provides and the reliability of the service (which is created artificially in priority systems) is one characteristic of the good.

A mixture of legislative and licensing systems are used to define these access rights and often these are far from perfect. One of the reasons for this imperfection is the fact that in the early stages of development, interim arrangements are put in place (often inequitably, on a "first in - best dressed" basis) with little thought to the way access will be managed once scarcity

[4] A rock or sediment in a geological formation, groups of formations or part of a formation which is capable of being permeated permanently or intermittently and can thereby transmit water (EPA 2004).

becomes a major issue. Problems arise when access rights are incompletely specified and, as a result,

- less water becomes available; and/or
- those higher in the queue can increase the proportion of water they take.

Unfortunately, incomplete specification is common in the early stages of water resource development and, as a result, it is common for access rights to be defined and then redefined several times. In fact, most licensing arrangements foreshadow the likelihood of this by initially issuing licences for a relatively short period of time. Uncertainty of rights is increased as well because allocation arrangements often remain silent on considerations that are fundamental to the allocation system. Classic examples of this from property right systems for catchments include

- failure to define return flow obligations when water is allocated; and
- failure to require people to account for the impact that land use changes have on water yield.

Failure to fully define return flow obligations, for example, means that sewage treatment authorities can be reluctant to invest in wastewater distribution systems if they feel demand is uncertain. Once they have made investments, they could become very aggressive if a developer or investor proposes not to connect to the system and/or mine a sewerage supply system. In essence, sewage water treatment has traditionally been defined as a health and environmental management issue with little consideration to the possibility that sewage could become a resource. In fact, **failure to recognise the potential worth of recycled sewage streams and to define access rights to them is one of the impediments to the development of many small-scale sewage treatment technologies that are suitable for use in large cities.**

Similar problems arise with stormwater. Stormwater has been seen as a thing to be disposed of with little consideration to the water being a potential resource. In a world where water is scarce, however, it undoubtedly will become an asset. When stormwater in urban areas is flowing down a concrete stormwater channel to the ocean, the water is under the control of the entity that owns the infrastructure, and this is typically the local council. In this case, it could be argued that water is a public good and that the council is only controlling this potential asset. Alternatively, it could be argued that the council owns the right to harvest and profit from using this asset. Understandably, most of the management arrangements have tended to focus on the search for ways to disperse or dispose of stormwater at minimum cost. Viewed from a local council perspective, stormwater management is a flood management problem not an opportunity to make money. As a result, who owns the stormwater is not well defined though responsibility for managing the water is straightforward and defined. With the encouragement of full cost pricing, water restrictions and catchment planning and management, the issue of stormwater is likely to become a more interesting question.

In the case of rights to access groundwater, access in Perth, for example, has been relatively unconstrained, with continuing growth in the number of backyard wells and the drying of a number of wetlands signifying that extraction may exceed recharge. Unless access to aquifers is curbed, the incentive for water reuse in Perth is limited, in spite of recent experience of reduced rainfall. This appears to be a case where water rights and sustainability of resources are not well aligned and with fragmented management of different parts of the water cycle, substantial opportunities for water reuse are currently foregone. Hence, better management of groundwater would likely lead to improved opportunities for water reuse.

4.3 Rights to access infrastructure

Following recommendations from the 1993 Hilmer report, the Commonwealth Government has introduced means for third parties to apply for access to publicly owned infrastructure under reasonable terms and conditions. If the parties fail to come to an agreement, then the party seeking access can seek binding arbitration by the Australian Competition and Consumer Commission (ACCC).

Access to water related infrastructure is occurring with a recent example given in the textbox below.

The potential to access infrastructure re-enforces the importance of getting pricing policies and property right in line with social and environmental goals. The policies and rules need to be set out clearly for the owners of infrastructure as well as those who access it.

Example of a Water Industry Infrastructure Third Party Access Application

On 3 March 2004, the National Competition Council received an application under Part IIIA of the Trade Practices Act 1974 (TPA) from Services Sydney Pty Ltd for a recommendation to declare the following services currently provided by Sydney Water:

(1) a service for the transmission of sewage via Sydney Water's Sydney Sewage Reticulation Network from the customer collection points to the interconnection points (transmission services); and
(2) a service for the connection of new trunk main sewers owned and operated by Services Sydney to the existing Sydney Sewage Reticulation Network at the interconnection points (interconnection service).

The Council must consider the application against the criteria in sections 44G and 44F(4) of the TPA and make a recommendation to the decision-maker on whether the service should be declared. The decision-maker then has 60 days to make a decision. The decision maker for this application is the New South Wales Premier. His decision is subject to review by the Australian Competition Tribunal.

Source: http://www.ncc.gov.au/publication.asp?publicationID=185&activityID=32, accessed 29 March, 2004

4.4 Rights to aquifer storage

One of the most promising water reuse technologies is the use of aquifers to store water until it can be used again. This is done by treating water to bring it to a reasonable standard and then injecting it into an aquifer. For this to occur, those who incur the costs of preparing and injecting water into an aquifer need to have an incentive to do so. One of the easiest ways to do this is to grant them a legal tradeable right to extract water from that aquifer at a subsequent point in time.

When water is injected lawfully into an aquifer, the rules are not clear on who owns the injected water. It could be argued that this water is like water held in a dam where it is the property of the dam owner or, alternatively, that it remains a public good. A State government might argue that water in an aquifer is the State's and that only a right to access the water can be granted.

A pragmatic approach is to see the water access problem as an incentive problem rather than a legal problem. There is opportunity to define the rights clearly. A pragmatic incentive-focused approach would be to give any person or body that injects water into an aquifer in a non-harmful manner, an entitlement to extract a defined proportion of the volume injected and if they wish, to transfer the resultant allocation to another party. Groundwater trading is still in its infancy in Australia but it is sufficiently well defined to allow trades to occur to nearby areas. There is potential for harvesting and storing stormwater in the aquifer and then building/accessing a pipeline to deliver the stormwater to buyers when required.

Without the rules being clearly set out, risk and uncertainty will limit private sector involvement in and investment in this technology. At present, there are only a few precedents that have been established such as the agreements between Salisbury Council and the Northern Adelaide Plains Barossa Catchment Management Board in South Australia to allow stored stormwater to be sold to commercial users.

5 GOVERNANCE

Responsibility for the overall management of water, wastewater and stormwater is often spread across several entities. Water service and sewage disposal are generally provided through a corporate entity. Stormwater, as part of flood management, is often the responsibility of a local council. This is the case in South Australia where water services are largely managed by State statutory authorities and commercialised arms of government and implemented by contractors. Local governments are responsible for stormwater as part of flood mitigation. In Victoria, separate water authorities are independent of Local Governments who manage stormwater.

There are notable exceptions, such as Brisbane Water, Gold Coast Water and Ipswich Water, which are all commercialised business units of their respective local councils. Connected stormwater, water and wastewater service provision has allowed for a more integrated approach towards new subdivision planning in urban areas of Queensland. The Gold Coast area, which faces population pressure and dwindling water resources relative to the expected population growth, has taken a progressive approach to water reuse with the Pimpama Coomera Water Futures planning project (Cox and Hamlyn-Harris, 2003).

An interesting model is emerging from Victoria with the Associated Bayside Municipalities (ABM) which is a group of 10 Councils that have coastal frontage to Port Phillip Bay. The group is committed to enhancing the effectiveness of Local Governments' management of the Bay. The main aim of the group is to identify, resolve and advise on matters of common interest to the bayside councils and to improve the overall management of the coastal environment, of which they are a key stakeholder and decision maker. Its value is that it can approach such matters on a baywide or regional basis.

The advantages of an integrated model of water, wastewater and stormwater service delivery coming under the control of local council can be seen in greenfield developments. Innovative urban designs may be far ahead of local planning policies, catchment plans and EPA guidelines (Mitchell, 2003). Innovative designs may require trade-offs between development controls, stormwater management, water and wastewater considerations. For instance, if a developer of a new subdivision proposes to reuse significant amounts of stormwater or be self-sufficient with respect to wastewater treatment, there can be considerable friction between developers and utilities with respect to charges. There are valid arguments on both sides but the potential for a fixed connection charge for existing infrastructure presents a significant barrier to innovative design. If the developer is undertaking a project that fits into the goals of the local government then there may be more flexibility over headworks charges.

Strong connections between the service providers and local government may prove to be a means of balancing the sometimes conflicting goals if expertise can be developed and integration occurs across organisations. The Queensland models will be interesting to observe and post-project evaluation of the Pimpama Coomera Water Futures project could provide critical information about this sort of institutional arrangement.

6 HEALTH & SAFETY

The Australian approach to the health risk associated with reclaiming and re-using rainwater, stormwater, greywater and wastewater generally has been very conservative and cautious. It is easy to see why - history teaches us that separating water from sewage has been instrumental in reducing waterborne disease in developed countries and clean drinking water is one of the public health victories of the last century. This is an important message that cannot be lost in discussions of using alternative sources of water.

The major risk for human health is with respect to infection from micro-organisms including various types of bacteria, viruses, helminths and protozoa. Detection and treatment is advancing (Haas, 2002) but some level of risk will always be present. Risk and perceptions of risk have to be managed, as risk in water supplies cannot be eliminated. However, risk presents itself in many areas of our day-to-day lives, not just through water considerations and realistically, we know we cannot eliminate risk from our lives.

In this context then, there are opportunities for periodically re-examining where lower quality water could be used safely if there are advances in detection, modelling of the exposure - illness pathways, etc. There may be opportunity for better management of risk through further investment in research and development of strategies. Mitakakis, *et al.* (2004) report on the need for well designed studies using water quality relevant to Australia in order to assess health outcomes from reuse water. Here, water quality is being used as a proxy health-risk measure. More rigorous scientific evidence and efforts to disseminate this information is required to ensure that the right proxies and indicators are being used (Ashbolt, *et al.* 2001).

Some trends have emerged in recent years for managing risk. For instance, risk management approaches developed for food and food processing such as Hazard Analysis & Critical Control Point (HACPP)[5] introduce a framework for thinking about risk in water, reuse water and sewage disposal. Brisbane City Council was the first Australian authority to have attained a fully integrated and accredited management system for its water treatment systems. Four management systems have been combined: Quality Assurance, Environment, Safety and HACCP. All four management systems are incorporated into the same Quality Assurance database to produce a fully integrated management system (AWA, 2001). This theme also emerges with the Victorian approach with the Safe Drinking Water Act that will take effect in July 2004.

In general, guidelines have been prepared by each State in Australia concerning the various qualities of water for varying use. The use of rainwater in urban areas is being regarded as a reality that has to be managed in light of the water restrictions across States. Local councils, the Green Plumbers Association, the

[5] HACCP is a methodology for systematically identifying, evaluating and controlling hazards significant for food safety with a focus on preventative measures rather than relying entirely on end-product testing. HACCP is an internationally recognised effective food safety risk management methodology.

States and many of the water utilities have been providing consistent advice on the importance of tank maintenance. This is an area where consumer education is important. There is also a significant opportunity for firms and/or water utilities to offer contracts and undertake the maintenance of household rainwater tanks.

While rainwater (with provisos) is generally acceptable for non-potable purposes to health authorities, reclaiming greywater in urban settings is viewed with more caution. Policies in WA, NSW and Victoria allow for very limited urban residential reuse in urban settings during the drought and while water restrictions are in place. For instance, NSW Health allows for the use of greywater from non-kitchen sources such as the bath or the final rinse from the laundry when it can be applied with a bucket. By limiting the greywater to manual application, the health authorities are attempting to limit the health and environmental risk. (NSW Health, 2002) Although this approach presents barriers to potential retrofitting, pilot projects in Victoria have demonstrated significant water savings (Yarra Water, 2004). There may be site-specific issues that limit the volume of greywater that can be used without detriment to the site such as the soil, plants, etc., pollution of adjoining sites and the groundwater below (EPA Victoria, 2003; EPA Victoria, 2004).

The Case for National Coordinating Effort

There are opportunities for building on best practice which limits risk to acceptable levels. As technologies develop, such as smaller scale filtration systems, combination of treatments, etc. risks associated with rainwater, stormwater and reclaimed wastewater may be reduced.

From time to time, reviewing the acceptable level of risk may also be required. Acceptable levels of risk in our society are context specific. It is not clear why the risk of water borne illness is considered to be different from risks to health and safety in other day-to-day activities.

As the public becomes more aware of how to manage the relatively low risks associated with alternate sources of water, there will be opportunities to match quality of water with quality required. The public and health authorities appear to be having to impose stringent safety requirements in the absence of this public awareness. At present, health authorities are very cautious in their approach to greywater reuse and reclamation of wastewater. New national guidelines based on risk management for use of water from a range of sources to replace uses other than drinking supplies are in preparation during 2004, and will be based on current knowledge of the risks and the means of managing them.

Example of an Impediment - Christie Walk, Adelaide

An example of Integrated Urban Water Management (IUWM) cited in Mitchell (2003) is an interesting case study of water sensitive design as part of an urban infill project. In early designs of Christie Walk in Adelaide SA, there were plans for extensive use of treated wastewater. However, the $1000 per week monitoring regime required was considered cost prohibitive. The challenge for smaller projects is how health and safety of residents can be protected while ensuring that costs are not prohibitive.

7 ENVIRONMENTAL PROTECTION GUIDELINES

The cornerstone national document is the National Water Quality Management Strategy (NWMQMS) and forms the basis of water quality protection policies in States. New guidelines, currently in preparation, will take account of both health and environmental risks. A major challenge with these guidelines is how evaluation and approval processes can be streamlined.

At the State level, uneven or excessive application of the precautionary principle by State Environmental Protection Authorities (EPAs) has the potential effect of inhibiting innovation in development proposals. Hence there is merit in using pilot projects to explore reasonable options and learn, while at the same time, limiting potential damage. Allowing for flexibility in managing risk can lead to significantly cheaper and superior solutions than conventional practice. Hence, there is an opportunity to demonstrate leadership by supporting and strategically investing in research and pilot projects.

There is a risk that over time, EPA decision-making may become isolated from the larger environmental concerns and may not be taking into account overall water scarcity and larger environmental consequences. There is considerable variability on this issue across States. One solution is a move to better coordination of water policy and resultant regulation across levels of government. For example, in some inland towns the flow in ephemeral streams in the dry season is composed entirely of Sewage Treatment Plant (STP) discharge on which ecosystems and irrigators depend and quality and quantity considerations cannot be divorced.

There are a number of situations where exemptions to regulations and rules are commonly sought and they are approved. This suggests that the regulatory system is inefficient. For example, a recently developed Environment Protection (Water Quality) Policy (EPP) (2003) in one state requires that: (a) salinity of groundwater not be reduced, or (b) salinity of groundwater not be increased by more than 10% by an aquifer storage recovery project. However, every existing aquifer, storage and recovery (ASR) operation in that State reduces groundwater salinity by more than 10% and therefore every operation now requires an exemption from the EPP. This is not atypical of regulatory responses to new technologies. Applying for exemptions represents a further transaction cost for proponents of innovative projects. Similar situations arise in other states. Approval processes may be streamlined by issuing and regularly updating codes of practice as innovation continues.

8 REMAINING POLICY ISSUES

Finally there are a number of assorted policies that have emerged in our review that require highlighting and short discussion.

Research and Development

Since the cessation of Commonwealth funding for the Urban Water Research Association of Australia in the early 1990s there has been less coordinated research in water conservation and reuse with notable exceptions such as the Integrating Technology Implementation and Risk Management in Water Recycling at the University of Wollongong and the Australian Water Conservation and Reuse Research Program established by AWA and CSIRO in 2003.

For a decade, conservation and reuse research has been more fragmented, more poorly resourced and outcomes more poorly communicated than would be ideal. A backlog of knowledge coordination and transfer needs to be addressed. The associated research and development gaps are identified in companion reports of AWCRRP Stage 1. There is also a continued need for national icon demonstration projects to reinforce the initial confidence by water utilities, planners, natural resource managers, health and environment regulators on performance and reliability of innovative systems. Undoubtedly, risk can be reduced and managed by public and private investment in research and development.

Plumbing Codes

Workman, *et al.* (2003) identified a number of issues with respect to plumbing codes that present potential barriers to effective implementation of best practices for rainwater, greywater and onsite sewerage treatment. In general, the issue of cross contamination is the most serious issue. It can be addressed by educating the plumbing industry and the home "do-it-yourselfers" about keeping the potable and recycled water lines separate.

For **rainwater,** collected off rooftops, funnelled into a tank and plumbed for indoor or outdoor uses, the key impediments include:

- the lack of standards for plumbing hot water with rainwater within a household; and
- the need to review how a single rainwater tank could have multiple uses in a house while avoiding cross contamination of the potable water supply.

For **greywater**, State authorities and Local Councils are reluctant to deal with permanent greywater interception and reuse in anything other than a case-by-case basis. Storing greywater presents potential health risks because the water can become septic when stored for more than 24 hours. As well, the problem of reducing greywater flows may result in increased concentrations of waste contaminants in sewerage systems, which in turn can have detrimental effects on treatment plants. There appear to be ways to minimise the health risks by limiting the storage and reuse of greywater to high quality sources such as showers, bath, laundry rinse and hand basins. For new construction, there may be opportunities in the future if low risk greywater sources run in separate pipes to the outside of foundation walls.

Technologies currently exist for onsite **sewage** treatment, however, the monitoring requirements are cost prohibitive. This is in sharp contrast to monitoring requirements for domestic septic tanks, which can and do fail with households often unaware of the need to service and maintain these systems.

Fixed Charges

Inescapable fixed headwork charges for developers present a disincentive to water reuse. While providing a revenue stream to cover costs for utilities, the charges represent a barrier to innovative design. Suggestions have been floated in a few forums concerning ways to encourage retrofitting using a rating system where fixed charges are reduced based on water efficiency (Connor and Hatton MacDonald, 2002 and Young 2003). These rating systems could be adapted to the subdivision level.

Revenue streams

Existing infrastructure for delivery of urban water and disposal of wastewater have been planned for given projected populations and past estimates of use without reuse factored into the capacity estimates. Traditional designs have been planned so as to take advantage of economies of large scale where average treatment costs decline as plant size increases. Expectations based on these designs factored in an expectation of cost recovery through future charges based on expected future usage. Extensive reuse in a suburb, stormwater reuse, etc. has the potential to displace revenue streams for existing utilities, which were built for a much larger scale without reuse in place. Over the long term, governments will need to come to terms with reconciling their need for on-going revenue generation with water conservation goals.

Long Term Sustainability of Reuse

There is a significant step in going from the development stage to property management with water sensitive design. Successfully taking this step requires a commitment to ensuring the long term sustainability of reuse (Marks, 2004). Rainwater tanks, stormwater reuse, ASR projects and third pipe systems require on going maintenance and investment which may be beyond the scope of many households and even property managers. A public policy challenge will be to decide whether maintenance contracts will be required up-front or the owner of the assets will have to arrange for these services. This challenge is imminent given that many of the States will be requiring rainwater tanks with new houses in 2005.

9 CONCLUDING REMARKS

The fundamental economics of reuse projects is such that very few proceed without some level of subsidy. There is considerable resistance by consumers to reuse and this is a serious impediment to investment. Without communities coming on side, project developers face enormous risk with respect to consumer backlash.

There are important institutional and policy impediments that exist in addition to the financial considerations and consumer resistance. For example, transaction costs are high for innovative projects. Reuse projects are evaluated at the project level without accounting for benefits and costs across cities and catchments. In addition, adding to the uncertainties, are poorly defined rights to stormwater, sewage, aquifers and engineered infrastructure (pipes and treatment plants).

It is evident that current institutional arrangements are not going to lead to the most efficient use of water resources because of the existence of the impediments discussed in this paper. Hence, in order to secure sustainable water use while these impediments persist, there is a need for compensating measures, at least in the interim until institutional and policy impediments are addressed. Incentives to encourage innovation with clear timeframes for winding back could include national funding initiatives, for example for innovative projects and national policy initiatives that encourage pricing reform for urban water.

10 RECOMMENDED NEXT STEPS

There are two levels of 'next steps' that need to be taken in order to reduce institutional impediments to conservation and reuse. At a high level, it is necessary to first address the overarching information flow and policy coordination concerns raised in this paper. At the next level, it is necessary to take the steps that improve the uptake of reuse at the grassroots level.

At the most general level it is necessary to

- improve the information networks that link the knowledge, policies and regulations that are evolving at each layer of reuse governance.

On the ground, it is necessary to

- focus codes and regulations on outcomes rather than inputs so as to encourage cost minimisation and creativity in meeting the requirements; and
- concentrate expert advice on standardising codes and regulation in order to, for example,
    - reduce costs by eliminating the need to 'reinvent the wheel' for each new proposal so that small local groups, which do not have in-house expertise, can reasonably consider cutting edge options; and
    - improve the knowledge base about reuse in the plumbing industry and move towards national consistency for plumbers' accreditation.

In addition, since there are broad public benefits associated with coordinating research efforts, there should be continued

- support for public investment in conservation and reuse research and development;
- support for streamlined and formalised networking among researchers, policy makers and regulators; and, most importantly,
- support for communicating cutting edge information among policy makers, regulators, researchers, industry stakeholders and communities.

BIBLIOGRAPHY

AATSE 2004, *Water Recycling in Australia*. <http://www.atse.org.au/publications/reports/waterrecycle1.htmAWA 2001>

Ashbolt NJ, Grabow W, Snozzi M 2001, "Indicators of Microbial Water Quality". *Water Quality: Guidelines, Standards and Health*. IWA Publishing London UK

AWA 2001, *AWA Water News*, http://www.awa.asn.au/news&info/news/11mar01.asp

Connor J and Hatton MacDonald D 2002. *Incentives, Policies and Voluntary Approaches to Natural Resource Management in the Onkaparinga Catchment.* Consultancy Report 3 for the Onkaparinga Catchment Water Management Board. CSIRO Land and Water.

Cox S, Hamlyn-Harris D 2003, 'Pimpama Coomera Water Futures: Pushing the Boundaries', 2nd National Conference, Water Recycling Australia, Conference Proceedings Sept 1-3, 2003

Commonwealth of Australia, Department of Agriculture, Fisheries and Forestry (2004) 'New National Stormwater and Effluent Guidelines' 2001, accessed 28 March 2004, <http://www.affa.gov.au/ministers/truss/releases/01/01190wtj.html>.

Commonwealth of Australia 2000, *Guidelines for Sewerage Systems: Reclaimed Water*,

Department for Water Resources 2001, *Aquifer Storage and Recovery: Future Directions for South Australia*, CSIRO Land and Water & Department for Water Resources.

Department of Human Services & Environment Protection Agency 1999, *South Australia Reclaimed Water Guidelines*, Environment Protection Agency & Environmental Health Service, Adelaide.

de Rooy E and Engelbrecht E 2003, *Experience with Residential Water Recycling at Rouse Hill*, 2nd National Conference, Water Recycling Australia, Conference Proceedings Sept 1-3, 2003

Environment Protection Authority SA 2003, *Environment Protection (Water Quality) Policy 2003 and Explanatory Report*, (J Bridgland, ed.), Environment Protection Authority, Adelaide.

Environment Protection Authority Victoria 2003, *Guidelines for Environmental Management: Use of Reclaimed Water*, Environment Protection Authority, Victoria.

Environment Protection Authority Queensland 2003, *A Review of Water Quality Criteria in Australia Reclaimed Water Guidelines and Sewage Effluent Discharge Licenses*, (Higgins, J, Warnken, J & Teasdale, P, producers), Environment Protection Agency, Queensland.

Environment Protection Authority SA 2004, *Code of Practice for Aquifer Storage and Recovery*, EPA South Australia.

EPA Victoria 2002, *Guidelines for Environmental Management: Disinfection of Treated Wastewater*, EPA Victoria, Victoria.

EPA Victoria 2004, *Greywater Reuse: The Dos and Don'ts of Greywater Reuse* <http://www.epa.vic.gov.au/Water/Programs/reuse.asp>

Fisher D 2000, *Water Law*. LBC Information Services, Sydney, NSW.

Godden L 2003, *Perception of Water in Australian Law: Re-examining Rights and Responsibilities*, <http://www.atse.org.au/publications/symposia/proc-2003.htm>.

Hatton MacDonald D 2004, *The Economics of Water: Taking Full Account of First Use, Reuse and Return to the Environment.* Client Report, CSIRO Land and Water.

Haas C 2002, "Progress and Data Gaps in Quantitative Microbial Risk Assessment". *Water Science & Technology* 46: 277-284.

Kaufmann B 2003, "The organization of economic activity: insights from the institutional theory of John R. Commons". *Journal of Economic Behavior & Organization* 52: 71-96.

Kennedy R 2004. Manual on Supplier / Purchaser Agreements Reclaimed Water. Report for the Australian Water Conservation Reuse Research Program.

Marks J 2004, 'A Sociological Analysis of the Sustainable Management of Decentralised Water Reuse' in *IWA 6th Specialist Conference on Small Water and Wastewater Systems*, International Water Association and Australian Water Association.

Mitakakis T, Sinclair MI, Leder K 2004, 'Alternative Water Sources and Reuse: What are the Public Health Issues?', *The Medical Journal of Australia* 180: 260-261 <http://www.mja.com.au/public/issues/180_06_150304/mit10731_fm.html>

Mitchell, GM 2003, *Integrated Urban Water Management: A Review of Current Australian Practice*, Client Report, CSIRO Land and Water.

NSW Health 2002, *Environmental Health Fact Sheet Greywater Re-use During the Drought.*

NSW Recycled Water Coordination Committee 1993, *NSW Guidelines for Urban and Residential Use of Reclaimed Water.*

Po M, Kaercher JD, Nancarrow BE 2003, *Literature Review of Factors Influencing Public Perceptions of Water Reuse*, Client Report, CSIRO Land and Water.

South East Water 2004, *Household Greywater Reuse Guidelines*, viewed 28 March 2004, <http://www.sewl.com.au/sewl/index.asp?link_id=30.375>.

Sydney Water 2003, *Water Conservation & Recycling Implementation Report 2002-2003*.

Syme, G 2002, *Balancing Community Values, Needs and Water-use*. Western Australia's Water Symposium, Conference Proceedings, October 1-7, 2002.

Workman G, Herbert R, Tink G 2003, *Overview of Plumbing Legislation Reform Needed for Urban Water Recycling,* 2nd National Conference, Water Recycling Australia, Conference Proceedings Sept 1-3, 2003.

Yarra Water 2004, Greywater. accessed March 31, 2004 <http://www.yww.com.au//savingwater/inthegarden/greywater.html>.

Young, M 2002, Imagine if we valued ecosystems if they mattered - towards opportunity and prosperity, *Australian Edition*, Monday March 25, 2002.

P:\PERU\Water Pricing\AWCRRP\Institutional Impediments 15 Client Cover Report.doc