Decentralised Wastewater Treatment and Recycling Systems (DeWaTARS) in WA Urban Villages: Development of a Legislative Framework

Honours Thesis
A Premier's Water Foundation Scholarship Project

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2005
Revised March 2006

Declaration

This thesis is presented to fulfil the requirements of a Bachelor of Science (Environmental Science) with Honours.

I, Bethwynne Margaret Strang, declare that the information contained in this thesis is the result of my own research unless otherwise cited.

B M Strang
07 November 2005

Abstract

In Perth, like many cities around the globe, there is a shortage of potable water. There are many reasons for this shortage; an increasing population (2 million by 2021); decreasing rainfall; aging infrastructure of existing supply systems; as well as the persistence of inefficient water use.

By incorporating into the existing centralised system, decentralised treatment units, wastewater can be introduced into new markets as a source of water supply for non-potable use. Implementing a new water market will be difficult and there will be pricing, technological and legislative challenges that need to be addressed.

To ensure that water recycling systems can be incorporated into new urban development, current State legislative frameworks will need to be reviewed so that the uptake of water recycling technologies can be. These technologies need to be economically viable and sustainable.

This research develops a new concept for wastewater treatment and reuse in WA and a legislative framework, in which, the concept will operate. A new regulatory tool will be required to implement the concept into WA, taking into account health, environmental and other regulatory concerns. A possible version of that tool has been developed in this thesis.

Papers Arising from this Study

Decentralised Wastewater Treatment and Recycling Systems (DeWaTARS) in WA Urban Villages: Development of a Legislative Framework abstract accepted for the 7th IWA Specialised Conference on Small Water and Wastewater Systems, Merida Mexico, 2006.

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Abbreviations

AWWS	Alternative Waste Water Systems
ATU	Aerobic Treatment Unit
BLV	Bridgewater Lifestyle Village
CoAG	Council of Australian Governments
CoP	Code of Practice
DeSa/R	Decentralized Sanitation and Reuse
DeWaTARS	Decentralised Wastewater Treatment and Recycling Systems
DoE	Department of Environment
DoH	Department of Health
DPI	Department of Planning and Infrastructure
DPUD	Department of Urban Planning and Development
EcoSan	Ecological Sanitation
EDPH	Environmental Health Service of the Department of Health
EIP	Environmental Improvement Plans
EPA	Environmental Protection Authority or
EPA	Environmental Protection Act
ERA	Economic Regulation Authority
HACCP	Hazard Analysis and Critical Control Points
IUWM	Integrated Urban Water Management
KIT	Key Informant Technique
LGA	Local Government Authorities
LWMP	Local Water Management Plan
LWMS	Local Water Management Strategies
MBR	Moving Bed (Biofilm) Reactor
NCS	Network City Strategy
NIMP	Nutrient and Irrigation Management Plan
NWI	National Water Initiative
NWQMSG	National Water Quality Management Strategy Guidelines
OWR	Office of Water Regulation
RIWI	Rights in Water and Irrigation Act 1914
SBR	Standard Biofilm Reactor
SPP	Statement of Planning Policy
STA	Strata Titles Act 1985
SWS	State Water Strategy
SWQMS	State Water Quality Management Strategy for Western Australia
TPaD(S)R	Town Planning and Development (Sub-Division) Regulations 2000
TPDA	Town Planning and Development Act 1928
UWMP	Urban Water Management Plan
WA	Western Australia
WAPC	West Australian Planning Commission
WRCA	Water and Rivers Commission Act
WSP	Water Smart Australia Program
WSUD	Water Sensitive Urban Design

Acknowledgements

I would like to thank my supervisors Dr Martin Anda and Dr Kuruvilla Mathew for their support of my research. The Western Australian State Government and the Premier's Water Foundation have been central to providing my research with a focus and I am grateful for their financial support. I would also like to thank National Lifestyle Villages Pty Ltd for providing project support in the form of a Scholarship, unlimited access to the Bridgewater Lifestyle Village in Mandurah. The staff at NLV have been invaluable to the development of this project. I would also like to thank all the interviewees and stakeholders who gave freely of their time and always showed strong support for my research. Kat Taylor, Mark Langdon, Stewart Dallas and Nicolai Bonne, reading about legislative challenges isn't everyone's cup of tea; your comments were appreciated and I'm grateful for your assistance. Thankyou Jack Strang, Julia Wee-Whistle and Peter Stuart; the three that know my work and me best! Lastly, my gratitude to my colleagues at the Environmental Technology Centre and the School of Environmental Science who have supported me through the trials of completing this Honours year.

Chapter 1 Introduction

1.0 Introduction

Climate change, urbanisation and increasing demands on resources are placing pressure on traditional forms of water management. Traditional centralised, "big pipes in, big pipes out", wastewater systems have come under pressure to meet new objectives in cities adopting an evolving sustainability agenda (Newman, 1993). The new agenda encourages cities to look at how they supply water when traditional measures, such as building dams, are no longer viable or sustainable options (SWS, 2002). These pressures are encouraging cities to develop alternative wastewater systems (AWWS), with a paradigm shift towards decentralised AWWS occurring (Dillon *et al*., 2004).

Legislative and regulatory frameworks for wastewater management have a huge impact on the implementation of decentralised AWWS. In Western Australia (WA), the current frameworks discourage the deployment of decentralised AWWS. Creating a legislative climate that supports and encourages the implementation of decentralised AWWS can develop new water supply markets.

1.1 Need for study

Global climate changes, unsustainable water demand practices and urbanisation are all placing pressure on Perth's aging centralised wastewater system, while environmental considerations inhibit expansion (Radcliffe, 2004). In order to meet existing and future water supply demands, new supply options for Perth need to be researched and developed (SWS, 2002).

The emergence of reliable, economical and socially accepted decentralised AWWS, overseas and interstate, has led to the creation of new water markets, supplying recycled water for non-potable uses. Local research is needed to ensure that legislative frameworks and regulatory tools properly instruct and guide the development of new water market opportunities in WA (PWF, 2005).

1.2 Objective

The aim of this research is to address the challenges related to the implementation of AWWS in WA urban developments. To aid in the beneficial development of AWWS, the research objectives are:

- To understand the barriers to recycling wastewater in WA;
- To understand the management requirements needed for successful implementation and operation of AWWS;
- To identify a framework to guide regulatory authorities and land developers implementing AWWS in WA; and
- Develop recommendations for implementing AWWS in WA.

1.3 Research Questions

This research used an exploratory method, including key informant techniques, within a qualitative framework to answer the following research questions:

- Can a decentralised AWWS concept be developed that is applicable to the WA housing environment?
- What is an appropriate legislative framework for AWWS implementation in WA urban developments?
- What is the required regulatory tool for AWWS implementation in WA urban developments?
- What are the management requirements for effective AWWS implementation in WA urban development?

1.4 Context

Before legislation can be enacted, policies need to be formulated. By proposing a policy context, legislation can be enacted that meets the government's objectives. In this case the proposed legislative changes outlined are prepared with the following policy context in mind:

- Wastewater reuse is utilised efficiently and effectively;
- Water conservation remains a priority;
- Continuation of the Waterwise Rebate Scheme;
- Continuation of funding to the Premiers Water Foundation; and
- Increasing the use of recycled wastewater above the 20% mandate set within the State Water Strategy by 2020.

1.5 Thesis outline

The thesis reviews the current legislative and regulatory challenges impeding the implementation of decentralised AWWS in WA. It also develops a new model for implementing AWWS in urban villages.

Chapter 2 presents a broad review of current and contemporary literature on why recycling wastewater systems are needed and the challenges facing their implementation into urban developments in Western Australia. The methodology adopted is outlined in Chapter 3. A new AWWS concept is developed in Chapter 4. The proposed new legislative framework is explained in Chapter 5. The development of a new regulatory tool is stated in Chapter 6. The recommendations from this research are listed in Chapter 7. The conclusions are presented in Chapter 8, followed by the references. A series of relevant Appendices is also included.

Chapter 2: Literature Review

2.0 Introduction

This chapter outlines factors affecting the supply of potable water in cities; the benefits of recycling wastewater; the shift away from traditional centralised wastewater system approaches; the benefits of decentralised systems; and challenges to their implementation. To complete the chapter, a review of WA wastewater governing bodies and the federal and state legislative challenges are examined.

2.1 Why recycling systems are needed

Around the world there is a movement for cities to be more sustainable[1] and to encourage sustainable practices. Along with this push, some cities are facing shortages in the supply of potable[2] water due to various factors including climate change, water demand issues and urbanisation pressures (Newman, 1993, Dillon *et al*., 2004).

Added to a shortage of potable water is the increasing need to consider environmental requirements (WRC, 2004; Gardner and Chung, 2005). The recognition of the effects of current water management practices on the environment, in particular the effect on wetland and river dependent organisms in WA, has seen the environment become an important consideration when determining future water supply options, thereby placing pressure on traditional water supply practices. Over the past twelve months,

[1] There are various definitions of sustainability for example, the World Commission on Environment and Development described it as "meeting the needs of the present without compromising the ability of future generations to meet their own needs". As this is a very broad interpretation of sustainability the concept of 'Triple Bottom Line' i.e. social, economic and environmental equity is the author's preferred rationale.

[2] Potable is another term used for water that is fit to drink.

there have been a number of sewage overflows into the Swan-Canning river system (Dortch *et al.,* 2005) and, in May 2005, traffic in Perth descended into chaos when a burst water main caused the shut down of the Kwinana Freeway[3]. Incidences such as these are becoming commonplace demonstrating a need for major maintenance and/or system upgrades. In light of these factors the adoption of AWWS is growing in popularity.

Overseas, there has been an increase in the implementation of AWWS. For example in Germany, the concept of decentralized sanitation and reuse (DeSa/R) is being promoted. This concept involves the separation and treatment of different wastewater streams for optimal reuse (Huber, 2004). There will be many challenges implementing AWWS in WA; however these challenges can be addressed. As the following background review of the state of water recycling in Perth will show: Recycling wastewater in urban areas is no longer a luxury; it is a necessity for the sustainability of Perth's water supply and for the benefit of future generations.

2.1.1 Climate change

Global weather patterns are shifting and the effects of global warming are yet to be determined. International model-based predictions indicate lower rainfall events worldwide (Hochstrat *et al*., 2005; Lockyer, 2005). The Indian Ocean Climate Initiative has shown that winter rainfall in the southwest of WA has decreased significantly since the mid 1970s (IOCI, 2002).

Since severe droughts in the 1980s, Perth has experienced repeated episodes of below average rainfall frequency and intensity; this has seen potable water resources stretched (IOCI, 2002). For example, in 2001 there was an 18% decrease in rainfall going into water catchment dams, compared to the average rainfall figures for the previous 25 years; which included drought conditions in some years (Anon, 2004).

Decreasing rainfall places pressure on groundwater extraction levels as water is drawn to replace the lower dam levels in the water catchment areas. Wastewater recycling is one option available to help secure potable water supplies in times of drought (Dixon *et al*., 1999; Okun, 2002). In Perth new water supply options are few. AWWS can provide water for non-potable uses, such as toilet flushing and garden irrigation; this reduces demand for potable water and relieves the need to expand the existing centralised infrastructure.

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[3] The Kwinana freeway is the main southern arterial road that heads leads in and out of the city of Perth; and connects with the main northern arterial road, the Mitchell freeway. The freeway follows the Swan-Canning river system leading into the Mitchell freeway north connection.

2.1.2 Water Demand

"…Our water use has been so wasteful that in many respects the problem is not one of water shortage, but of wasteful, unsustainable and environmentally irresponsible management of water…" (COA, 2004 p86).

Everybody needs water, we drink it, wash our clothes, bathe ourselves, and water can be manipulated to generate electricity and flush away our waste. Water helps drive all forms of industry and farming, and globally, cities are facing water demands that outstrip their ability to supply (Anderson, 2005). The natural environment also needs water allocations. The environmental flows required to protect surface and groundwater systems, and their dependent ecosystems, need to be balanced with the needs of our own (WRC, 2004; Gardner and Chung, 2005).

The Australian water economy, like many developed countries, has been hampered in the ability to increase the volume of water supply by economic and environmental factors, such as catchment volume variability and capped catchment and aquifer withdrawal levels[4], yet there has been no diminishing demand for water; in most cases demand has been increasing. In cities like Perth, cultural desires to have lush lawns and gardens can equate to 50% of total household water use (Mouritz and Hedgecock, 1992; Loh and Coghlan, 2003; Anda and Ho, 2004; Radcliffe, 2004). Further, as a community, Perth will discharge more stormwater and treated sewage into ocean outfalls than is collected within the Perth catchment areas (Bjornlund and McKay, 2001; Bixio *et al.*, 2005; Cunliffe *et al.*, 2005; Dillon and Ellis, 2004).

Demand management is an ongoing challenge for cities. In WA many strategies have been implemented to encourage better water demand practices. These strategies vary from economic incentives, such as the waterwise rebate for water efficient appliances, education for best practices for watering gardens and the implementation of water restrictions.

Demand management initiatives will be a necessary planning requirement for federal, state and local governments. New urban developments where a managed AWWS is in place can participate in management driven demand initiatives in various ways. The management arrangement of the development, and therefore the system, will influence the level of involvement. For example, the Bridgewater Lifestyle Village (BLV), Erskine WA, provide extensive ongoing education and support for their

[4] Public environmental concerns can restrict the development of further dams for example, the public outcry to the Frankland River dam in Tasmania saw Federal intervention, whilst aquifer limits are set to preserve the aquifers integrity as well as allowances for the thousands of home owners in Perth that have unrestricted bores.

residents. Village managers live on-site, operating and maintaining the greywater systems and providing support; this arrangement leads to a high interaction between the management of the AWWS (in this instance greywater reuse on gardens) and the residents (NLV, 2005).

2.1.3 Urbanisation

Across the world, cities are dealing with the phenomena of urbanisation, i.e. the pattern of high-density living incorporating recreation, work and shopping areas within an integrated transport system. Led by rapid economic growth, increasing population concentration is placing huge demands on cities' water supply systems and it is essential to develop new water resources (Miller, 2005; Anon, 2005) even in high rainfall countries such as Japan and England (Tillman *et al*., 1999; Dixon *et al*., 1999; Ogoshi *et al*., 2000; Janosova *et al*. 2005).

Population migration toward cities has been increasing since the 1950s when estimates placed 30% of the world's population in cities. During the 1980s estimates had 40% living in cities and it is thought that within 20 years, more than 60% of the world's population will be living in cities (Jackson and Ord, 2000; Jennings, 2003). The majority of Australians live in cities located along the coastline. With rapidly increasing populations within these areas, there has been a trend towards high density, residential urban centres (Apostolidis, 2004; Apostolidis and Hutton, 2005).

Currently, Perth is a low density, automobile dependent city with large areas of urban sprawl served by a centralised wastewater system. It is estimated that by 2051 the population of Perth will reach 3.2 million people (ABS, 2005). In response, the Department for Planning and Urban Development has devised a strategy for the Perth and Peel regions, known as "Network City". The new strategy aims to transform Perth from a sprawling urban centre into an integrated transit-oriented series of urban villages, connected by "activity corridors" that allow for the movement of people and freight (WAPC, 2005). It offers Perth an opportunity to participate in community scale AWWS. Community scale systems offer new supply options previously unavailable in urban environments (Anda *et al*., 1997; Chanan and Woods, 2005).

The urbanisation of Perth has seen the service industry become a major economic driver. This industry generates employment, which leads to increasing the average household income. An increase in household income can lead to new water market opportunities, as AWWS become affordable for households looking for sustainable wastewater options. The higher disposable incomes have led to a higher standard of living expectation by residents in Perth's urban and peri-urban[5] areas (WAPC, 2003).

[5] Peri-urban refers to the fringe where dense urban areas meets suburban sprawl.

The community can play a significant role in determining priorities and risk acceptability. It is important to engage with community stakeholders and actively seek their involvement in developing AWWS (Hartley, 2005; Hurlimann and McKay, 2005).

2.2 The Benefits of Recycling Water

There are many benefits to recycling water. Recycling water provides an alternative supply of water, where potable water is not necessary, such as public open space irrigation and car washing (McKay and Hurlimann, 2003). Alternative sources of water reduce demand on potable water supplies, thereby reducing the need to expand existing infrastructure (Hermanowicz and Asano, 1999; McKay and Hurlimann, 2003). In some cases recycling of wastewater represents the only opportunity (apart from desalination) of adding a substantial, and sustainable water yield (COA, 2004).

Recycling reduces the amount of wastewater disposed of into the environment via ocean outflows; it can also be returned to the environment to enhance environmental flows. By not pumping water to ocean outflows there is also a net saving of water; as water is not required to flush waste long distances; this also reduces energy consumption (Hermanowicz and Asano, 1999; Hurlimann and McKay, 2005).

2.3 A Paradigm Shift for the Urban Water Industry

"…*Sanitation systems are one of the most important supply systems in a society and is decisive for hygiene and health, the latter being particularly critical for a city.*…" (Hedberg, 1999 p9).

Traditional approaches to water services have come into question. The increasing sustainability agenda; pressure to reduce greenhouse gases; the ability to expand aging infrastructure; and increasing demand patterns, are challenging traditional centralised water services. There is a new paradigm emerging. This new approach incorporates demand management alongside supply management (Pinkham, 1999; Livingston *et al*., 2004; Mitchell, 2004). This paradigm incorporates AWWS, such as the previously mentioned German approach, DeSa/R and the Swedish approach of Ecological Sanitation (EcoSan), which builds on a link between people and the resource (Winbald and Simpson-Hebert, 2004).

A comparison between the old and emerging paradigm can be found in Table 1. This table shows that there is a move towards closing the water loop and recognising the value in the various streams of wastewater. The shift away from centralised systems allows for solutions to wastewater treatment and recycling in diverse locations, that can be built to meet local needs, be cost effective and reduces the need to build bigger, more expensive treatment plants (Bischof *et al*., 1996). A major concern of these emerging systems is the ongoing operation and management. To ensure best practices and reduce risk factors, the emerging systems will need to have an

integrated and well co-ordinated management system in place, as is the current practice with the centralised system. Such a management system will address health, public safety and environmental concerns.

Currently, Perth's wastewater is disposed of via centralised sewerage systems that discharges into ocean outfalls, sometimes described as "big pipes in, big pipes out" (Newman, 1993). With the expected increase in population, projections indicate that by 2005-2007 new water sources will be required (Khan *et al.*, 2004). It is now 2005 so AWWS do need to be developed[6].

[6] The West Australian Government has recently approved a desalination plant to be constructed in the Kwinana Industrial Area, which is a key water market target. Although support for the controversial 'Kimberley Canal' proposal was seen as the political undoing of the Liberal Party at recent State Elections, a 'Feasibility Study' is still being undertaken to review the proposal.

Table 1 Characteristics of the New emerging paradigm compared to the old paradigm in urban water systems. Source: Pinkham (1999).

The Old Paradigm	The Emerging Paradigm
Human waste is a nuisance. It is to be disposed of after the minimum required treatment to reduce its harmful properties.	*Human waste* is a resource. It should be captured and processed effectively, and put to use nourishing land and crops.
Stormwater is a nuisance. Convey stormwater away from urban areas as rapidly as possible.	*Stormwater* is a resource. Harvest stormwater as a water supply, and infiltrate or retain it to support suburban aquifers, waterways, and vegetation.
Build to demand. It is necessary to build more capacity as demand increases.	*Manage demand*. Demand management opportunities are real and increasing. Take advantage of all cost-effective options before increasing infrastructure capacity.
Demand is a matter of quantity. The amount of water required or produced by water end-users is the only end-use parameter relevant to infrastructure choices. Treat all supply-side water to potable standards, and collect all wastewater for treatment in one system.	*Demand is multi-faceted*. Infrastructure choices should match the varying characteristics of water required or produced by different end-users: quantity, quality (biological, chemical, physical), level of reliability, etc.
One use (throughput). Water follows a one-way path from supply, to a single use, to treatment and disposal to the environment.	*Reuse and reclamation*. Water can be used multiple times, by cascading it from higher to lower-quality needs (e.g. using household greywater for irrigation), and by reclamation treatment for return to the supply side of the infrastructure.
Gray infrastructure. The only things we call infrastructure are made of concrete, metal and plastic.	*Green infrastructure*. Besides pipes and treatment plants, infrastructure includes the natural capacities of soil and vegetation to absorb and treat water.
Bigger/centralized is better. Larger systems, especially treatment plants, attain economies of scale.	*Small/decentralized is possible, often desirable*. Small-scale systems are effective and can be economic, especially when diseconomies of scale in conventional distribution/collection networks are considered.
Limit complexity: employ standard solutions. A small number of technologies, well known by urban water professionals, define the range of responsible infrastructure choices.	*Allow diverse solutions*. A multiplicity of site-based solutions is required in increasingly complex and resource-limited urban environments, and enabled by new management technologies and strategies.
Integration by accident. Water supply, stormwater, and wastewater systems may be managed by the same agency as a matter of local historic happenstance. Physically, however, the systems should be separated.	*Physical and institutional integration by design*. Important linkages can and should be made between physical infrastructures for water supply, stormwater, and wastewater management. Realizing the benefits of integration requires highly coordinated management.
Collaboration = public relations. Approach other agencies and the public when approval of pre-chosen solutions is required.	*Collaboration = engagement*. Enlist other agencies and the public in the search for effective, multibenefit solutions.

2.3.1 Decentralised or Centralised Wastewater Systems?

Centralised systems have been the norm in water supply and wastewater removal. Centralised sewerage infrastructure is capital intensive and once built, creates a lock-

in effect by binding capital for long periods of time. This makes strategy or management changes difficult to implement and discourages innovation (Tillman *et al*., 1999). Cities now face large infrastructure costs as these systems age and fail. Cities have to look towards alternative options such as decentralisation (Douglas, 1998).

A comparison between centralised and decentralised systems is shown in Table 2. From this table we can see that decentralised systems offer competitive operating and management costs, better source contamination control, better environmental outcomes however this emerging paradigm faces legislative challenges.

Table 2 Comparison of benefits and shortcomings between centralised and decentralised wastewater systems (Adapted from Anda and Ho, 2004; with additional references Douglas 1998; Mattila, 2003; Livingston et al., 2004, Otterpohl et al., 2005)

Centralised	Decentralised
Ownership. The water service provider controls ownership of unit: designing, constructing, operating or maintaining systems are considered too complicated to be in the control of homeowners. Not much flexibility in delivery and disposal options.	*Ownership.* Ownership and management are options available to the homeowner. Units can be altered to be site specific to allow for environmental factors and can be effective solutions for ecologically sensitive areas. For example, in the USA town of Jericho, 95% of homeowners rely on individual on-site sewage systems to help protect groundwater and surface water quality.
Cost. Initial cost average Aus$ 5,000 to 10,000 per property, with the majority (up to 80%) of the cost is in the set up of pipes and pumps. $/unit decreases as number of units increases economies of scale. $/unit would increase if deep sewage with pumping over long distances was needed.	*Cost.* Initial cost average Aus$ 5,000 to 10,000 per system. (Mainly in the treatment unit and reuse or disposal land area). $/unit decreases as number of units increases economies of scale.
Operation & maintenance costs. Aus$ 500 to 1,000 /property/ year (costs in operation and maintenance of the sewerage system).	*Operation & maintenance costs.* Aus$ 500 to 1,000 /property/year by a service provider (costs in operation and maintenance of treatment unit and reuse or disposal land area costs).
Nutrients. Safe disposal of treated wastewater is primary objective. This may leave nutrients within the wastewater that can cause problems for the receiving water bodies; further treatment is increasingly being required. To reuse this treated water additional plumbing at additional cost will be necessary.	*Nutrients.* Onsite reuse of treated wastewater is generally the objective of onsite systems with nutrients being recycled back onto land. The opportunity to reuse the sludge residue on-site via additional processes such as vermi-composting is possible, with the end product becoming a useful garden fertiliser.
Source. The wastewater comes from various origins, including industry, which contains various contaminants that increase the costs of treatment and disposal.	*Source.* Communities have a certain amount of control over the inputs into the systems and contamination by toxic substances can be limited, whilst wastewater reuse onsite can further reduce costs.
Stormwater can cause sewerage overflow, this may cause health or environmental harm.	*Stormwater* management incorporated into a system can recharge local groundwater supplies, reducing the risk of environmental harm.
Standard System. This is the standard type of wastewater system and there are clear policies and regulatory framework, responsible for its management.	*Alternative Systems.* Alternative wastewater options do not have clearly defined policies. In the past decentralised has meant individual septic tanks with local government being responsible for approvals and landowners being responsible for management, sometimes with detrimental environmental impacts. The evolution of alternative wastewater technologies has highlighted the need for clear policies and regulatory frameworks. In Finland, the rapid development of decentralised systems caused confusion amongst authorities, manufacturers and homeowners, in an emerging industry it is important to get the governance in place to guide future developments.

With technological advances in decentralised systems, unit prices are becoming more competitive, as well as environmentally beneficial, and are quickly becoming a valid

option for urban development. This will create new water service industries including new types of companies, co-operatives and entrepreneurs producing wastewater services (Mattila, 2003).

The USA Environmental Protection Authority found individual homeowners with a centrally managed and operated AWWS meet public health and environmental concerns "*...over the long-term and do so at a lower cost than conventional systems...*" (USEPA, 2000 p18).

The USA model is based on remote monitoring by centralised management professionals. This takes the management of the decentralised systems out of the householder and into the professional domain; where suitable performance standards can be monitored and maintained (West, 2000). In Finland, "*…homeowners themselves cannot assume responsibility for designing, constructing, operating and maintaining the treatment units. In many cases even the septic tanks have proven too difficult for them to take care of, not to speak of more complicated systems…*" (Mattila, 2003 p1). In Sweden it is important to have "*…regular monitoring, professional support for service, maintenance and technical support…*" as well as "*…service agreements necessary for the whole lifetime of the system…*" (Anon, 2003 p1).

West (2000) outlines system elements, which are adapted from the USA example:

1. Household watertight interceptor tank (anaerobic or aerobic) with effluent filter;

2. Watertight small diameter PVC or polyethylene pipes with heated welded joints;

3. On-going education of householders, regulators, real estate agents and other stakeholders;

4. Remote monitoring; and

5. Professional training for on-site service people.

In WA, AWWS is practiced at the scale of single units (such as Septic Tanks) at the single household level. On-site systems are not always feasible for urban developments. An AWWS could also be a local treatment plant delivering non-potable water to households via a third pipe system (Gray, 2003). Third pipe delivery projects have been developed in new urban areas of Rouse Hill, NSW; Aurora, Vic;

and Mawson Lakes, SA. All these projects employ management operating systems similar to the USA model. The similarities in climates and standards of living between Australia and the USA allow the USA model to provide a starting point, from which, a local AWWS concept can be formulated. The following model for best practice in sewerage service has been promoted to Sydney Water:

1. Wastewater source control;
2. Watertight collection units;
3. Watertight reticulation;
4. Advanced onsite treatment systems reconfigured to service a cluster/village/town;
5. Ultra-violet disinfection;
6. Effluent recycling and reuse; and
7. Centralised management facilitated by remote monitoring.

This model for best practice for the deployment of small-scale AWWS needs to be supported through a series of manual/technical sheets and management guidelines and is an appropriate model to be used in Australia (West, 2000).

2.4 Challenges to Wastewater Recycling

*"…The main barriers to reuse of water in Australia are issues of public confidence, health, the environment, reliable treatment, storage, economics, the lack of relevant regulation, poor integration in water resource management and the lack of awareness…" (*Dimitriadis, 2005 p10).

There are many challenges facing the implementation of AWWS in new WA urban developments. The following section will look at some of the pricing challenges including the need for the creation of a fair pricing policy; technological challenges follow.

2.4.1 Pricing

Water is sometimes seen as a "free" resource. Often the end user pays for the cost of service delivery only and not the associated costs such as infrastructure, storage and disposal (Thwaites, 2003). Therefore, pricing of water doesn't reflect the scarcity of the resource or the environmental impacts of the water supply systems.

In countries overseas, where demand for drinking water in urban areas has increased the cost of supply, recycled water has become a viable, cost effective alternative for activities not requiring potable water. In Fukuoka, a densely populated Japanese city for example, the cost of drinking water is $3.73/kL, whilst recycled water used for toilet flushing is only $2.99/kL, thereby providing the community with a direct economic benefit (Ogoshi *et al*., 2000). In Luxemburg there is a proposal to implement a Water Framework Directive which if successful will lead to a doubling of water prices in that city (Anon, 2005b).

In Australia, external costs in water supply such as catchment management and environmental protection measures are generally not included in pricing systems. Consequently average cost of water is less than $1/kL (Khan *et al*., 2004). In the Rouse Hill Development, NSW, the cost of producing recycled water is approximately $3-$4/kL whilst the selling price was $0.28c/kL; this was in order to be competitive with the $0.98c/kL conventional water supply costs; making recycling wastewater uneconomical (MacDonald and Dyack, 2004; Mitchell, 2004). Luckily for the residents of Rouse Hill, the decision to institute an AWWS was for environmental factors and not economical ones. The low price of recycled water led to an increase in demand, as residents took advantage of the lower priced water supply, and as a consequence is a prime case study on the difficulties of AWWS in relation to the current pricing structure.

This issue of pricing is quite a predicament for AWWS projects. An effective pricing policy is required to ensure that new water markets introduced are competitive (Braden and van Ierland, 1999; Banyard, 2005). A survey of Australians currently connected to recycling systems has shown that few people are willing to pay extra for recycled water (Marks *et al*., 2003).

In Perth, where groundwater is estimated to cost as little as 5c/kL to extract (Radcliffe, 2004), there will be strong opposition to any changes to the existing costing of potable water; especially in light of the fact that WA is the only state where homeowners can sink a bore, with minimum set up costs, and gain access to unlimited free water (MacDonald and Dyack, 2004). A fairer pricing system incorporating a whole of water cycle management approach could provide the economic incentive for developers to start incorporating AWWS (Khan *et al*., 2004).

In 2005 the WA Economic Regulation Authority held an inquiry into urban water and wastewater pricing, which looked into various aspects of pricing issues. The review

offered some changes, namely the restructuring of supply and disposal fees with an emphasis towards higher end users paying more, but on the whole has offered little in regards to water pricing reform that includes full-cost recovery mechanisms (ERA, 2005).

The cost of recycled water to the consumer is not the only pricing issue. Added costs to developers for initial infrastructure, treatment measures, the financial commitment to maintenance, monitoring schedules and cross connection checks (Anderson, 1996; Shelef and Azov, 1996) are costs that need to be considered when choosing which AWWS to implement.

Under the Australian National Water Initiative there are opportunities to receive government funding to assist with infrastructure costs, which is further discussed in Section 2.5.1. Charging an initial connection fee can also recoup some of the initial set up costs. In the USA and New Zealand centrally managed on-site AWWS are charged regular service fees, similar to fees paid by customers connected to the conventional system. This fee is roughly two thirds the fee customers connected to the conventional system pay; and covers all management, monitoring, servicing, repairs, spare parts and periodic pump-outs (West, 2000). For example, the USA sewerage service fees are:

- US$30-35/month connection fee for conventional sewerage service.
- US$20-30/month connection fee for decentralised sewerage service.

It is in the financial interest of the utility, or service provider, to ensure repairs are done quickly. A managed approach removes responsibility from the unskilled and untrained householder and places it into the operational hands of professionals. At Bridgewater Lifestyle Village, Erskine, Park Managers operate, monitor and maintain the 380-greywater systems, in the village, with the costs of this service being incorporated in weekly rental. (*Pers. Comm*., Trowbridge, 2005)

2.4.2 Technology

There are many technological challenges facing projects incorporating AWWS, listed below are some of these challenges:

1. AWWS are emerging technologies and there are few people in WA qualified to install, operate and maintain these systems and fewer AWWS maintenance services available (Dillon *et al*., 2005); In Finland the EPA states "…*Only a person involved in the sector daily knows always what is the newest and best technology for the property in question…*" (Mattila, 2003 p1);

2. Integration of new emerging technologies may not be possible into existing infrastructure systems (Dillon *et al*., 2005);

3. If recycled water is not used for in-house use, winter storage may become a problem. This will mean that creative solutions to storage problems will be required, some options include flexible bladder tanks and modular fencing with wall panes that store water (Dillon *et al*., 2005);

4. There are a large number of regulatory stakeholders combined with an excessive plumbing code (Dillon *et al*., 2005). The introduction of a new national plumbing code will reduce this challenge, as more plumbers are made aware of wastewater recycling conditions. The training of designers, manufacturers and installers, who previously had only worked with septic tanks or aerated wastewater treatment systems will need to be co-ordinated (West, 2000); and

5. The reliability of a recycling system in meeting environmental and public health concerns (Harremoes, 1998).

The greatest health concern associated with the recycling of wastewater is that it can contain pathogenic micro-organisms (Higgins *et al*., 2002; Khan *et al*., 2004). A major concern lies in the ability of technologies to remove such contaminants and their ability to ensure continuity of a contaminant free water supply.

A factor compounding this issue is the lack of knowledge in regards to the survival of viruses; their susceptibility to disinfectants in treatment processes; and at what concentration levels infection or disease outbreaks occur (Jackson and Ord, 2000). Analytical techniques are improving and increased rates in detection may only be a reflection of analytical capability[7], rather than increase in health risks due to significant increases in concentrations (Harremoes, 1998; Khan *et al*., 2004; Jackson and Ord, 2000).

To ensure that health and environmental concerns are addressed, technology must ensure:

[7] Analytical technique refers to the scientific technique used to detect viral or bacteria numbers in wastewater. The technology is so advanced that minute amounts can now be detected.

1. Technical solutions adequately consider costs - both set-up and on-going costs, to ensures that cost equity is maintained over the whole life of the system;

2. Appropriate technologies – technologies that have been tested and proven elsewhere in similar conditions, and are considered to be the best technologies for the given site conditions; and

3. Employ a risk management plan – the construction phase and implementation phase have differing risks attached and therefore will require separate risk management plans.

In Japan innovative technologies have facilitated wastewater reclamation and reuse for non-potable urban applications such as toilet flushing and in-stream flow augmentation (Ogoshi *et al*., 2000). In Australia new recycling technologies are being implemented to help reduce demand for potable water in our urban regions. An example of this can be seen in the suburb of Aurora, Victoria, where third pipe technologies deliver treated wastewater to the residents for use in toilet flushing, garden watering, car washing, fire services and the watering of public open space (McLean, 2005).

In Australia AWWS have commonly been used in response to environmental health issues (Elledge, 2003; Coulthurst *et al*., 2005). For example, the AWWS implemented at Rouse Hill, NSW, was to stop nutrients flowing into the Hawkesbury-Nepean River (Law, 1996). The large economic investment required to implement wastewater reuse technologies has been seen as too high a cost for implementation. There is a need to incorporate resource conservation, such as wastewater reuse, and to do so sustainably (Chanan and Woods, 2005). This means that new technology will need to be creative in meeting health and environmental issues, whilst attaining economic viability.

2.5 Legislation

In WA, wastewater policy and implementation is administered across several government departments and agencies. To help understand the role that each plays in wastewater governance[8], it is important to understand key federal and state Acts, Guidelines and Policies; as these will affect how governing authorities approve new developments choosing to adopt AWWS.

[8] Governance means the method of management (Macquarie, 1998).

2.5.1 Australian Federal Government

Given the limited powers granted by the Australian Constitution to the Federal Government,[9] it is hard to imagine how the Federal Government could influence water resources yet, through constitutional external powers[10] and funding incentives, water resource issues can be influenced by many Federal Policies and Guidelines. The last decade has seen a series of Federal Policies on water management and wastewater recycling. Table 3 illustrates the acceleration of national water reform (Radcliffe, 2005).

The Council of Australian Governments (CoAG) water reform is a significant framework with a variety of provisions, over a range of water issues including, institutional reform; community education and water pricing; all challenges previously highlighted as impediments to the implementation of AWWS in new urban developments.

Table 3 Australia's Water Resources: recent policy perspectives. Principal federal legislations that have led to an impact on the production and use of recycled water (adapted from Radcliffe, 2004b).

Year	Policy
1991	Ecological Sustainable Development
1994	CoAG Water Reform
1996	1st State of Environment Report
1999	Environmental protection and biodiversity conservation Act
1996-2000	National Water Quality Management Strategy Guidelines
2000	Australian and New Zealand Guidelines for fresh and marine water quality
2000	Australian guidelines for water quality monitoring and reporting
2002	National Land and Water Resources Audit
2003	Senate – Australia's Management of Urban Water
2003/4	National Water Initiative
2004	National Water Commission Bill

[9] The individual States deal with resource management in all areas including health, transportation, as well as water resource management, while the Federal government role is to disburse tax revenue and government earnings on an equitable basis across the states and to deal with 'issues of nationhood'.

[10] International Treaties signed by the Federal Government are to be adhered to by the States and Territories. The "*Convention on Wetlands of International Importance especially as a Waterfowl Habitat (Ramsar Convention) 1971*" is one that often comes into conflict with developments on or near the various protected wetlands, located on the Swan Coastal Plain.

The initiative for the CoAG water reform arose through issues over "…*seemingly intractable legal and attitudinal differences*…" (CoAG, 2005 p1) between states sharing water resources (Banyard, 2005), with a particular focus on the Murray Darling basin. WA has not signed this bilateral agreement with the Commonwealth. In place of the CoAG agreement, the series of National Water Quality Management Strategy Guidelines (NWQMS) have been influential in regards to WA water recycling legislation (McRae *et al*., 2001). Of particular interest for AWWS is the Guideline for Sewerage Systems: use of reclaimed water (NWQMS, 2000). The NWQMS were agreed to at a Ministerial level, which obligates states to adopt the approaches outlined (MacDonald and Dyack, 2004).

The Guidelines respond to identified limitations within current practices and provides a framework that addresses specific issues designed to provide guidance to State governments, where regulatory power lies, and to promote best practice throughout the water industry (McRae *et al.,* 2001). Although these guidelines are designed to guide municipal wastewater plants, the guidelines can be adapted to provide guidance for AWWS. For example water quality guidelines outlined in this documents can be adapted into new state guidelines for village scale AWWS projects, refer appendix 4.

In 2003, CoAG revised its 1994 reform agenda and proposed the National Water Initiative (NWI). The initiative covers many issues including urban water reform, best practice water pricing and integrated management of environmental waters. Full implementation of the NWI aims to provide a nationally compatible system for managing surface and groundwater resources. It seeks to optimise economic, social and environmental outcomes (COA, 2004; MacDonald and Dyack, 2004; CoAG, 2005) and offers states and territories a framework in which to reform water policy. The NWI addresses issues of demand practice, water pricing and institutional reform, all of which are challenges facing AWWS.

Via the Australian Water Fund, the Federal Government provides funding to implement reform packages as well as research funding for AWWS projects. In September 2004, the Federal Government announced an investment of $2 billion over five years for water infrastructure, improved knowledge and water management and includes the Water Smart Australia program (WSP). The WSP is designed to accelerate development and implementation of smart technologies and practices in water use (COA, 2004) and is a possible funding option for developments utilising AWWS technologies. The Australian Government Water Fund Communities provides community funding to promote the wise use of water including water efficiency and education; water sensitive urban design[11] (WSUD); and decentralised

[11]WSUD - A way of replicating the power of the natural system as a water cleansing and regulation agent. It considers treatment for the whole of catchment not just individual development sites (COA, 2004).

water delivery. Once again WA is not a signatory to this initiative. Reasons given by the WA Government include claims that some clauses are restrictive and that National Water Commission, the enforcing body of the NWI, has much power in their role of assessing the implementation progress of states and territories (CoAG, 2005). There is significant pressure from the Pastoralists and Graziers Association (PGA) for the State Government to sign. The PGA has twice called upon the government to sign the NWI and to instigate fair water trading practices (PGA, 2004; PGA, 2005).

2.5.2 WA Sate Government

"…Current guidelines, standards and regulations need to be more flexible to allow innovation whilst protecting public health and the environment…" (Dillon et al., 2004 p5).

The Western Australian State Government has control over water issues and policy implementation[12] and there are several policies and acts that relate to water issues (refer Table 4 for list and Appendix 1 for a detailed explanation). The Government Sewerage Policy has significant impact on AWWS implementation, while the State Water Strategy (SWS) provides a statewide strategy on water issues.

Table 4 Principal West Australian legislative and regulatory documents that have an impact on the production and use of recycled water in Urban WA (adaptation of Radcliffe, 2004b).

Date	Policy/Act
1911	WA Health Act
1914	Rights in Water and Irrigation Act
1928	Town Planning and Development Act
1974	Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974
1984	Water Agencies (Powers) Act
1985	Financial Administration and Audit Act
1986	Environmental Protection Act
1995	Water Corporation Act
1995	Waters & Rivers Commission Act
1996	Government Sewerage Policy: Perth Metropolitan Region
1997	Wetlands Conservation Policy for WA
2000	Town Planning and Development Subdivision Regulations
2001	State Water Quality Management Strategy for WA

[12] Policy implementation – is via laws & regulations, economic measures, information & education programmes and the assignment of rights and responsibilities for providing services (Elledge, 2003).

2002	Water WA: a state of water resources report for WA
2002	State Water Strategy
2003	The WA State Sustainability Strategy
2003	A State Water Strategy for WA
2005	Code of Practice for the reuse of greywater in Western Australia

The most challenging requirement in regards to implementing AWWS is the need for developers to abide by the Government Sewerage Policy in the Perth Metropolitan Region (the Policy) (WAGov, 1994). The Policy requires mandatory provision of reticulated sewerage to all new subdivisions in the Perth Metropolitan Region, unless special conditions exist. The departments of Health, Planning and Environment endorse this policy and have an enormous influence on all wastewater applications. This requirement adds extra costs to developments, with some stakeholders seeing mandatory connection, in case of overflow, malfunction or incident, as overly cautious and therefore it is seen as a deterrent to AWWS application (Cocks, 2005; Broughton, 2005).

The Policy was re-examined in 1990 with a two-year trial of small-scale unsewered developments to either R20 or R30[13]. The review, while highlighting the improvements in wastewater technology, remained convinced that reticulated sewerage system remained the most "…*reliable and environmentally acceptable means of wastewater disposal…*" (WAGov, 1994 p2). In light of rapid advancements in AWWS technologies in the last decade and increasing international and interstate AWWS case studies, perhaps it is time for another review.

The SWS was formulated after a series of public forums on the future of WA's water (Duggie and Hodgson, 2003). The objectives for the SWS are:

- Improving water efficiency in all sectors;
- Achieving significant advance in water reuse;
- Fostering research and innovation;

[13] R20 & R30 is a town planning term and refers to the housing density per hectare. The higher the R number the more dense the development.

- Planning and developing new sources of water in a timely fashion; and

- Protecting the value of our water resources, with specific targets of 20% reuse by 2012 (SWS, 2002).

The SWS instigated a Steering Committee to review irrigated agriculture in WA. The review recommends a move away from the current water management framework, Figure 1, towards one modelled on market-based approaches (GWA, 2005). The existing framework indicates four ministers (Treasury, Government Enterprises, Environment and Planning) involved with decision–making and management. This complexity of management has led to various governance and management co-ordination difficulties, with the Steering Committee stating that the framework is "*…complicated, cumbersome, open to accusations of conflict of interest and therefore in need of change…*" (GWA, 2005 p42).

The review highlights the difficult position that the Water Corporation, metropolitan Perth's sole wastewater service provider, faces in complying with two Ministries. As a business, the ultimate responsibility over the Water Corporation lies with the Minister for Corporate Services and Divisional Management (formerly Minister for Government Enterprises), as per the Financial Administration and Audit Act 1985; however the management of water resources, of which the Water Corporation plays a significant role, is the legal responsibility of the Minister for the Environment.

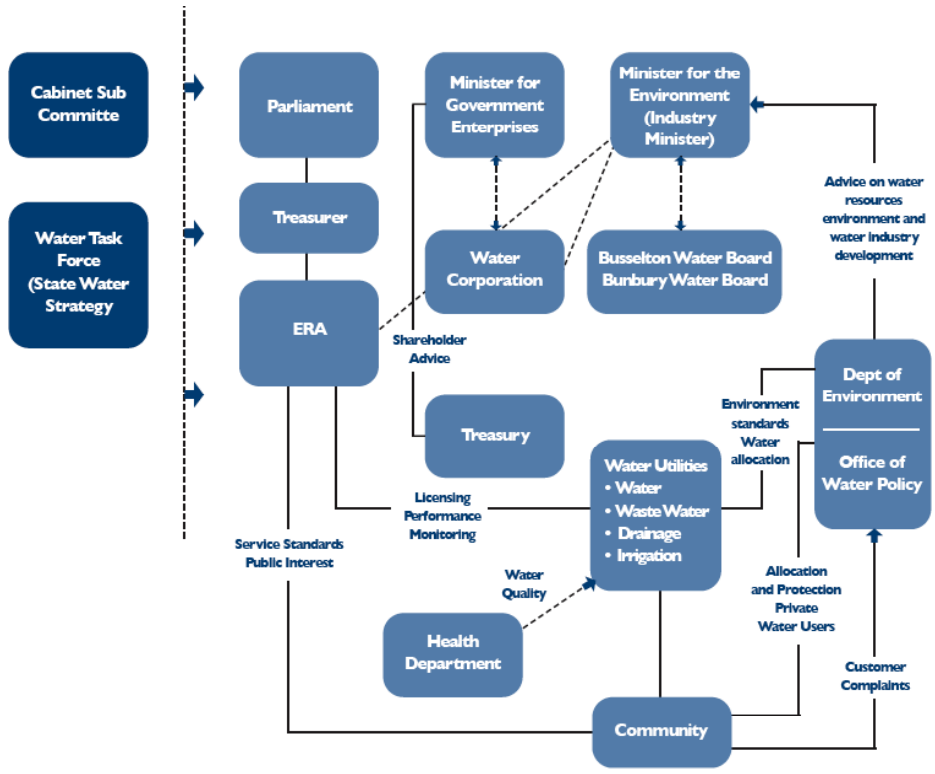


Figure 1 Relations existing between various entities involved in water management in 2004 (reproduced from GWA, 2005).

Since the implementation of the SWS there has been no evolution of water strategy in WA. There is a need to have a State Water Plan, as outlined by the review; the creation of a high-level "…*strategic framework will enable future demands for the state's water resources to be determined and managed effectively…*" (GWA, 2005 p15), to evolve a strategy that includes a range of options suited to the water demands of each sector (business, agriculture, mining, residential).

Town Planning regulations require developers to address land and water planning issues together, while Health and Environment Acts provide developers with targets to ensure that public and environmental health requirements are met. The following sections expand on these departments as well as looking at the role that the Economic Regulation Authority and Water Corporation plays in AWWS implementation.

2.5.3 Planning

The Department of Planning and Infrastructure (DPI) manages the WA planning system, with the WA Planning Commission (WAPC) acting as arbitrator. There are several policies and planning tools affecting AWWS. The State Planning Strategy provides a framework for land use planning and there are several principal guiding documents to assist project planners, these include:

Table 5 Principal-guiding documents as outlined by the State Planning Strategy.

Statement of Planning Policy 2 - Environment and Natural Resource Policy	This document acknowledges the value of the environment and provides information on Stormwater (flooding, nutrients & mosquito control), RAMSAR wetlands, and soil & land quality (waterlogging and acid sulphate soils/salinity).
Liveable Neighbourhoods	Provides guidance to sustainable development in WA to 2029. It promotes increasing integration of urban water management elements into the urban form and the adoption of water sensitive urban design (WSUD) principles and is the operational policy for the design and assessment of structure plans (regional, district & Local) and subdivision, strata division and development of new urban areas (WAPC, 2004; Armstrong and Head, 2005).
Statement of Planning Policy 2.9	This policy informs the WAPC the DPI and local government in the undertaking of their planning responsibilities in the protection of water resources.

In response to Planning Policy 2.9, Table 5, the WAPC proposes a model for integrated urban water management (IUWM)[14], with land use planning and is currently being trialed, Table 6 (*Pers. Comm.,* Shepherd Essential Environmental Services 2005). The proposed model involves a hierarchy of strategic[15] and statutory[16] planning activities, commencing at the State Government level progressing down to lot size (Shepherd, 2005). The new model will require developers to produce a Local Water Management Strategy, in conjunction with the Local Government, as well as prepare urban water management plans (UWMP).

The planning system identifies the need to improve stormwater management and to increase water reuse. Focusing on IUWM the system plays an important role in urban water management. This can be achieved "…*through assessing new development to ensure the principles and practices of IUWM are incorporated into the design and development of new urban areas…*" (Shepherd, 2005 p1).

Table 6 Scale of the land use planning system and relevant planning tools and the information to accompany planning actions (adapted from Shepherd, 2005).

Planning Stage/Scale	Land Area	Planning Tool	Water MGMT Information	Responsible Party
1.Regional Planning	>1 LGA[17]	Regional Strategy (Strategic) Region Scheme (Statutory) Regional Structure Plan (Strategic)	Regional Water management Strategy, incorporating an arterial drainage plan summarising in chapter of planning document and attached as technical appendix.	State Government
2. District Planning	Usually >300ha may be >1 LGA	District Structure Plan (Strategic) Regional Scheme Amendment (Statutory) Local Planning Strategy (Strategic) Town Planning Strategy (Statutory)	District Water Management Strategy, summarised in chapter of planning document and attached as technical appendix	State/ Local Government
3. Local Planning	<300ha	Town Planning Scheme Amendment (Statutory) Local Structure Plan (Strategic) Outline Development Plan (Strategic/Statutory)	Local Water Management Strategy, summarised in chapter of planning document and attached as technical appendix	Landowner/ Local Government
4. Subdivision	Small	Subdivision Application	Urban Water Management Plan	Land Owner

[14] IUWM can also be known as total water cycle management. IUWM provides communities with a balanced approach to water, wastewater and stormwater infrastructure and incorporates a more economic and environmentally friendly approach for water services, especially when incorporated within new urban developments (Apostolidis, 2004).

[15] Strategic planning is longer-term goals, integrating economic, social and environmental issues.

[16] Statutory planning refers to the legal arm of planning and is directed by legislation and regulations.

[17] LGA = Local Government Authority.

	<20ha Large >20ha	with conditions (Statutory) Detailed Area Plan (Strategic/Statutory)	(UWMP), accompanies application	
5. Construction of Subdivision	Small <20ha Large >20ha	Clearance of conditions Issuing the title	Building plan incorporates requirements of UWMP	Land Owner
6. Development of lot	Lot	Development Application (sometimes) Building licence	Building plan incorporates requirements of UWMP, scheme provisions or developer covenant.	Lot Owner

The system provides information that ensures developers are best equipped to complete UWMP. The Irrigation Review, refer 2.5.2, states "…*water allocation and planning need to be based on detailed scientific knowledge which pertains to the availability and status of the water resource…*" (GWA, 2005 p44). This allows developers to make informed decisions. The Irrigation Review also states that water resource plans "…*need to be statutory based in order to support market based systems for water trading…*"(GWA, 2005 p44). This requires planning to ensure that the "scientific knowledge" is available. The proposed timeframe for Regional Plans is ten years, District Plans 5 years and Local Plans 3 years. The DPI, Department of Environment, Water Corporation and Local Government have been assigned tasks to ensure completion of the plans, within the stated timeframes (Shepherd, 2005).

2.5.4 Health

In regards to issues of public health, there are two principal legislations influencing the implementation of AWWS; these are the Health Act 1911 (the Act) and the Health (Treatment of Sewage and Disposal of effluent and liquid waste) Regulations 1974 (the Regulations). The Act and Regulations provide public health guidelines for developers implementing AWWS in new urban developments. An important guideline, for developers, is the Code of Practice for the reuse of greywater in Western Australia (CoP); the CoP provides detailed guidance for developments installing greywater systems and has relevance for AWWS implementation.

The Act and Regulations provide general and specific requirements to the installation and operation of sewage systems. For AWWS the main challenge of these documents is the focus on municipal wastewater treatment plants and single dwellings (or a building that produces no more than 540 L/day of sewage). At high population densities, like those in Perth, it is not always feasible to employ individual solutions, such as septic tanks, due to space constraints. Traditional communal sewer networks become expensive over longer distances, so AWWS at the village scale becomes a viable user category (Hermanowicz and Asano, 1999). The lack of recognition along with the prescriptive language and confusing layout of the document has made it challenging for developers trying to interpret system requirements (Cocks, 2005).

The Act and Regulations were designed in an era where sanitary health risks were high. The traditional "big pipes in, big pipes out" systems were considered the best methods to ensure public health. Now, with the growing surge for cities to be more sustainable and improvements in public health, there is a new sustainability agenda driving health reform (DoH, 2005).

In WA the Department of Health (DoH) is the public health regulator and all wastewater reuse schemes need the approval of the Executive Director of Public Health. The DoH, is conducting a review of the Act and Regulations in order to develop a new framework for public health in WA. The proposed changes move away from traditional "Precautionary Principle[18]" and "Command and Control[19]" measures towards one with an underpinning theme of risk management. The DoH suggests that current sanitary provisions of the Act, in which the Regulation is one, "*…should be replaced by a general statutory duty vested in all individuals to protect public health by ensuring that actions do not risk harming others…*"(DoH, 2005 p4); or put simply, is there a risk to public health and how can identified risk be managed?

Codes of Practices are becoming a preferred method of implementing legislation. They provide guidance with an element of compulsion, due to regulatory requirements, and are easier to update than regulations, as parliamentary approval is not required before amendment. This enables CoPs to reflect current best practice, now and into the future.

The Code of Practice for the reuse of greywater in WA is an example of such a document. The objective of the document is to assist the promotion of acceptable long-term greywater reuse practice and to promote conservation of ground and surface water supplies by:

1. Establishing acceptable means of greywater reuse as a guide for local government, industry and homeowners;

2. Setting minimum design and installation standards and procedures for gaining approval for greywater systems installations;

3. Safeguarding the community from possible disease transmission arising from improper greywater reuse; and ensuring that greywater installations are

[18] The precautionary principle relates to a risk management approach when scientific knowledge is incomplete.

[19] Institutional measures aimed to directly influence the environmental performance of businesses by regulation

designed, installed and operated so that when used in households on a long term basis they do not harm the environment; do not cause a nuisance; and are appropriately sited and maintained to a satisfactory standard.

Even though this CoP is designed for single householders, the information has been used in village scale systems. The greywater system implemented at Bridgewater Lifestyle Village, WA, used the principles outlined in this CoP when installing 380 centrally managed greywater systems (Milani, 2005).

2.5.5 Environment

The Department of Environment (DoE) is responsible for environmental protection, water resource allocation and management. There is a perception that environmental considerations dominate water resource management decisions (SWS, 2005). Some irrigators who perceive a potential for conflict between the department's role as the water resource manager and the environmental regulator have questioned the DoE's role. A similar conflict existed prior to 1996 when water resource management was the responsibility of the Water Authority of WA (now operating as WaterCorp) resulting in the creation of the independent Water and Rivers Commission, which has since been incorporated into the DoE.

The DoE enforces many Acts, in regards to AWWS, with the major legislations being:

- Environmental Protection Act 1986 (EPA);
- Rights in Water and Irrigation Act 1914 (RIWI);
- Waters and Rivers Commission Act 1995 (WRCA);
- Water Agencies (Powers) Act 1984;
- Water Services Co-ordination Act 1995.

The most important, in regards to water quality is the RIWI. Entities applying to become a licensed water service provider, under the RIWI, must provide an operating strategy as per *Statewide Policy 10: use of operating strategies in the water licensing process*. This policy outlines issues to be addressed and the structure of operating strategies, specifically:

- Description of water abstraction methods;

- Administrative requirements;
- Operating rules (as per the licensee's operating rules);
- Monitoring requirements;
- Environmental impact management;
- Contingency plans;
- Water use efficiency;
- Associated maps; and
- Summary of licensee's commitments.

Although not mandatory, the DoE "…*envisages voluntary preparation*…" (DoE, 2004 p3) of Environmental Improvement Plans (EIP) for those companies provided an industry licence under Part V of the EPA. EIPs are currently being trialed and are designed to encourage sustainable practices beyond licensing conditions and require community and DoE representation during its development (DOE, 2004).

In order to maintain water quality Nutrient and Irrigation Management Plans (NIMP) are required by the DoE upon application for a licence. The components of a NIMP include:

- Site description;
- Soil description;
- Water resource description;
- Nutrient management;
- Irrigation;

- Drainage controls;
- Water resource protection;
- Pesticide use and storage;
- Monitoring and reporting; and
- Contingency plans (WRC, 1998).

In order for the DoE to maintain its objectivity there is a need to remove water resource allocation out of the DoE and into a new department, refer section 5.2.1. This will alleviate any possible insinuation of a conflict of interest and the DoE can focus on the environmental impacts of new water licence applications.

2.5.6 Economic Regulation Authority

The current regulatory structure separates service provision from resource protection. The DoE controls resource protection, as shown in 2.5.5, whilst the Economic Regulation Authority (ERA) controls service provision standards, as per the Water Services Licensing Act 1995. The ERA is responsible for a competitive and free-market place, under the Economic Regulation Authority Act 2003, in areas of water, gas, electricity and railways; in order to do this the ERA has different departments. The Office of Water Regulation co-ordinates and assigns the sole provider status to wastewater service providers in specified areas, e.g Water Corporation in the Perth metropolitan area and the Busselton Water Authority in Busselton.

The ERA recently conducted a review into urban water pricing. The review was the first independent review into water and wastewater pricing in WA. The review highlighted changes in pricing policy that can be implemented, namely increases in fees to householders for potable water supply and wastewater disposal (ERA, 2005). The ERA conducted community workshops to discuss the public pricing issues. The community supported change, but were reluctant to increase prices and felt that the review did not adequately cover the review objectives. It was felt that the ERA had done little in addressing issues at the heart of water pricing, namely the issue of unrestrained free access to water bores on the Swan Coastal Plain (Dortch, 2005). This sentiment reinforces the necessity to conduct complete pricing reform.

2.5.7 Water Corporation

The Water Corporation (WaterCorp) is the only licensed water and wastewater service provider in metropolitan Perth, although the current WA Government is not opposed to new water service providers entering the Perth water market (Piccinin,

2001). Under the Water Corporation Act, 1995, WaterCorp has operational control of the central water and wastewater infrastructure, and as such holds statutory powers[20]over connections to the infrastructure. The regulatory role WaterCorp would play in regards to connections to the centralised system is transferred to the Plumbing Licensing Board and the Office Of Water Regulation; this is required to ensure that regulation is separated from the core business role that WaterCorp plays.

WaterCorp has enormous political sway, as evidenced by their input into the State Water Strategy: Water Reform workshop. The proposed target for the SWS recycling mandate was a visionary 80% by 2020. However, the WaterCorp argued that 20% wastewater recycling was a more realistic and achievable target, the lower target prevailed. This lower target is going to be easily achieved by WaterCorp, especially with the introduction of the new treatment and recycling plant in Kwinana that is offering recycled water to heavy industry within the area. A compromise target of 30 or 40% would have at least placed pressure on the Water Corporation to look at all options in regards to wastewater recycling.

The WaterCorp has a significant role to play in AWWS implementation. They are the leading state wastewater service provider and hold the technical expertise and management structure to promote AWWS in WA. By developing partnerships with developers, WaterCorp can provide support until a new wastewater service market can be established. The projects that WaterCorp develop are important to the development of AWWS. As shown in section 2.5.3 (Planning) WaterCorp will play a big role in implementing Regional, District and Local Water Plans. The WaterCorp is also conducting a review into non-potable water use. This will guide developers, and their consultants, on integrated urban water management. This tool is further discussed in Chapter 5, (see section 5.2.5.), and is shown in Appendix 3.

2.6 Summary

Climate change, population movement and increasing demand on resources are placing pressure on traditional approaches to water management. International initiatives and innovative solutions to water supply and sanitation are being developed worldwide. Some have already achieved economic, environmental and social benefits; others continue to be developed and refined. In the WA housing environment there are obvious opportunities to adopt decentralised AWWS, at small community scales, that can address demand issues, are affordable and can meet environmental and public health concerns. Compromising WA's ability to take up these options is the complex legislative and regulatory framework that prescribes and arbitrates across Ministries and Authorities, making it clear that a new legislative

[20] Statutory powers – prescribed or authorised by statue (in this case the Water Corporation Act, 1995) powers, where offences can be legally punishable (Macquarie, 1998).

framework will be required to assist with the development of decentralised AWWS. The new framework will need to recognise the new user category, known as village/cluster scale developments and the ability of these developments in promoting wastewater recycling in urban areas.

Chapter 3 Research Design and Methods

3.0 Introduction

In the previous chapter we saw how alternative wastewater system (AWWS) are viable options for cities facing potable water supply shortages. In Perth, Western Australia (WA), AWWS is emerging as an alternative, sustainable option for the supply of non-potable water, in new urban developments.

A qualitative research approach was used to investigate the above research questions. Qualitative research focuses on understanding a situation, rather than trying to predict or control it, and is used when trying to research social phenomena or to understand stakeholder perceptions and attitudes to a situation (Nachmias and Frankfort-Nachmias, 1992; Neuman, 2000). This approach was adopted over other conventional approaches as it allowed the research to capture current perceptions, concerns and practices within the WA water industry towards decentralised AWWS implementation. Other approaches such as quantitative would not have been flexible enough to incorporate the various points of views from the different governing bodies, particularly in view of the development of a new category of water user, previously unrecognised by the governing legislation.

Within a qualitative framework, this research used exploratory design and key informant techniques. Exploratory research is used in subject areas that are ill defined or poorly researched. It is the initial research that builds to a deeper understanding of the problem or concept being studied (Neuman, 2000; Routio, 2004). This research implemented a "Deeper Understanding" spiral, Figure 2, as the preliminary understanding was broad and incomplete. The spiral approach gathers information together from various sources, defining the variables allowing for the project focus to narrow. Each new viewpoint added redefines the understanding of the issue until a point of point of "deep understanding" of the issues is reached, enabling the development of solutions that envelop the various viewpoints (Routio, 2004).

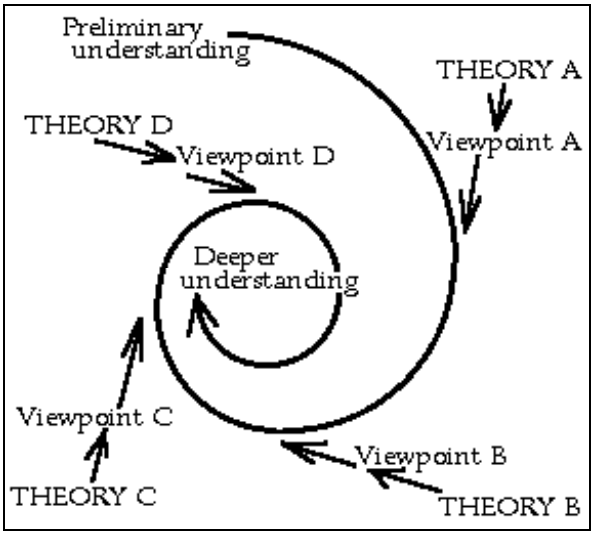


Figure 2 Exploratory research builds on initial understanding, where the variables are unknown, by engaging with other viewpoints to develop a deeper understanding of the issues (Routio, 2004).

Due to the emerging nature of the AWWS concept in WA, implementing an exploratory research design enabled an informed development of the research questions, whilst keeping them focused on the research aims.

Key informant technique (KIT) refers to the subjective selection of individuals (known as key informants). Key informants have first hand knowledge of the issues being investigated and represent different backgrounds, experiences and viewpoints (Neuman, 2000). By focusing on key informants knowledgeable in the implementation of water governance, this research evaluated current governance practices, legislative and regulatory challenges and the different roles of the regulatory authorities involved with the implementation of AWWS in urban developments.

To identify suitable key informants, a review of WA state documents was conducted, refer appendix 6. The review highlighted the following stakeholder groups that the key informants needed to represent:

- Department of Health;
- Department of Environment;
- Department of Planning and Infrastructure;
- Department of Premier and Cabinet;

- Water Corporation;
- Local Government Authority; and
- Land Developers.

The review highlighted several key informants and after discussions with academic advisors a list of key informants was developed. This list included a range of perspectives and insights that influence AWWS in WA urban developments. The key informants were selected based on:

- Their recognised knowledge of water governance issues;
- Their job position within an identified stakeholder group;
- Their participation in associated research; or
- Referral from another key informant;

A series of 30-45 minute face-to-face interviews were conducted. Face-to-face interviews encourage a freer exchange of ideas and allow time for complex questions to be answered (Nachmias and Frankfort-Nachmias, 1992). Where time constraints limited subject availability, 10-15 minute, telephone interviews were used instead.

The interview guide, refer appendix 5 for guide and responses, utilised different questions for each stakeholder group. By implementing different questions the effects of AWWS could be explored for each stakeholder group. The role that each stakeholder group plays in implementing AWWS could also be explored, along with the regulatory controls required to ensure public and environmental health.

3.1 Research Method

The following methods were used to conduct my research:

- Define the research questions;
- Review current literature including research papers & legislative documents;

- Design methodology;
    - Investigate suitable data collection techniques;
    - Select key informants;
    - Professional development (see Table 7 below);
    - Review of Australian examples (see Table 8 below); and
    - Design interview guide (see appendix 2).
- Conduct preliminary interviews.
- Develop an AWWS concept that can be applied to WA land developments;
- Develop a preliminary policy framework;
- Develop a new regulatory tool;
    - Including management options.
- Analyse results, presented in the following:
    - Chapter 4 A new AWWS concept;
    - Chapter 5 A new legislative framework; and
    - Chapter 6 A new regulatory tool.
- Derive conclusion:
    - Final legislative framework;

- Final new regulatory tool "Code of Practice for DeWaTARS in village developments; and

- Management options.

Table 7 List of workshops attended including the major highlights, attendees and who presented the workshop or seminar.

Title	Presented By	Attended By	Major Points
Inquiry on urban water and wastewater pricing	Economic Regulation Authority	Community Stakeholders	Discussion of the review into water pricing. Moderate changes proposed, with the ERA agreeing that another desalination plant is not the best option for infrastructure expenditure by Water Corp.
Managed Aquifer Recharge (MAR)	Environmental Protection Authority	Community Stakeholders and Regulatory Authorities	Discussed opportunities available by using recycled water in MAR applications. Community Stakeholder sentiment highlighted the urgency and the need to act now.
The introduction of the Building and Sustainability Index (BASIX) in Western Australia	Department of Planning and Infrastructure hosted by the Western Australian Sustainable Energy Association Inc	Developers, Tertiary Institutions, Local Government and Community Stakeholders	An overview of implementing BASIX into WA. The roll-on implications for new developments and the possible extension of the BASIX program to be applicable to Sub-division scale.
Water Law in Western Australia Conference	Environmental Defenders Office	Government Authorities, Tertiary Institutions, Local Government and Community Stakeholders	Focused on ways in which water policy might change under the influence of the National Water Initiative.

Table 8 List of Australian DeWaTARS example sites, which states they are located in and the management arrangement in place

Site Name	State	Management Option
Rouse Hill	NSW	Water Utility (multi-title, multi-connections)
Inkerman D'Lux Development (formerly Inkerman Oasis)	Vic	Strata Body (strata-title, multi-connections)
Aurora	Vic	Local Council/Water Utility (multi-title, multi-connections)
Mawson Lakes	SA	Local Council (multi-title, multi-connections)
Bridgewater Lifestyle Village	WA	Park Management (single title, multi-connections)
Timbers Edge	WA	Strata Body (strata title, multi-connections)

3.2 Data Analysis

The literary review identified the legislative challenges for AWWS in WA; and highlighted the lack of recognition of village scale AWWS as a 'credible' user group. The inclusion of village scale AWWS, as a valid user group, is important (Table 9); once included the specific challenges facing multi-connection systems are clearly seen.

Table 9 shows how the creation of a new user group starts to give different parameters to village scale AWWS. For example, village scale flow capacities are between 1.8 kL/day to 20 kL/day compared to single household flow of <1.8 kL/day, approximately 10 people, and Municipal wastewater treatment plants flows of more than 20 kL/day, approximately 900 people, and that there are two possible water streams suitable for AWWS application. Table 9 also shows the shortcomings in the current Legislation and how the inclusion of this user group can assist the development of a framework that developers can understand and interpret easily.

The development of an AWWS concept is key to instituting legislative appropriate frameworks. Frameworks provide a "*set of assumptions, concepts, values and practices that constitutes a way of reviewing reality*" (HMC, 2005 p1). Without a defined concept, legislative frameworks will either become too broad, where every alternative option is incorporated and runs the risk of having no substance, or very specific; which may lead to confusion if new technologies or practices are outside the framework.

Building on the parameters identified in Table 9, a new AWWS concept was developed. The acceptance of the new concept, as a valid entity, raised the question of management capability in relation to the successful operation of the AWWS. The next stage of analysis involved reviewing the different management options utilised by various Australian examples. This leads to four management options, Table 10, being identified as being appropriate for WA.

Table 9 Breakdowns of Flow Capacity into User categories, treatment required and typical technology in WA

Flow Capacity	Category	Streams	Treatment Required	Typical Systems employed				Regulatory Framework
				Screening	Primary	Secondary	Tertiary	
<1.8 kL/day (10 persons x 180 L/day, the minimum size for a single house hold w/w systems)	**(Existing)** Single House Hold	Grey Water	Primary +/or Secondary depending on end use	Grey Water Diverter	Septic Tank	ATU	Micro – Membrane units	Well documented with clear regulatory frameworks i.e. Code of practice for the reuse of greywater in Western Australia and Health Act 1911: Health (Treatment of Sewage and Disposal of effluent and liquid waste) regulations 1974
		All Waste Water	Secondary					
20 kL/day < 10,000 kL/day	**(New)** Small Scale Village Management Or Strata Body Management 20-1,000 kL/day	Grey Water	Primary +/or Secondary depending on end use	Coarse Mesh grit Screen	Septic Tank	ATUs	Wetland & Media Filter	Unrecognised category with unclear frameworks potential for a Code of practice for Urban DeWaTARS, although in practice regulators refer to DeWaTARS as municipal WWTP. The Department of Environment requires that any sewerage treatment facility producing 20 – 100 kL/Day must have a Works Approval or Works Approval and License respectively issued by the DEP prior to construction commencing (Environmental Protection Act 1986). Rights in Water and Irrigation Act 1914, administered by the Department of Environment, states that where high levels of N and P are applied to land and there is a risk to sensitive water resources, a Nutrient and Irrigation Management Plan (NIMP) may be required before a licence is granted. The Water Corporation (Water Corporation Act 1995) controls the engineering design standards for sewers by developers connecting to their pump stations and main trunks.
	(New) Medium Scale LGA or Wastewater Utility1,000-10,000 kL/day	All Waste Water	Secondary (Tertiary treatment to class A required if water is to be piped back into the house)					
20 kL/day >100 kL/day As prescribed by the Health Act	**(Existing)** Municipal Waste Water Treatment Plant	All Waste Water	Tertiary (Can be secondary depending on end use, eg in regional WA reuse schemes irrigate POS, ovals and golf courses)	Bar Screen Eg Woodman Point	Lagoons Eg Broome	SBRs Eg Rottnest	MBR'S Eg Inkerman	Well documented for Wastewater Treatment Plant operations with clear regulatory frameworks i.e. Health Act 1911: Part IV for Sewerage Scheme operated by a local government and Financial Administration and Audit Act 1985. Under the Environmental Protection Act 1986, the Department of Environment requires that any sewerage treatment facility producing >100kL/Day needs to be licensed.

Table 10 Management options and the management characteristics of each

Option	Land Structure	Land Owners	Management Body	Characteristics	Examples
1	Single Title	One	Village Management	Small Scale Development (20-1,000 kL/day)	Bridgewater Lifestyle Village, Erskine WA
2	Single Title	Multi	Strata Body	Small Scale Development (20-1,000 kL/day)	Timbers Edge Village, Dawesville WA
3	Multiple Titles	Multi	Local Council	Large Scale Development (1,000 – 10,000 kL/day)	Brisbane City Council, Brisbane QLD
4	Multiple Titles	Multi	Wastewater Utility	Large Scale Development (1,000+ kL/day) , but can supply to small developments (20-1,1000 kL/day).	Mawson Lakes, Adelaide SA

The management options, in Table 10, encompass the breadth of residential management varieties found in Perth, WA. In 1997, Boller (1997 p11) stated, "…*experience has shown that only skilled operation, maintenance and control of small treatment plants can guarantee satisfactory performance…*". The literature review highlighted the following management criteria; necessary for successful implementation of village scale AWWS:

1 The ability to develop and implement a risk assessment and management plan;

2 Public Liability insurance cover for residents and Workers Liability insurance for employees undertaking maintenance work on the system;

3 Management infrastructure needs to be in place to ensure that timely and efficient management of the system occurs;

4 Ability to monitor the system;

5 Technical ability to maintain, operate and update the system; and

6 A cost recovery mechanism that is fair and equitable.

Once the management criteria had been identified, the research then compared the criteria against the outlined management options, Table 11. The research found that all management options, other than wastewater utilities, could operate greywater systems. It also questions the ability of the management bodies to maintain the chosen AWWS. For example, if the management body is not technically equipped to manage the proposed AWWS, then there will be a requirement to contract external professionals.

Table 11 Identified management arrangements and their ability to meet regulatory requirements

MGMT Type	Can the management meet these requirements?						
	1. Risk MGMT plan	2. Insurance	3. Management Capacity	4. Monitoring	5. Maintenance		6. Management/ Fee
					Grey Water	Waste Water	
Single Home	Generally No	Generally No	Generally No	Generally No	Yes	Generally No	Yes
Village	Yes	Yes	Yes	Yes	Yes	Generally No	Yes
Strata Body	Yes	Yes	Yes	Yes	Yes	Generally No	Yes
Local Council	Yes	Yes	Yes	Yes	Yes	Generally No	Yes
Waste Water Utility	Yes	Yes	Yes	Yes	No	Yes	Yes

Once the management options were developed the key informants were given the opportunity to provide feedback. This ensured that key concerns discovered throughout the research were understood and considered appropriately.

3.3 Validity

Validity can be defined, as the efficacy of the findings by asking the question, is one measuring what one intends? According to Miles and Huberman (1994) internal validity, external validity and construct validity are three ways that validity can be distinguished.

Internal validity is defined as identifying the true cause of the outcomes observed during research, with selection bias[21] as the primary threat to internal validity (Miles and Huberman, 1994). In using a KIT approach, selection bias was a tool utilised in the process of selecting key informants. Due to the in-depth regulatory review required it was necessary to select key informants from very specific stakeholder groups; this expedited the process of selecting key informants as key personnel in regulatory authorities who were one of the target groups.

External validity is defined as the ability to generalise the research to other people and other situations (Nachmias and Frankfort-Nachmias, 1992; Miles and Huberman, 1994; Neuman, 2000). The key informant technique does not lend itself to external validation. However, as the aim of this research was to understand the legislative challenges to specific stakeholders involved in the implementation of AWWS in WA and not to generalise to a wider population, the use of the KIT was justified for this research.

Construct validity is defined as the correlation between concepts and the actual measurements taken (Miles and Huberman, 1994). It is important for valid research to measure what ever it is we set out to measure; and for those measurements to be relevant to the concepts or 'constructs' we are studying. By using exploratory research design, this research was able to use the 'deeper understanding', Figure 2 (Routio, 2000), principle and link the current challenges facing implementation of AWWS into WA urban developments. By continuously updating, adjusting and adapting differing viewpoints a new legislative and regulatory framework could be constructed from the measurements taken.

The methodology used in this research did not lend itself to the usual set of validity checks. For example in standard qualitative research methods, focus or target groups are asked the same set of questions with the answers being inputted into a computer program, such as NUDIST. The computer program will provide the researcher with a median answer from the number supplied. This methodology could not be used in this instance due to:

- The number of people within the industry with the technical capacity to answer the questions is small;

[21] Selection bias refers to the preferential selection of subjects, in this case the key informants, related to their experience and may seem to form non equivalent groups (Neuman, 2000).

- The development of DeWaTARS is unchartered with few people understanding the implications of decentralised systems and even fewer understanding the legislative requirements; and

- On-site wastewater treatment and recycling systems are new to WA; with no existing case studies to be led by it was difficult to find key informants within a relatively small community of people. The key informants selected were the best informed from their relative departments or industries. The small number of key informants was not seen to impede this investigation. The similarity of concerns and short comings of the current system between the key informants gave this research validation.

3.4 Reliability

Reliability is defined as the degree to which an instrument or assessment can consistently measure an attribute; the ability of these processes to be repeated; and the stability of these processes over time (Neuman, 2000). Due to the nature of exploratory research it is often difficult to repeat the precise procedures used in all their detail (Neuman, 2000).

This research is dealing with a dynamic system that, by its nature, will alter through time, as the environmental, economic, social and political environment changes. This research could not be conducted within an institution, as the research deals with key stakeholder perceptions, attitudes and viewpoints. This also meant that standardised question interview[22] techniques would not be able to reflect the true nature of each stakeholder's input into AWWS implementation. However, by implementing the above mentioned research design and methods, future research will be able to repeat this method, in purpose if not in detail, with the results being relevant for that time and place.

[22] In this instance, standardised question interviews mean instances where the same questions are asked to various stakeholder groups. This is used in situations when there is one particular challenge or detail trying to be researched.

Chapter 4 The concept of DeWaTARS

4.0 Introduction

"*...Adequately managed decentralised wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals…*" (USEPA, 2000 p18).

Before a new legislative framework and new regulatory tool is developed, as outlined in Chapter 3, it is important to define the concept for which the framework and regulatory tool will be applied. In Chapter 2 the German and Swedish concepts and the American and Sydney Water models were discussed. This Chapter will show how these concepts were adapted to develop the proposed concept of Decentralised Wastewater Treatment and Recycling Systems (DeWaTARS).

4.1 Decentralized Sanitation and Reuse™

In Chapter 2, one German approach was described as:

- Decentralized sanitation and reuse (DeSa/R)™ involving the separation and treatment of different wastewater streams to promote optimal reuse (Huber, 2004).

The Huber Technology Centre (HTC), in Germany, coined the term DeSa/R. The HTC create small wastewater treatment plants for up to 150 households. The centre promotes Huber technologies that can be implemented in DeSa/R projects and provides service support for their products such as the MembraneClearBox®, and the membrane technologies VRM® and VUM® (Hackner, 2004; Huber, 2004).

4.2 Ecological Sanitation

In Sweden a similar approach called Ecological Sanitation (EcoSan) has been created. This approach builds on the link between people and the resource (Winbald and Simpson-Hebert, 2004). The EcoSan website describes EcoSan as "…*a three-step process dealing with human excreta: containment, sanitization and recycling. The objective is to protect human health and the environment while reducing the use of water in sanitation systems and recycling nutrients to help reduce the need for artificial fertilizers in agriculture. EcoSan represents a conceptual shift in the relationship between people and the environment; it is built on the necessary link between people and soil…"* (EcoSan, 2005 p1).

In Sweden there are over 20 different wastewater service providers. The Swedish experience has shown that "*regular monitoring, professional support for service, maintenance and technical support*" as well as "*service agreements* (are) *necessary for the whole lifetime of the system*" (Anon, 2003 p1).

4.3 USA Model

The USA Environmental Protection Authority model promotes the best practice model for individual on-site AWWS. This model involves taking management of decentralised AWWS, out of the hands of householders and into the professional domain, where professional standards can be monitored and maintained (West, 2000). The system elements are outlined in section 2.3.1.

The model is based on single units at the household level within a centralised monitoring and maintenance program. The homeowners are charged a monthly service fee, which is similar to the service fees paid by customers connected to the traditional wastewater system; refer 2.4.1.

4.4 Sydney Water

West (2000) proposed the following model as best practice for wastewater services to Sydney Water:

- Wastewater source control;
- Watertight collection units;

- Watertight reticulation;
- Advanced onsite treatment systems reconfigured to service a cluster/village/town;
- Ultra-violet disinfection;
- Effluent recycling and reuse; and
- Centralised management facilitated by remote monitoring.

West (2000) also identified that to be successful this model would need to be supported through a series of manual, technical sheets and management guidelines.

4.5 DeWaTARS

Like the German and Swedish approaches, DeWaTARS connects people with their environment and reduces potable water demand. As the name implies DeWaTARS refers to wastewater treatment systems being separated from traditional centralised systems, promoting local reuse. The DeWaTARS concept differs in two ways from these international approaches. Firstly, this approach does not promote one particular product or method over another, as in the German model; only the idea of wastewater treatment and recycling is promoted. Secondly, DeWaTARS incorporates the American model of centralised management of decentralised systems.

Like the USA model and the proposed Sydney Water model, the DeWaTARS concept can be implemented for single on-site household units, with centralised monitoring, but can also be adapted to multiple homes connected to a single off-site unit. The new concept requires only that the chosen DeWaTARS technology implemented, whether a single home or cluster of homes, has a centralised management approach by a licensed wastewater service provider or LGA.

In order for legislative and regulatory tools to be effective, it is important to define the concept of DeWaTARS. Giving recognition of DeWaTARS allows regulatory authorities involved in DeWaTARS implementation, to provide guidance to developers. This means setting parameters for DeWaTARS projects. These are:

- Can apply to any treatment and recycling system that is independent from the centralised wastewater system;

- Involves either a) Multiple connections to the chosen DeWaTARS technology; or b) The central management of several on-site DeWaTARS;

- Treated wastewater is used for local reuse; whether that be for in-house, ex-house or for public open space irrigation;

- Will have centralised management by a wastewater service provider or LGA, who ensures operation, regular maintenance and monitoring;

- Will have a HACCP/Risk Management plan; and

- Can include any technology that has been approved by the relevant regulatory authorities.

4.5.1 Management Options

In order to implement DeWaTARS, management arrangements need to be defined. To develop management options, different categories of management were assessed against these criteria; refer Section 3 Table 11, with four categories of management being identified as suitable management options for DeWaTARS implementation. The National On-site Wastewater Recycling Association (NOWRA) describes medium scale development as those systems with a flow of 1 million gallons per day; this equates to approximately 3785kL per day, approximately 2100 homes (NOWRA, 2004; Wallace and Austin, 2004). In Table 12 flow rates, land structure, and the management bodies involved have been identified. The flow rates have been adapted from NOWRA, for the WA environment and are:

- Small Scale Developments – 20-1,000kL/day (10 ~ 500 Households); and

- Medium Scale Developments – 1,000 to 10,000kL/day (500 ~ 5000 Households).

The use of flow capacity of each development was chosen as the distinguishing factor between small and medium scale developments. This is in opposition of the Department of Planning and Infrastructures use of acreage size of the development, refer table 6, as the deciding factor. There are two reasons for this:

- Urban villages tend to have high population densities on a smaller acreage; and

- Technology requirements are on based flow capacity, i.e. the number of connections, rather than the size of the development. Especially as it is a requirement of WA planning that new development dedicate 20% of the acreage to public open space.

Table 12 Overview of management categories that can implement DeWaTARS

Option	Land Structure	Land Owners	Management Body	Characteristics	Typical wastewater flow rate kL/day	Examples
1	Single Title	One	Village Management	Small Scale Development	20-1,000	Bridgewater Lifestyle Village, Erskine WA
2	Single Title	Multi	Strata Body	Small Scale Development	20-1,000	Timbers Edge Village, Dawesville WA
3	Multiple Titles	Multi	Local Government Authority	Medium Scale Development	1,000-10,000	Brisbane City Council, Brisbane QLD
4	Multiple Titles	Multi	Wastewater Utility	Medium Scale Development	1,000-10,000	Mawson Lakes, Adelaide SA

The options reflect the various village scale (more than 10) residential arrangements available in Perth that have been identified as being capable of meeting health and environmental requirements.

The USAEPA guidelines for management of on-site/decentralised wastewater systems lists the five levels as:

1. Systems inventory and awareness of maintenance requirements

2. Maintenance contracts

3. Operating permits

4. Utility operation and maintenance (the householder owns the sewerage equipment)

5. Utility ownership and management (the private or public water utility owns it)

By using these parameters, regulatory bodies will be able to recognise DeWaTARS projects and new legislative frameworks, described in Chapter 5, and new regulatory tools, described in Chapter 6, can be utilised to aid the implementation of DeWaTARS in new WA urban developments.

Chapter 5 A New Legislative Framework

5.0 Introduction

Chapter 2, discussed how climate change, increasing water demands and urbanisation are placing pressure on Perth's centralised wastewater system; and that there is a global move towards AWWS. There is also pricing, technological and legislative challenges to implementing AWWS in Perth; and that by focusing on the legislative challenges, issues with pricing and technology can also be addressed. In Chapter 4 the new concept of DeWaTARS was explored; this concept also highlighted the need for a new legislative framework; one that recognises village scale systems. This chapter will discuss the proposed legislative framework and the requirements needed from the federal government, state departments and agencies involved.

5.1 Australian Federal Government

The role of the federal government, in relation to water governance in WA, is to provide guidance to the states and territories on water reform processes and to promote best practices within the water industry. This is achieved through the National Water Initiative (NWI), via community education funding, national guidelines and industry codes.

The NWI offers the states and territories a process in which to reform water policy. As shown in chapter two, demand practices, water pricing and institutional reform are three of the challenges facing the implementation of DeWaTARS that are addressed by the NWI.

"…The principles expressed in the National Water Initiative will be highly influential in the development of WA's water policy; we can learn from the mistakes being made over east…" (Banyard, 2005 p6).

The Council of Australian Governments website states "*WA declined to sign the NWI Agreement because there was no real benefit for WA*" (CoAG, 2005b p 1). This stance by the WA State Government is in complete contrast to the statement by Banyard, above; and is one that is hard to understand. The benefits to WA, of having a nationally cohesive approach are significant and include: best practice guidelines for wastewater services; federal funding opportunities to encourage DeWaTARS projects; community education programs; and a federally supported water reform framework.

The Federal Government's role in the proposed DeWaTARS legislative framework will be to assist the WA State Government in undertaking water reform, for example the yet to be released National Guidelines on water recycling and the 2004 Australian Plumbing Code; provide industry benchmarks for best practice.

5.2 WA State Government: New Department of Water

In light of the SWS Irrigation Review, the State Government has started to initiate reform with the appointment of the Premier as Minister for Water Resources responsible for:

- New Department of Water (Incorporating aspects from the DoE, Water Corporation, SWS, Office of Water Regulation);
- Water resource management;
- Water policy;
- Strategy and planning; and
- Water utilities, including WaterCorp (WAGov, 2005).

The Minister has created the Office of Water Strategy, within the Department of Premier and Cabinet, and given the office the task of reviewing current water policies. The State Government advises the role of the review is to "…*streamline and modernise an archaic and unwieldy catalogue of 14 Water Acts*…" (WAGov, 2005 p1). In light of the recent paradigm shift towards DeWaTARS, including significant improvements in technology, this research suggests that a new review of the Government Sewerage Policy be conducted.

The State Government has identified the development of strategic water plans as a high priority, including the development of a State Water Plan (SWP) and Regional Water Plans (RWP), and has committed to ensuring that "*…the water resource manager is adequately resourced and appropriately skilled to deliver on key strategic and operational priorities…*" (WAGov, 2005 p1). The development of a SWP can promote the DeWaTARS concept by encouraging IUWM. Regional Plans can identify areas suitable for DeWaTARS implementation.

A Minister to assist the Minster for Water Resources, has been appointed, whose responsibilities include:

- Operational oversight of the Department of Water;
- Legislative responsibility; and
- Coordination for water services, planning and delivery.

The split of powers between the Minister and the Minister assisting is considered by some as a political strategy rather than an improvement to water services, stating that having two Ministers "muddy the waters" when the importance of the Department of Water dictates that one Minister only should be responsible (Taylor, 2005). Having the Premier, as the Minister for Water Resources, emphasises the political importance that water holds within the WA political arena. The task of water reform will not be easy and needs the co-operation and co-ordination of many regulatory authorities. The role of the Minister is to focus on the review of policy and strategy; while the Minister assisting can focus on the operational aspects of water reform.

The new Department of Water is the prime candidate to instigate legislative reform and to maintain DeWaTARS implementation. With water reform already on the cards it will be important to acknowledge the role that DeWaTARS will play and the ability of the new category of water users, village/cluster scale, to operate and maintain systems under DeWaTARS.

5.2.1 Department of Environment

Under the new proposed framework, planning and licensing is removed from the Department of Environment (DoE). This would see the Water Services Planning Branch being transferred to the new Department of Water. This leaves the DoE solely with the

responsibility of assessing applications purely from an environmental impact assessment point of view.

When a DeWaTARS application is submitted the DoE will be notified and forwarded the following:

- Nutrient and Irrigation Management Plan; and
- Environmental Improvement Plans.

5.2.2 Department of Health

Under the new proposed framework the role of the Department of Health remains the same, to protect the health of the public. The Health Act review will impact on the health requirements for DeWaTARS applications. Regardless of whether or not the DoH revises the existing Health Act, it is important for the preparation of either a regulation or code of practice to assist developers wishing to implement DeWaTARS at a scale smaller than municipal and larger then an individual household.

5.2.3 Department of Planning and Infrastructure

The DPI are moving towards connecting land and water use planning, with land developers being required to develop detailed Local Water Management Strategies (LWMS). The quality of detail provided on LWMS is dependent on the background information provided in higher level management plans, and the analytical tasks required of developers' consultants, and it is important that the DPI have significant input into the development of these plans along with the Department of Water.

5.2.4 Local Government

The co-operation and involvement of local government authorities (LGA) is vital for the smooth implementation of the new DeWaTARS legislative framework. LGAs are the public face of the government regulatory bodies; they are first point of call for developers wanting to initiate DeWaTARS. Having a clear framework to work within, the LGA can provide clear and concise instruction to developers. This enables quicker turnaround times for approvals and the early detection of problems.

Within the new concept, LGAs are potential future managers of DeWaTARS. For example, the GoldCoast City Council has developed a Pimpama Coomera Water Future Master Plan. The Master Plan incorporates a LGA run DeWaTARS concept in a new Greenfield development, designed to accommodate 50,000 residences (Gold Coast

Water, 2004; Livingston *et al*., 2004). The Master Plan is "*…a good example of what a single authority can do with relatively few impediments in a new greenfield development…*" (Livingston *et al.*, 2004 p588). In WA, the Mandurah City Council has been supportive in the development of two greywater DeWaTARS projects, Bridgewater Lifestyle Village, Erskine and Timbers Edge lifestyle Village, Dawesville, and as the council is located on the boundaries of the metropolitan sewerage system is in a position to develop their own DeWaTARS project.

5.2.5 Water Corporation

In the new framework, the Water Corporation (WaterCorp) is key to the development of DeWaTARS projects. As the sole service provider for Metropolitan Perth, the WaterCorp is the prime candidate to assist in the development of a new wastewater service industry, in WA. The WaterCorp is best placed, as a 100% Government owned utility, to develop best practice principles to guide DeWaTARS compliant under environment, health and planning regulations. At present, however, WaterCorp is opposed to the development of village/cluster scale, preferring to investigate recycling opportunities within the commercial market; such as the new Wastewater Treatment and Recycling Plant within the Kwinana Industrial Park. Although domestic recycling is not a high priority there is discussion of a proposed treatment and recycling plant at Alkimos, instead of building the standard Wastewater Treatment Plant. This will provide the option of a 3rd pipe system of delivering treated wastewater to homes, in the rapidly expanding northern suburbs of Perth.

The development of a new wastewater service industry, in Perth, dealing with the management and operation of DeWaTARS projects will require technical and managerial expertise; WaterCorp can be a provider of this. At the moment the population of Perth is not sufficient to warrant several new businesses offering wastewater services. With the expertise that WaterCorp has, it would possible to open a new business arm dedicated to the provision of wastewater services. This would provide the opportunity to develop this burgeoning industry under strict protocols and given time provide WaterCorp with another avenue to meet recycling targets set by the State Water Strategy. Alternatively the development of a new business arm will provide WaterCorp with an asset, which could then be on-sold once the industry, is developed and able to sustain itself. This development would need careful consideration, as under the Water Corporation Act, WaterCorp are required to provide discounts to pensioners, as per their community service obligations. Hypothetically, should the business arm be on-sold, either pensioners, should the community service obligations be withdrawn or the new owners, should the obligations remain, would be at a disadvantage.

What is required in the short-term is for the Government owned wastewater service provider to develop planning tools and best practice principles so that DeWaTARS can

be integrated into Perth's existing centralised system. Two examples of the leading role WaterCorp is playing in providing developers with planning tools are the:

- Proposed model for integrating urban water management with land use planning (the Model) (Shepherd, 2005), Table 6 Section 2.5.3; and

- Non-potable water use: guidelines for developers and their consultants (the Guidelines) (GHD, 2005), Appendix 3.

The model aims to integrate urban water management with land use planning. The Model was initiated to "*…aid in the development of the Integrated Land and Water Management Plan for the Southern River area…*" (Shepherd, 2005 p 2), and is currently being trialed; the model outlines details required from developers by the DPI; these being:

- Local Water Management Plan (LWMP); and

- Urban Water Management Plan (UWMP) (Shepherd, 2005).

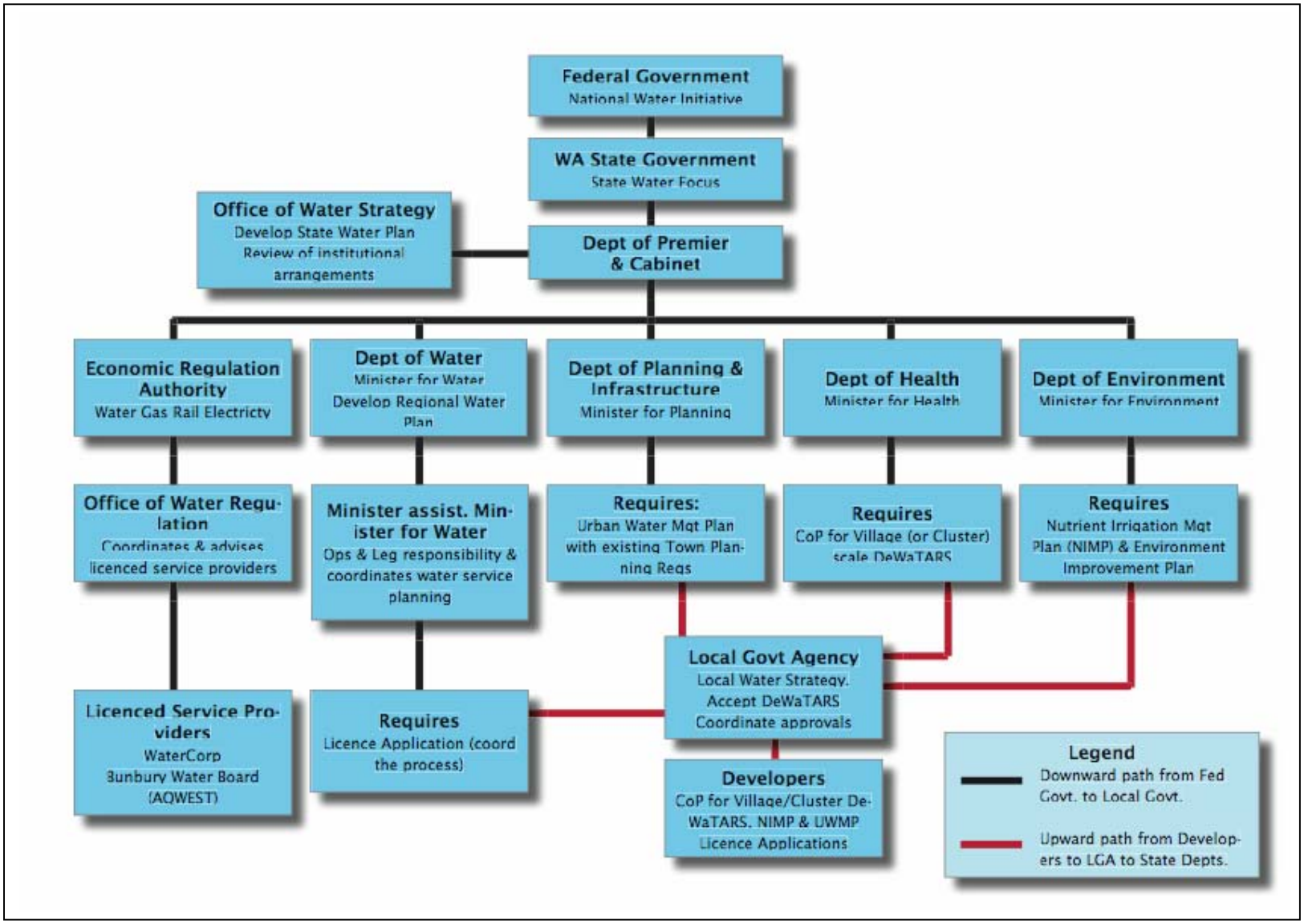
The Guidelines also promote IUWM and highlight alternative water supplies for non-potable use. The Guidelines are still a work in progress; with workshops being conducted to develop best practice options for non-potable use. During the workshops, conducted to date, there has been much debate over the use of non-potable water inside the residence. Representatives from the DoH reinforced the requirement that if recycled water was going in-house for non-potable use, eg toilet flushing, then the treatment process required will be to a Class A standard, refer Appendix 4. The high cost in meeting these requirements deemed in-house use unlikely and therefore the Guidelines did not look closely at this option (GHD, 2005). The Guidelines highlight that groundwater and greywater are the best options for the supply of non-potable water. The economic costs, sewerage connection costs and the lack of technical operating ability were considered barriers that impeded the use of recycled wastewater as a viable supply of non-potable water and without the impetus of a higher SWS target there has been no pressure to investigate these barriers. However the high costs of pumping to the nearest Water Corporation pumping station may justify DeWaTARS.

5.2.6 The New Framework

A proposed new legislative framework is outlined in Figure 2. The new framework includes the new Department of Water and the Water Services Planning Branch within

this Department. Due to the regulatory requirement of separating service provision from resource protection the ERA will still manage the OWR. However, there will be a close connection between the OWR and the new Department.

Local Government Authorities provide the public connection to the new framework. The new framework indicates the main regulatory information developers need to provide for DeWaTARS applications, on top of the standard Town Planning Development requirements. The clarity of roles provided by this framework, enable LGAs to provide clear guidance to developers implementing DeWaTARS in new urban developments.


Federal Government
National Water Initiative
WA State Government
State Water Focus
Office of Water Strategy
Develop State Water Plan
Review of institutional arrangements
Dept of Premier & Cabinet
Economic Regulation Authority
Water Gas Rail Electricty
Dept of Water
Minister for Water
Develop Regional Water Plan
Dept of Planning & Infrastructure
Minister for Planning
Dept of Health
Minister for Health
Dept of Environment
Minister for Environment
Office of Water Regulation
Coordinates & advises licenced service providers
Minister assist. Minister for Water
Ops & Leg responsibility & coordinates water service planning
Requires:
Urban Water Mgt Plan with existing Town Planning Regs
Requires
CoP for Village (or Cluster) scale DeWaTARS
Requires
Nutrient Irrigation Mgt Plan (NIMP) & Environment Improvement Plan
Local Govt Agency
Local Water Strategy.
Accept DeWaTARS
Coordinate approvals
Licenced Service Providers
WaterCorp
Bunbury Water Board
(AQWEST)
Requires
Licence Application (coord the process)
Developers
CoP for Village/Cluster DeWaTARS, NIMP & UWMP Licence Applications
Legend
Downward path from Fed Govt. to Local Govt.
Upward path from Developers to LGA to State Depts.

Chapter 6 A New Regulatory Tool

The new concept of DeWaTARS was developed in Chapter 4. A new legislative framework was developed for DeWaTARS in Chapter 5. It became clear in this research that a new regulatory tool would be required. Current tools do not recognise the new 'village scale' user category, which was described in Chapter 3. Moreover, the current tools are for the use of greywater only, not combined wastewaters.

6.0 Introduction

As discussed in Chapter 2, the current regulatory tools available to developers are:

- NWQMS Guidelines for sewerage systems: use of reclaimed water (Municipal/community wastewater plants);
- Code of Practice for the reuse of greywater in WA (single homeowner); and.
- Code of Practice for the design, manufacture, installation and operation of Aerobic Treatment Units (Single Dwellings).

This Chapter will discuss a new regulatory tool, and the components required to ensure that:

- The concept of DeWaTARS is clearly outlined;
- There are clear performance standards in the system design;
- There are clear health and environment targets;

- These standards and targets are presented in a clear and user friendly manner;

- Homeowners and Developers have clear guidance on how to meet their legal responsibilities when implementing DeWaTARS technologies;

- Local Government Authorities (LGA) understand the DeWaTARS concept, enabling the recognition of DeWaTARS applications;

- Local Government Authorities have a tool that aids in the application approval process;

- By using the tool, developers will be able to incorporate DeWaTARS principles into the planning process.

With the Health Acts currently under review, it is an opportune time to consider the best practices approach for DeWaTARS projects to ensure public health. The Health review discussion paper (DoH, 2005b), proposes a new Health Act based on risk management approaches. This means that projects will be assessed on whether or not there is a risk to public health. If there is a risk then, there will be a series of Codes of Practices or Regulations for implementation guidance.

It is feasible for the existing Health Regulations to remain Regulations, under the new Health Act. The Regulations would be a stand-alone regulatory document and not a referred adjunct of the Health Act as it presently is. Unless there are significant changes to the Regulations, this is not the preferred option as it is the prescriptive language and the complicated layout of this document that is impeding the implementation of DeWaTARS. Regulations take a long time to amend, as they need to have parliamentary approval. Codes of Practices on the other hand are easier to implement and amend, normally use simple language and offer options rather than being prescriptions.

6.1 National Water Quality Management Strategy Guidelines for sewerage systems: use of reclaimed water

The NWQMS Guidelines for sewerage systems: use of reclaimed water (the Guidelines) provide advice on reclaimed water quality, level of treatment required to meet this quality, and necessary safeguards, controls and monitoring, refer Appendix 4. The Guidelines "*…foster the use of reclaimed water in a way that provides safeguards for public health as well as community and environmental benefits…*" (NWQMS, 2000 pV).

The Guidelines address effluent arising from municipal, or community, wastewater plants and do not consider reclaimed waters from individual household systems or undiluted liquid wastes of industrial origin. The adaptation of the Guidelines down to village scale DeWaTARS projects can be simple, despite the focus on larger scale infrastructure.

Specific areas that can be adapted are:

- Microbiological Water Quality;
- Chemical Water Quality;
- Treatment processes;
- Safeguards and controls;
- Public consultation requirements; and
- Legal responsibilities

6.2 Code of Practice for the reuse of greywater in WA

The DoH, DoE and the Water Corporation prepared this Code of Practice that guides the reuse of greywater in single dwellings. This document has several points that could be adapted to a new guiding document for village scale DeWaTARS, these are:

- Current list of approved systems;
- Current list of approved suppliers;
- A homeowners guide to reusing wastewater; and
- A list of the application requirements.

6.3 Code of Practice for the design, manufacture, installation and operation of Aerobic Treatment Units (Single Dwellings)

The Environmental Health Service of the Department of Health (EDPH) prepared this Code of Practice. This code sets out the "…*requirements for the approval by the EDPH of ATUs serving single dwellings using a combination of anaerobic and aerobic processes for the treatment and disposal of wastewater of domestic origin…*" (DoH, 2001 p2). As the title suggests the code is prepared to guide the design, manufacture, installation and operation for DeWaTARS at the scale of the single dwelling. The technical information provided in this document can be adapted to a new guiding document for village scale DeWaTARS; these include:

- System design parameters:
    - Hydraulic Loads;
    - Biological Loads;
- Materials and construction conditions;
- Compliance testing;
- Effluent disposal methods;
- Maintenance schedules; and
- Schedule No. 1 Technical Information.

6.4 New Code of Practice for DeWaTARS in village (or cluster) scale developments (CoP)

Currently the DoH refers to the NWQMS Guidelines for sewerage systems: use of reclaimed water for guidance in approving applications, and it is this document that forms the basic background information required for the new CoP, which are:

- Principles
    - Public consultation requirements

    - Legal requirements
    - Contractual arrangements and provisions
- Essential Consideration
    - Water quality parameters
    - Treatment processes
- Management Operating Strategies
    - Hazard Analysis and Critical Control Points (HACCP) risk management approach
    - Safeguards and controls (including hazard and risk management protocols)
    - Monitoring and reporting
- Specific reclaimed water applications
    - Potable
    - Non-Potable
        - This could include the new planing tool outlined by the Water Corporation; refer Appendix 3.
- Irrigation scheme

The new document needs to be written in easy to understand, non-prescriptive language (other than when referring to water quality standards) and should present information in a methodical manner. One method that developments, incorporating DeWaTARS, can use to meet health and environmental monitoring and maintenance requirements, is to develop and incorporate management operating strategies (MOS). The Water Allocation branch of the Department of Environment, in Statewide Policy 10, states that the use of MOS *"…allows the licensees to participate more effectively*

in managing the impacts of taking the water, increasing awareness and responsibility…" (SPP, 2000 p8). Although this statement relates to water access licenses, the use of MOS can be correlated and adapted to DeWaTARS projects.

Implementation of MOS enables clear documentation of commitments and responsibilities for the management of impacts, to residents as well as the environment, of any DeWaTARS being installed. The underlying theme of risk management will enable uniformity of requirements while being flexible enough to allow for varying site conditions.

There is a broad spectrum of DeWaTARS technologies available and the new CoP will need to be able to recognise the different technical capabilities of the various management bodies. In order for a document like this to encapsulate the broad spectrum of management bodies and in order to give valid guidance to them, a new subsection is suggested at the beginning of the document.

This new subsection, named Management Options, will identify the different management types, as illustrated in Table 10, Section 3, and highlight the different requirements necessary for DeWaTARS implementation, as illustrated in Table 11, Section 3. For example a small DeWaTARS project managed by a body corporate, like the one found at Bridgewater, WA, might be capable of managing and operating a greywater recycling system but may struggle to manage and operate a combined wastewater stream.

This will enable specific management conditions to be set for different management types and provides clearer trains of responsibility for DeWaTARS projects.

Chapter 7 Conclusion

The increased urbanisation of Perth is placing pressure on the aging centralised wastewater system. The threat of yet another summer of water restrictions, demonstrates a need to develop and implement alternative strategies to meet existing and future water supplies of the city. The "big pipes in, big pipes out" traditional systems do not fit in with the new sustainability agenda. There has been a shift towards decentralised systems that include water-recycling measures. The ability to recycle water reduces demands on potable water supply.

Recycling water at the village or cluster scale reduces the demand on potable water supplies. International and interstate concepts and models have shown that a decentralised AWWS concept can be developed that is applicable to the WA housing environment and have provided the basis for the new decentralised wastewater treatment and recycling systems (DeWaTARS) concept. The concept of DeWaTARS differs from the other concepts and models by incorporating the use of management options that will allow for effective DeWaTARS implementation in WA refer chapter 4. The inclusion of management options requires management criteria to be identified, these include the following characteristics:

- The ability to develop and implement a risk assessment and management plan;
- Public Liability insurance cover for residents and Workers Liability insurance for employees undertaking maintenance work on the system;
- Management infrastructure needs to be in place to ensure that timely and efficient management of the system occurs;
- Ability to monitor the system;
- Technical ability to maintain, operate and update the system;

- A cost recovery mechanism that is fair and equitable.

As was discussed in chapter 5 a new legislative framework can be formulated to assist with the implementation of DeWaTARS. There will be many challenges to implementing DeWaTARS, the most significant being the legislative and regulatory impediments. These impediments can be addressed in three ways:

1. Adoption of the DeWaTARS concept and management options as defined in this thesis, by developers, regulators and households;

2. Adoption of a new legislative framework, that incorporates the DeWaTARS concept, refer chapter 5; and

3. The adoption of a new regulatory tool, the Code of Practice for village (or cluster) scale DeWaTARS, refer chapter 6.

WA is in a prime position to start initiating the DeWaTARS concept. The experiences in the eastern states, where the National Water Initiative has delivered best practice models, can assist the development of a WA model. For example the installation experiences of the Rouse Hill Development in NSW can be used to deliver best practice procedures.

The DeWaTARS concept was developed based on focusing research on the challenges facing developers in new WA urban developments. These challenges are not restricted to new urban developments. The DeWaTARS concept is adaptable to country areas, urban renewal projects, mining sites, Aboriginal communities and remote tourism sites.

Finally, further research into risk management, appropriate operation, management procedures, and service provision for the variety of urban village scales that typically occur in WA is required to ensure that DeWaTARS is successfully implemented.

Chapter 8 Recommendations

The concept of DeWaTARS provides cities with a local, sustainable and economical option to the provision of water for non-potable uses. This research investigated the necessary legislative and regulatory changes required for DeWaTARS implementation. The following recommendations address the issues impeding the adoption of DeWaTARS technologies in WA urban developments:

Recommendation 1.

The National Water Initiative (NWI) offers WA a process in which to reform water policy. Whether the State Government signs the National Water Initiative is up for debate, what is not is the need for water reform in WA. Pricing, policy and regulations restrict new water market opportunities and need to be addressed. The most restricting of these policies is the Government Sewerage Policy: Perth Metropolitan Region. In light of the shift away from traditional centralised wastewater services, this research recommends:

The State Government reviews the Government Sewerage Policy: Perth Metropolitan Region, with a view to creating a new vision for the Perth Metropolitan Region.

Recommendation 2.

The concept of DeWaTARS is emerging as a sustainable water practice for urban villages. This research recommends:

That the State Government adopts the concept of DeWaTARS, as outlined by this research, and includes DeWaTARS concepts within future State and Regional Water Management Plans.

Recommendation 3.

This research has illustrated the complexity of governing arrangements that currently exist for wastewater services in WA. With the development of the new Department of Water, the State Government has started the process of simplifying these arrangements.

A new wastewater services market will require clear frameworks to guide the implementation of DeWaTARS in new urban developments, this research recommends:

That the legislative framework outlined in this research be adopted as the preferred framework for developers implementing DeWaTARS technologies.

Recommendation 4.

As a trial, companies issued an industry licence under Part IV of the Environmental Protection Act are being asked to voluntarily complete an Environmental Improvement Plan, to encourage sustainable practices beyond the license conditions. This research recommends:

That Mandatory Environmental Improvement Plans be required from wastewater service licence holders be introduced.

Recommendation 5.

The Health Act and Regulations are prescriptive, difficult to use and do not recognise village or cluster scale DeWaTARS. With the move towards a new risk management based Health Act, there is an opportunity to address these issues. Regardless of whether or not the Health Act and Regulations are amended there is a need for a new regulatory tool that can be implemented to help guide developers choosing to implement DeWaTARS within new urban developments. This research recommends:

That a new regulatory tool, called Code of Practice: for DeWaTARS in village (or cluster) scale developments, be further researched and implemented.

Recommendation 6.

Due to time constraints, this research was unable to develop suitable risk management or HACCP approaches required by developers operating DeWaTARS concepts. This research recommends:

That further research is conducted into the necessary risk management approaches required of developers implementing DeWaTARS into new urban developments.

Recommendation 7.

Further research into specific type of operation and management plans is required for DeWaTARS for each of the different village scales described in this thesis. This research recommends:

That further research is conducted into the necessary operation and management plans required for the different village scales outlined by the DeWaTARS concept.

Recommendation 8.

The identification of the appropriate service providers likely to be able to implement the operation and management requirements at each scale of urban village is required. This research recommends:

That further research is conducted into the appropriate service providers able to implement the operation and management of village scale DeWaTARS.

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Appendix 1 Principal State Acts impacting on the production and use of recycled water

Legislation	Enforcing Body	Water Service Interest	Compliance Requirements/Comments
Environmental Protection Act 1986 Environmental Protection Regulations 1987 Any sewage treatment facility of 20-100M^3/Day – to be registered and licensed	Department of Environment	In new development proposals the Environmental Protection Authority (EPA) will be notified to determine whether or not an EPA assessment is required. Assessment varies, from no assessment to formal assessment. Formal assessment will be required if the EPA considers the environmental impact of the project is likely to be significant. Formal assessment will require a detailed report describing the proposal, possible environmental impacts and the planned management of these risks. After public consultation, the EPA prepares a report and makes recommendations on suitability of the proposal to the Minister for the Environment.	Licences and works approvals are issued with legally binding conditions that apply to specific premises and are intended to prevent or minimize the potential for pollution. SCHEDULE 1 - PRESCRIBED PREMISES PART 1 (Works Approval and Licence) Category number/Description of Category/Production or design capacity 54 Sewage facilities: premises - (a) On which sewage is treated (excluding septic tanks); or (b) From which treated sewage is discharged onto land or into waters. 100 cubic metres or more per day PART 2 (Works Approval, and Licence or Registration) Category number/Description of Category/Production or design capacity 85 Sewage facilities: premises - (a) On which sewage is treated (excluding septic tanks); or (b) From which treated sewage is discharged onto land or into waters. More than 20 but less than 100 kL/day 85A Sewage pumping station: premises on which sewage is pumped (other than to or from septic tanks) and where a discharge of waste from the station may enter the Swan River or the Canning River. Not applicable
Rights in Water and Irrigation Act 1914 (RIWA)	Department of Environment	Provides legislation for allocating and managing all access rights to surface and ground water resources in WA. The Act vests in the Crown the rights to manage use and flow, and the rights to control surface or ground water resource. It also empowers Water Resource Management Committees to make and enforce policies and by-laws for water resources within their management area	Where high levels of N and P are applied to land and there is a risk to sensitive water resources, a Nutrient and Irrigation Management Plan (NIMP) may be required before a licence is granted.
Waters & Rivers Commission Act 1995	Department of Environment	Confers the powers to manage the State's water resources on the Water and Rivers Commission. The Commission manages water resources through a number of mechanisms, including the use of planning controls and the granting of licenses.	
Water Agencies (Powers) Act 1984	Water Service Planning Branch of	Provides ongoing advice to the Water Industry Minister in relation to the review and reform of water services	If a scheme is inside a controlled area a service provider is required to be licensed If a scheme is not inside a controlled area a service provider must give the coordinator of water

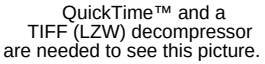
Water Services Coordination Act 1995	the Department of Environment	legislation. The branch also provides support to the Minister in meeting the obligations of existing legislation. These obligations include the approval of major works such as water tanks and mains, the approval of prices set in by-laws and the appointment of members to the regional water boards.	services 3 months advance notice
Health Act 1911 Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 For all wastewater systems with on-site treatment Health Act 1911 Part IV For Sewerage Scheme Operated by a Local Government	By Executive Director Public Health [EDPH] Submitted via Local Government By Governor Submitted via Local Government with EDPH Recommendation	Applications for all wastewater systems must be made to the EDPH or local government. Applications to the EDPH are to be accompanied by a report from local government, provide full details of the proposed system and include payment of the required application fee. Construction shall not commence until an approval for the system to be constructed has been issued. Once the system has been constructed, the local government should perform an inspection to confirm the system has been constructed in accordance with the requirements of the Health Act 1911 and Health Regulations in addition to any conditions of approval imposed. The system may not be used until that final inspection has occurred and the local government has issued an approval for the system to be used.	Applications for all wastewater systems must be made to the EDPH or local government. Applications to the EDPH are to be accompanied by a report from local government, provide full details of the proposed system and include payment of the required application fee. Construction shall not commence until an approval for the system to be constructed has been issued. Once the system has been constructed, the local government should perform an inspection to confirm the system has been constructed in accordance with the requirements of the Health Act 1911 and Health Regulations in addition to any conditions of approval imposed. The system may not be used until that final inspection has occurred and the local government has issued an approval for the system to be used.
Water Corporation Act 1995	Water Corporation	Control over the engineering design standards for sewers by developers connecting to their pump stations and main trunks	
Financial Administration and Audit Act 1985	Office of Water Regulation	Regulates “sole provider status” requirements of Water Corp. Decentralised systems challenge this status and perhaps collaborative partnerships between developers and Water Corporation is an option.	
Town Planning and Development Act 1928 Strata Titles Act 1985 Town Planning and Development (Sub Div) Regulations 2000	Western Australian Planning Commission	WAPC is responsible for determining applications for freehold (green title) subdivision and survey strata under the TPDA & STA, with the information required is authorised by regulation 4 of the TPaD(S)R.	WAPC SPP No 2 Environment and Natural Resources Policy, is made under the TPDA, applies throughout WA. Is ‘consistent with the guiding principles of the NWQMS and the SWQMS’ and the ‘Wetlands Conservation Policy for WA (1997)’. Encourages Urban Water Management via water sensitive design approaches that best manage stormwater and mitigate risk of nuisance or disease vectors, such as mosquitos and midges.

Appendix 2: Interview Guide

Name	From	Contact Details	Guide Questions (refer Appendix 5 for complete list and responses)
Dr Paul Van Buynder	Chief Medical Supervisor, DoH	93884999	Health Requirements; Legislative challenges within the Health Act; DeWaTARS from a Health perspective
Mr Charles Sabato	Water Corporation	94202420	The role of Water Corporation; DeWaTARS as a new business opportunity;
Mr Sam Milani	Resources Project Manager National Lifestyle Villages	92219099	What technologies work best, how easy is the approval process, what are the barriers/opportunities for DeWaTARS
Mrs Shelley Cocks	Environmental Health Officer, City of Melville	93145884	How many DeWaTARS applications are received; what happens to them once you receive, what are the impediments to DeWaTARS
Mr Kevin Broughton	Town Planner, National Lifestyle Villages	92219099	Town Planning requirements; impediments from the developers perspective
Mrs Meredith Blais and Mr Jeff Camkin	Conducting the WA Water Industry Arrangements Review, the Department of Premier and Cabinet	92229384	What are the legislative barriers; what is the current framework; the impact of the new Department of Water; the Perth sewerage policy
Mrs Mescal Stephens	Researcher, CSIRO Floreat	93870330	Public perceptions of wastewater reuse; regulatory impediments
Mr John Williams	Principal, Timbers Edge, Dawesville WA	jrw@webace.com.au	Case Study of greywater management and ownership
Mrs Shelley Shepherd	Essential Environmental Services	0403170040	DPI involvement, proposed model for integrating urban water management with land use planning
Mr Mike Mouritz	Manager, DPI	92168491	DPI role in water recycling; new requirements for developers
Mr Philip Hine	DoE	philip.hine @environment.wa.gov.au	Environmental requirements for DeWaTARS; the effect of the new Department of Water
Mr Chris Higgs	Minister assisting the Minister for Water office	0427081114	The role of the new Department of Water; the Minister assisting the Minister for Waters role
Mr David Horn,	Senior Engineer, GHD	94296666	Development of the Non-Potable guidelines
Mr Ertan Barkman	Project Co-ordinator, Infra Tech Pty Ltd	93541177	Impediments from the developers perspective
Mr David Beyer	LandCorp	94827499	Implications for DeWaTARS; Harvest Lakes development what

			they did and didn't do
Mr Dallas Trowbridge	Maintenance Manager, NLV	92219099	Bridgewater Lifestyle Village and the greywater system implemented

Appendix 3 GHD & Water Corp Non-Potable Water Use Options



Appendix 4 NWQMS Process Trains, Water Quality and Options uses for reclaimed water

Process level	Process examples	Removal Aims	ANRG* Class		Use Options under ANRG
Preliminary Stage	- Physical screening	Removal of coarse particles such as small stones, sand and gravel	N/A		N/A
Primary Treatment	- Screening - Comminution (if req'd) followed by coagulation +/or flocculate before sedimentation	Removal of most of the remaining particulate matter.	Class D Lowest Quality, PR is site specific as per stream requirements	Thermotolerant coliforms: < 10000 org/100mL (median) pH: 6.5 – 8.5 (90 percentile) For aquaculture, salinity TDS < 1000mg/L, < 10% change in turbidity (seasonal mean conc.), may need dissolved oxygen controls for fish, zooplankton	Silviculture, turf, cotton etc with 4 hr withholding period, aquaculture (non-human food chain) and stream augmentation
Secondary Treatment	- Activated sludge with settling or clarification; - Trickling filters with settling or clarification; - Oxidation ditch with settling or clarification; and - Lagoons or oxidation ponds.	Removal of dissolved and suspended organic material. These processes remove up to half the N and convert phosphorus to phosphates. About 80-95% of the BOD and suspended solids are removed.	Class C (+ PR) Class B (+PR)	Thermotolerant coliforms: < 100 org/100mL (median) pH: 6.5 – 8.5 (90 percentile)	- Agriculture (i.e. no direct contact with water, have a peel or those products sold pre-cooked), fodder for grazing & dairy stock (withholding periods), controlled municipal use and mine sites. - Agriculture (i.e. no direct contact with water, have a peel or those products sold pre-cooked), fodder for dairy stock (no withholding periods) and drinking water for stock except pigs.
Tertiary	-Microstaining;	Removal of colloidal and	Class A	Thermotolerant coliforms: <	Groundwater recharge,

Treatment	- Detention in polishing lagoons; - Filtration via sand, dual media Artificial wetland processes; - Microfiltration; + - Reverse osmosis	suspended solids by chemical coagulation and filtration, with the removal of specific metals, pathogens and nutrients.	(+ PR)	10 org/100ml (median) Turbidity: 2≥ NTU (mean), 5 NTU (max) pH 6.5 – 8.5 (90 percentile) CL2 residual: 1mg/1 after at least 30 minutes contact time or equivalent level of pathogen destruction Consider salinity controls	uncontrolled municipal use, non-potable residential use, direct irrigation of raw and salad crops.
Pathogen Reduction (PR)	-Chlorine; -Chlorine O; - Ozone (O3); and Ultraviolet (UV) irridation	To be used in conjunction with the above processes			

Appendix 5 Interview Questions and Summary

Department of Health

Questions
Is there scope for the development of a third pipe system in new greenfield developments like that found at Rouse Hill in NSW?
The identification of a new user group the 'urban village" as opposed to "single dwelling" or "municipal wastewater" allows the possibility of stand alone wastewater treatment and reuse systems that can be separate from the WC. What are the major hurdles from a DoH perspective?
Is it possible to incorporate a new category of new user to incorporate the urban village i.e. single household, urban village and municipal wastewater?
Overseas examples have shown that health and environment concerns can be met? How confident is the DoH?
How do you respond to the suggestion that when discretionary provisional approval under the sewerage policy is seen, as hand balling between departments as each can fall back on the other should the decision be difficult.
Can the DoH recognise the ability of urban villages, such as retirement villages and caravan parks, to meet maintenance and monitoring requirements?
"Localised treatment of sewage represents a lower cost than sending the wastewater to a remote regional wastewater treatment facility" if this is the case then why are

more systems not approved?

What does industry need to do, what factors are important from a DoH point of view?

Answers

The guidelines are quite clear depending on what the start water is storm, grey or blackwater and what the expected use will be then based on a fit for purpose scenario the health department will advise the amount of treatment required. So the rules are depending on the human exposure determines the quality and depending on the start level will depend on the level of treatment required.

The other thing is, the three levels of monitoring; validation: prove it works beforehand; ongoing monitoring: have a capacity plan so if it mucks up people won't get sick and verification: which is those systems that don't work in time can be looked at.

The problem with developers they start with a quality of water which is risky, both black & grey water both have human pathogens then that has a high level of contamination and then they want to put it in-house therefore human contact and need to get rid of all the bugs and they blanch when told to meet a certain standard; and validation means this particular process and if you have a development of a couple of hundred houses its going to cost you a seven figure sum to prove this system is going to work their view is we (developers) shouldn't have to do this and want to do something else, the DoH are saying if this doesn't meet your cost benefit analysis then don't put it in the house; do something different its very clear to DoH, they are not going to change the health act because its not economically viable of an individual developer; its not in their or DoH best interest to have a project fall over, the other problem is governance is this being run by a body that has an ongoing interest in the system governance is not normally an issue, if its being set up by a developer and wants to walk away at the end of the process then there is a process being run by who.

The other problem a number of items with developers who presented a particular proposal and haven't met the guidelines or to get them to a meet guidelines would not be economical and their response has been to not redo the proposal but to lobby Jos Mensink or the premiers department with a view to saying that the DoH is not being receptive (difficult). The DoH responsibility is to public health not to get the development up and if their development is inconsistent to the health guidelines then the development will need to change or not proceed, the guidelines are very clear.

Single home use Vs WTP

No there are only two levels of guidelines 1. The single home, where they are already sharing the bugs within the home unit. The risk is only to those within, user be aware, they are not posing a public health risk. 2. Anything other than that is level 2, generally only look at the big picture stuff due to the costs involved effectiveness works, its generally not efficient to do something in between, Beenyup or the whole of Port Hedland, but the guidelines for the stuff in the middle is the same for the big picture plants; because as soon as you move outside the individual house your sharing the risk there is a duty of care which goes beyond the household making the decision for their family; so the guidelines for the big stuff is the same for the little & medium stuff as the risk to the public is the same; regardless if its 500 people or 50000; developers are always given the information that they need to meet do big ticket guidelines in regards to health safety and the problem is, its not worth it.

Big-ticket guidelines suitable

The guidelines don't tell them what sort of plant but here are the water quality required, regardless of the size of the home 50 or 50000. Its still the same water quality, and they can come up with any sort of method to meet these guidelines where they usually stumble is the three levels of monitoring (validation, on-going and verification); the ability to demonstrate the governance problems for the developer (especially a small developer) with the exception that the further away from human contact the less you have to prove something works i.e. its easy to get approval for sub surface drip line for public open space, because where's the risk to the public, just need something in there to ensure that its not bubbling out of the ground.

Paradigm shift – re increase in applications – so be it

To us we are not here to set rules for the most cost effective way to provide a service, come across this all the time, so somebody wants to run a class A horticultural system they will need to make the decision based on how many of them there are and whether they reconfigure Beenyup or they ship it 10k's from Beenyup and put the extra treatment there at a much lessor cost because they are the only people that need class A as everyone else along the way doesn't, now these are economic decisions that somebody will make the DoH perspective if you want to do it on a horticultural then it needs to be class A now what ever makes sense for you from a cost effective basis; is the developers or the water treatment people; what we need to do is make sure that a certain quality of water required and that exists; now if we get extra ones due to a whole lot of smaller applications, then it doesn't matter. From a DoH point of view as the guidelines are there people need to understand that they exists and if they are unclear of the process then the DoH is willing to share; to discuss the process that they need to do to meet these guidelines, because that's the only bit that's

variable.

If you come to him and say that you are going to use title 22 technologies without being proven then a trial period of say two months would be conducted. If you say you have a new widget that does everything that title 22 does then a 12 month trial to prove so that the public

Sometimes allocation issues with the waters and rivers drive these things, not a green agenda, but they're (DoH) not going to change the health guidelines because developers can't get a larger water allocation.

MAR – EPA storage and reuse during summer

Extra treatment controls before the water goes into the aquifer, MAR is not something that will be introduced so that developers can get a larger allocation, to fix ecosystem damage and give us potable drinking water, because they have to get rid of the chemicals, won't be a trial of MAR that cost less than $20M; no trial of MAR using treated wastewater that gives out less than 200 the likely hood of something like that to benefit developers is unlikely as its huge amounts of money to get some drinking water for Perth which is the main focus for the MAR review so I don't think you'll get impact on developers the technology might help the local bits but I don't think this can be seen as an opportunity to

That's one of the reasons the guidelines are there, to protect scheme water and public health; we cannot afford to have mistakes; we would love to meet the 20% by 2012 we would like 30% by 2012 and the stuff that we are talking about has no difference in the big scheme of things, we would got make it safe.

The DoH staff training

Medical advisor on reports not his staff, there are a group of people who look at approvals for technologies if there is something new they will look at it in conjunction with a group of people to review (inside and outside the department); are they trained fully equipped engineers no they're (without knowing the exact details) not but there is a balance with out knowing the specific; it probably doesn't matter that much because in the end what they have to show is that it works, whatever technology that is brought to them there needs to be evidence that it works, a history of the technology; and then they get added to the list of approved works; its assessed on the way the technology protects the public not whether its good or bad so understanding the engineering of something is not as important as knowing what it needs to protect understand what it has to do.

Greywater systems, wanted to do something in-house class A, instead of a trial they've have told the project developers is that they are going to review what has been done in the eastern states and may well turn out to be a single trial that all the states can then review instead of having to do one in NSW/Vic/SA etc if that validates the technology then it will get a lot of ticks from all the states but it won't be because they got someone to look at it here and agree that the technology is consistent with appropriate technology; it doesn't matter it either works to protect the public or it doesn't;

Rouse Hill & Mawson Lakes Case Studies

We learnt a lot from these projects, RH was a large development they made enormous number of mistakes and a significant number of cross connections, the DoH look at these projects and that is why the health regs are as they are; why they have particular qualities; and why they want the government to sort out pricing policy. RH selling recycled water for 20c/kl when it cost $3/l to produce. Who going to do that the developers aren't going to do that and neither are the public do that and despite that amount of infrastructure there where cross connections; if offering free water then people are going to deliberately cross connect as they don't want to pay there water bill; the DoH review all these things risks in the process.

Meet the current guidelines, where they want the water to go; the problems that they invariably face are:

- If you don't go into the house what are you going to do with it.

- If you do go into the house then the treatment levels are increased and the costs rise

Me "that's where MAR would have been good to solve this problem at the smaller scale winter excess and summer reuse"

The task is for drinking water so that the scope needs to be increased to perhaps include this option, this is more of a discussion for the EPA rather than the DoH; nutrient loads and all those other consideration.

Sometimes the environmental conditions are more stringent then the DoH, MAR trial for a gold course in Mosman but it was stopped on the basis of the nutrient load, need to protect both sides of the argument health and environment and it will be very difficult to manage both and it would most definitely be on a site by site basis.

He agreed with me that MAR may be the saving grace, to keep costs down as without in-house use then storage is an issue. May need extra processes i.e. nitrogen removal processes; might still need to be class A;

Health Act overhaul

Significant change as its 1911 draft, open for pubic comment 22nd of November for public consultation perhaps 2 weeks now if not on website then contact Mary Adams should be able to direct me.

Department of Environment

Questions

What thoughts do the DoE have on direct recharging of the aquifer with recycled water for use in dry months?

Is there confidence within the department of technologies and their ability to meet regulatory requirements?

Are DNIMP and waste load processes adequate to ensure developers meet the regulatory requirements laid down?

What issues for effluent reuse are valid for the Peel region?

How do current regulations respond to these issues? Are they a barrier for developers?

Can the approval process be streamlined?

Answers

30th of August 2005: Philip Hines

http://www.slp.wa.gov.au →EP Reg 1987 schedule category #6

DoE – Nutrients DoH – Bugs

Recycling by WaterCorp is not beyond them but is hard to implement

People can manage their own destiny and to encourage this DoE are looking into the SA Wasteload Program (with the Department of Agriculture, is a technical tool of waste characteristics) and customise to WA i.e. the program is unduly conservative and restrictive.

Instead of licence having a regulation model with a risk-based tool. Do it like this and you wont have a problem.

Registration category – 3 instruments (water allocation & license; water allocation, license & regulation; regulation only)

Increased irrigation from effluent

Both are licensed

Ineffective pollution control device

Doesn't encourage efficient use

Annual fee = annual licenses (now its longer up to 5 years with application fee)

Collecting money from recycle ventures is not seen as encouraging

In relation to NIMP mainly for ground water extraction

Recommended Nick Turner at WaterCorp

Department of Planning and Infrastructure

Questions

How focused is the DPI in wastewater recycling

Does the DPI have an opinion on decentralised systems and wether or not they believe these types of systems can be considered a viable approach for new greenfield urban developments within the peri-urbanised areas of Perth?

Do you see the BASIX's program having any affect on w/w recycling in new developments?

How much influence does the DPI have on the implementation of new wastewater treatment plants such as those proposed at Alkimos in the northern suburbs?

I today spoke with Mike Mouritz at DPI who has confirmed to me that there is indeed a review going on and this is the ideal time to present a critique of the Sewerage policy and other regulatory instruments.

What role can zoning play in encouraging w/w systems?

Answers

1st June 2005 Siddhartha Jha BASIX

Perth to be 20% drier by 2030

Perth to be 60% drier by 2070 (CSIRO data)

↓ Rainfall + ↓ Streamflow = ↓ Storage

4↑ Pressure on groundwater

Measures potential performance for sustainability

Establishes a sustainability benchmark for new dwellings (residential)

Water target of 40% reduction over similar building (dependent on the # of rooms)

Energy target of 25% reduction over similar building

Quantifiable policies are drawn out and inputted into the program, with a target of July 2006

Cost savings to society far greater than short term cost to housing buyers

Building regulations: department of Housing & works and the DPI

New buildings for the moment, however retro fit for existing buildings will be the next logical step

$3000 - $5000 extra for BASIX compliance (expected extra cost)

Implementation

Works within EP&A Act (in WA via the Planning of Local Government misProvisions Act and Building Regulations 1989)

New Building Act being developed which may be able to incorporate BASIX

Overrides previous water & energy controls

24th August 2005 Phone interview with Mike Mouritz

Referred Shelley Shepherd and Meredith Blais

Confirmed that the DPI is in the process of review of policies and process issues

6th September 2005 Shelley Shepherd

#1 Rezoning – broad land use concepts that include IWM requirements

#1A Structure Plan – a strategic plan that needs WAPC approval and where most of the effort is spent; series of compliances that once met that's it

#2 Sub-division – breaks down into individual lots, conditions can be placed on infrastructure; requires development approvals (DA) however these are not required for single residences, otherwise compliance is required for the BCA (Building Code Australia); this is the document where changes can be made and emphasis on recycling promoted.

BASIX's is an additional layer of approval house-by-house scale.

WAPC taking on board Total Water Cycle and proposes a model for integrating urban water management with land use planning; this is an tool in which to implement the SPP 2.9 water resources and helps meet the objectives set out in this document. Breaks the state into regions with the southern river being the first to implement the "planning bulletin" trial fro 6-12 months followed by peel. Once the trial has been completed there will be a review and amendments made then it will be gazetted.

In the eastern states local government is more separate/independent from the state government and are more empowered to implement

Town planning scheme:

What are your requirements (developer asks local council)

Do a structure plan

It then gets advertised

Sent for approval

- Recognise the need for changes

- Trying to simplify the process
- Reduce impediments
- Any process works well with other agencies
- There is no overarching federal government involvement
- Water conservation was traditionally not seen as important
- Need much better understanding of the site
- Strategic plans force the developers to show how they are addressing state & local regulations

Water Corporation

Questions

Can decentralised (individual w/w systems) w/w systems be incorporated within WC's existing infrastructure and future supply options?

In 1996 Dr Robert Humphries (the then Manager of Environmental Management at WaterCorp) talked about:

Corporatisation of water utilities can lead to a weakening of environmental outcomes. Is this still the thinking? How important is EMS? ISO 14000? How hard has it been for WC to implement EMS to ISO 14000? Is this system adequate to meet prior environmental concerns?

Integrated catchment management approaches will need to be implemented to enable better drainage quality. Can decentralised systems be a part of WC ICM?

Localised treatment of wastewater creates the possibility of a community being more involved in deciding what sort of treatment and how water management in the locality should be implemented (Ho, 1996). Do you think that community are able to make

these decisions? Are the technologies available to enable these decisions?

What role can small-scale high quality sewage treatment with localised reuse play in future development for WC?

New developments are allowing communities to have a say and there is an increasing demand for on-site sewage treatment plants. What are the main problems from a WC perspective in allowing small-scale sewage treatment plants? Is there a future in new licences being issued to these communities?

Is there room for economic concessions for new developments that implement wastewater recycling systems?

In the 2003 annual report it is stated that the WC has met the target of 10% of treated wastewater in re-use schemes throughout the State. How much of this was met by reuse schemes in the Perth metropolitan region?

Is there room for a third pipe system, as seen interstate and overseas examples? Can third pipe in new homes in preparation for recycled water connection be a reality?

The domestic sector accounts for about 70% of Perth's total demand. As per WC user study 2001. If this is the case what steps have WC done to introduce recycling systems within the home in order to meet SWS recycling targets.

Answers

Risk Management Tool has to be some middle ground between what the system costs and running cost as well as having a reliable supply to cover health & enviro & social cost.

Economically socially and environmentally; if the costs are to high for non-potable water it might sink the project; if you can find the middle ground you can implement your risk mgmt scheme and share the load with government involvement.

WC come to the realisation that if we want to explore non potable supply we have to acknowledge that we can't have a water source that's quasi potable or a level treatment near drinking water; having said that in those sorts of proposals are not viable in a developmental sense the costs are so high its ruled out as an option almost

immediately; issues of who runs the system; operates owns it; take over issues; land owners are happy to put these systems in place (infrastructure costs) but want a water utility/service provider to take over the running of the systems in perpetuity; this is where most of the risk; as you pointed out earlier our operationally new ground many variables public health & environmental.

Haven't got security of source; can be turned of at any time; need to be able to switch back to a potable source in case of failure of system the risk mitigation is fairly comprehensive it needs to be as it nots normal business line, need to partner industry in the ventures that's the line we need to adopt in terms of association of schemes will become service provider.

Local Government

Questions

How supportive are government bodies been with w/w systems in new greenfield developments?

Do you have clear protocols when dealing with w/w recycling applications in new greenfield developments?

Have there been w/w recycling system projects not go ahead? If so why?

How often does your city/shire see applications of this type?

Is your locality within the existing sewerage network?

Would your council be prepared to have a stand alone licensed system within your jurisdiction?

What are the barriers to getting developers to incorporate these systems?

City of Mandurah – recently the City approved a greywater recycling system for a development at Erskine. The fees that were charged to the development for inspection fees was charged for each individual home as if they where stand alone systems, yet when it came time to approve the number of chickens allowed for the subdivision the City of Mandurah deemed the project to be one parcel of land

therefore allowing only 12 chickens, which is it?

Answers

Premiers Department

25th August 2005: Meredith Blais (ph9222 9384) & Geoff Campcon (brief meeting with Jeff Major PWF)

WA Water Industry arrangements Review – working group looking into government agency arrangements and ID legislative needs (as there are 14 water acts)

State Policy General needs

Need to manage water cycle (IWM) – all deliveries i.e. industrial, residential and environmental

Strategic frameworks with clear objectives and principles

State water framework

Look at the cascade effect and holistic approaches – regional water plans → water allocations → licensing

Demand management source options

Agency accountability

Statutory regulations

1 Legislation – water resource management

Integration

Statutory planning

Improving certainty of allocation (water trading) →admin needs revamped

Shared aquifer systems

2 Policy – water licensing & service standards

3 Regulation – compliance with policy and regulation

National code due September 2005

Sewerage code – National WSAA voluntary code

Sole provider licence – local government act

Confirm a direction

Pilot studies/trial models – residence associations/specified area rate

Set time line to review policy/community consultation

6th September 2005 Chris Higgs Policy Advisor for the Minister Assisting the Minister for Water Resources

Gazette (goes through the minister)/bylaw/regulation – more prescriptive

Our water future – blueprint of the water industry for the future Irrigation review (steering committee) has future motions that can be relevant to all aspects of the water industry not just irrigation

Implementation of a licence fee/volumetric charge system, first step irrigators next step private bores, who knows where the madness will end!

Industry

Questions

What technologies do they suggest work best in new greenfield developments?

What deterrents have they come across that have discouraged them from incorporating w/w recycling within new greenfield developments?

Is there demand for water saving and recycling systems by the public?

What is the average cost increases?

How easy is it to obtain regulatory requirements? What are the costs involved in meeting legislation?

What are the barriers/opportunities for these systems?

Answers

1 **GHD**

25th August 2005: David Horn, Rebecca Gianotti (rgianotti@ghd.com.au) & (?)

Emphasis on agreeing to non-potable use identification. Rainwater in-house easiest to implement. Volumes meeting demand. Health issues – logistics, very conservative stance from the participants. Talked for a while on the data in the workshop notes (refer hardcopy for side points). 21st September workshop key stakeholders

2 CSIRO

29th August 2005 Phone interview with Mescal Stephens (93336000 or mescal.stephens@csiro.au)

Health Act is being reviewed contact Richard Fearbold at DoH)

Concern about technology constraints

Plumbing to be in line with the National Sewerage Code

Suggested looking at LandCorp Port Philip Bay, Melbourne and St Kilda test building for in-house use

3 9th June 2005 Kevin Broughton NLV

Good examples to look at South Beach (GW system approval problems) Harvest lakes, he worked on this project with David they didn't even consider implementation at a community scale.

Contact ref: Tracey Powers @ LandCorp Snr Project Mgr @ South Beach, talk to her via David Beyer

Reasons

- +Ve point of difference, makes the development stand out they might get brownie points
- - Ve no economic incentive
- - Ve sustainable targets list, water reuse is ranked 4th in selection criteria of public wants
- - Ve 3 out of 8 sustainable criteria for home approval and financial incentives
- - Ve no one could get GW approvals so no-one did it
- Everyone wants GW but can't get approval, always the DoH:
- Management issues: having to deal with anything other than an individual;

- Pathogen issues

Alannah McTiernan wants it on her sustainability scorecard but is hesitant due to health concerns.

Biomax etc only in non-sewered areas approved without connection to sewer.

No requirement for compulsion to do, it comes down to what the company/developer is prepared to do.

Greywater on a strata basis, with centralised management systems can meet WaterCorp and Health regulations.

4 Irrigation Review

Indian Ocean Climate Initiative WA Southern rainfall has declined

Chose a deregulated market based approach to water management in preference to greater regulation and tighter control.

Factors: ↑ demand ↓ rainfall

The need to integrate land and water planning

7 ministers impact on water management and policy

Metered irrigation (refer newspaper articles on your wall): recognises the need to meter all users so water use issues in the Gnangara mound can be better understood and managed

Allowing the rezone of wetlands to urban: ↑ recharge and ↓ nutrient loads [proposed Gnangara horticultural precinct

Adjustment of water allocations to match the new land use patterns and if necessary further reduce water use in critical areas by 'buying back' water from irrigation for allocation for the environment of domestic use.

Create

A new ministry for Water Resources

New Water resources Management Act

New Department for Water Resources by combining

The water resource functions of the DoE

State Water Strategy Unit

Office of Water Policy

Relevant functions within WaterCorp

DoE – Environmental Protection & water resource management and allocation

Potential conflict of interests where ministerial conditions set under the EPA Act 1986 conflict with Water Resource Management programs established under the Rights in Water & Irrigation Act 1994

The Planning of land use & water use are separated from each other. They need to be more integrated and co-ordinated

DOE (amalgam of DEP & WRC in 2002) – assesses water resources and determines how much water should be retained within natural systems.

DPI – land use planning → SPP: Water Resources, requires land use decision makers to take into account water resource issues in their decision making and that they have access to water resource info.

SWS – all applications for licences to be accompanied by an acceptable Water Conservation Plan.

Economic Regulation Authority

Questions

Is it feasible for a water pricing system that incorporates recycled water as a viable source of non-potable water? What barriers and how can they work within these boundaries.

Is there confidence in approving sole provider status to new development such as retirement villages?

Eastern states systems suggest that where sole provider status has been granted there has been an increase in recycling systems (re Rouse Hill), is this a valid statement? Can you see benefits in granting SPS in WA?

Do you receive many requests for sole provider status? What are the common reasons for non-approval of systems?

Can the ERA see a benefit in opening up the ability for urban villages to deal with their sewerage and recycle where possible on site?

"Localised treatment of sewage represents a lower cost than sending the wastewater to a remote regional wastewater treatment facility" if this is the case then why are more systems not approved?

Can sole status or partnership with WC (supply of water) be feasible under strata management, or are there to many complications.

One of the outcomes from the recent enquiry into water pricing was to "encourage investment in the water industry", has this been accomplished? What options have been identified via this process that can be instigated that will encourage investment?

Another outcome was the need to promote competitive and fair market conduct, can this be the case when there hasn't been a single sole provider status approved in the Perth Metro Region

Answers

18th May 2005 Lyndon Rowe Chair ERA

Report to government for implementation for the 2006/2007 pricing assessment

Challenges: climate, competing users, reliable supply, affordability, environment, efficient service delivery.

Align price with cost → consumers need to meet the cost of supply and future source development

Manage demand by changing current tariffs

Encourage optimal investments in source development/recycling

Move water to its highest value use (efficient allocation)

Pass on or avoid environmental costs → over extraction/resource management

Recover efficient costs of water provision, deliver affordable access to water for basic needs (equitable pricing)

Water Pricing tools:

Level of total bill

Inclining tariff with steps 150kL = 41c level 1

Balancing fixed & usage charges (total bill stays the same)

Concessions, both senior citizens and pensions as well as tariffs the same no matter where you live.

Conclusion:

↑ Fixed charge disguises the costs of water usage to customers

5 step tariff is complex and may not be the best way of achieving financial equitability

Aligning $ with costs reveals customer preferences for source development

Aligning prices with costs also reveals the value of water in alternative usage

Residential w/w $ is largely an equity issue

There are options for minimum the impacts of changes for vulnerable groups

Water Pricing

Objectives	Current	Alternative
Align price with cost	~ 50% of total bill is fixed charge	Greater relationship between total bill and amount used
Manage demand	Tariff with 5 steps	Rebalance tariff i.e. ↑ tariff ↓ fixed
Reflect environmental cost	Prices recover costs of meeting licence conditions	Increase resource management costs
Generate revenue	Budget/SDP	Enhanced transparency and certainty
Equitable pricing	↑ Tariffs & concessions	Rebalance tariff

Appendix 6 Documents Reviewed

1911	WA Health Act
1914	Rights in Water and Irrigation Act
1974	Health (Treatment of sewage and disposal of effluent and liquid waste) Regulations
1996-2000	National Water Quality Management Strategy Guidelines
1996	Government Sewerage Policy: Perth Metropolitan Region
1998	Water quality protection note: nutrient and irrigation management plans
2000	Australian guidelines for water quality monitoring and reporting
2000	Guidelines for sewerage systems: use of reclaimed water
2000	Guidelines for management of on-site /decentralized wastewater systems (USA, EPA)
2001	State water quality management strategy for WA
2002	State Water Strategy: securing our future

2002	Water WA: a state of water resources report for WA
2003	Senate: Australia's management of urban water
2003	A state water strategy for WA
2003	Greater Perth sustainable environment discussion paper iv
2003/4	National Water Initiative
2004	The parliament of the commonwealth of Australia: sustainable cities
2004	Water resources statement of planning policy 2.9
2004	Statewide planning policy 10: use of operating strategies in the water licensing process
2004	Liveable neighbourhoods: draft for public comment
2004	Environmental Improvement Plans: explanatory document
2004	Draft water resources statement of planning policy 2.9
2005	Code of Practice for the reuse of greywater in WA
2005	Economic Regulation Authority review into urban pricing
2005	Premiers Water Foundation: our water future
2005	Network city: a milestone in metropolitan planning
2005	A new public health act for WA: a discussion paper

2005	State Water Strategy: Irrigation review final report
2005	Governments response to the report of the irrigation review steering committee
2005	Water reform framework