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# Potable water reuse in Australia: Legal and regulatory frameworks, communication strategies and experiences

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## Summary

This chapter focuses on the legal, regulatory and policy frameworks on recycled water (also known as water reuse) in Australia in general, with particular reference to potable use in Queensland and Western Australia. It also gives consideration to communication strategies as essential instruments to promote stakeholder involvement. Information presented is on potable and non-potable water reuse. However, it emphasises reused water for drinking purposes. Two regions have been selected for this study. Queensland, because of the two potable water reuse projects that have been halted due to poor communication and public opposition in the case of Toowoomba and on lack of continuity of necessity and political support in the case of the Western Corridor Recycled Water Project. Western Australia was selected because of the Groundwater Replenishment Scheme operating in Perth. Potable recycling has proven to have numerous benefits as a reliable source of clean water for all uses.

**Keywords:** Potable water reuse; legal and regulatory frameworks; communication strategies; Australia

## 1 Introduction

Australia has been shaped by droughts and floods throughout its history. Droughts have played a fundamental part in the planning, management and development of water resources, including the diversification of water supply options to ensure the provision of clean water in the long-term and on efficiency measures. Water supply options include traditional surface and groundwater resources, and increasingly, stormwater management and reuse, purified recycled water for potable and non-potable uses, seawater desalination, and the use of rainwater tanks, water carting and water sharing between regions. Alternatives selected will depend on the conditions of the specific cities and regions (Water Services Association, 2020).

This chapter focuses on the legal, regulatory and policy frameworks on recycled water (also known as water reuse) in Australia in general, with particular reference to potable use in Queensland and Western Australia. It also gives consideration to communication strategies as an important element to promote stakeholder involvement. Information presented is on potable and non-potable water reuse. However, it emphasises reused water for drinking purposes.

Queensland was selected for this study because of the two potable water reuse projects that have been halted due to poor communication and public opposition in the case of Toowoomba and on lack of continuity of necessity and political support in the case of the Western Corridor Recycled Water Project. Western Australia was selected because of the Groundwater Replenishment Scheme operating in Perth.

Findings indicate that legal, regulatory and policy frameworks for potable water reuse are very robust in Australia. Also, that there are policy instruments that refer to community involvement and awareness on water quality in general and recycled water in particular, including for potable purposes. This, however, did not prevent one major project in the country being cancelled and another being suspended.

The reasons why projects in the State of Queensland were cancelled are complex. In Toowoomba, studies point to strategies on education, communication and involvement of the community that were not implemented well in advance. In the case of the Western Corridor Recycled Water Scheme, the reasons reported are more complex. While public support has been discussed, detailed analyses indicate that it was a combination of governance arrangements, regulatory frameworks, cost implications, post-drought negative views by the media and opportunistic politics that influenced the decision to recast the scheme as an emergency option and later on, put in care and maintenance mode.

In Western Australia, in Perth, engagement with the public that started more than a decade before the indirect potable recycling project was implemented is noteworthy. The Water Corporation (utility responsible of the initial trial sponsored by the State premier and then the Groundwater Replenishment Scheme) engaged with the public, regulators and the industry as a part of a long-term strategy that started in 2004. Since then, the several communication strategies have had the objective to understand and track attitudes and awareness of the community; improve public perceptions; and prepare documents where the project has been presented as the best future water option. When the Groundwater Replenishment Trial was completed, it had fulfilled the goals of providing technical feasibility, established a framework for policy and regulation and ensured community and government support. Stakeholder engagement has continued after the Groundwater Replenishment Trial was decommissioned.

The first stage of the full-scale Groundwater Replenishment Scheme was built by 2016 and stage two by 2020. The Water Corporation keeps opinion leaders and the community informed (in this order), emphasising uses, benefits and water quality aspects of recycled water use. Together with the Department of Health, the Water Corporation has the responsibility to develop and implement public education programmes.

Communication aside, the several projects developed in Australia with the purpose to diversify sources of water and the very large related investment (\$2.4 billion in the case of the Western Corridor) that were not used when it started raining, resulted in considerable criticism due to their high costs for the consumers.

This chapter is organised as follows. A brief history of water reforms in Australia at the federal level is presented, followed by a discussion of the National Guidelines for drinking and recycled water, community awareness and possible future of potable recycling at the national level. Regulations in Queensland and Western Australia and the potable recycling projects in these regions are discussed in depth, as well as communication as a policy instrument to promote potable recycling. We finalise with lessons learnt.

## **2 Brief History of Water Reforms in Australia (Federal Level)**

Constitutionally, water in Australia is a States/Territories responsibility.

The federation of the Australian colonies in 1901 through the *Commonwealth of Australia Constitution Act, 1900 (UK)* resulted in the Commonwealth having powers for “Trade and commerce with other countries and among the States” [s. 51 (i)] and “external affairs” [s. 51 (xxix)]. Section 100 precluded the Commonwealth from “abridging the right of a State or its residents therein to the reasonable use of the waters of rivers for conservation or irrigation”. Water management remains a states’ issue.

In the 1980s, the focus of State and Territory Governments with regards to water resources became geared towards expanding irrigated agriculture and augmenting water supply to satisfy the demand of the growing population (Productivity Commission, 2017). While the traditional strategy worked for Australia during this time, increasing environmental concerns (e.g. algal blooms, salinity) and costs in water infrastructure services provided an impetus for reform.

In cognisance with the aforementioned issues, the National Water Quality Management Strategy (NWQMS) (Commonwealth of Australia, 2018) was introduced in 1992. The strategy was a joint initiative between the Commonwealth of Australia, state and territory governments which were covered by the National Resource Management Ministerial Council. The objective of the strategy

was to promote sustainable use of water supply while ensuring water quality vis-à-vis economic and social development.

On 25 February 1994, the Water Reform Framework was launched. The framework was slated to run over a seven-year period, covering water pricing reforms, clarification on water property rights, allocation of sufficient water for environmental purposes, promotion of water trading, assessment of new rural water projects and reforms in water industry institutions (Willett, 2009). In 1995, the National Competition Council (NCC) was designated as the oversight agency for the implementation of the Framework.

From late 1996 to the late 2000s, Australia experienced a prolonged dry period called the “Millennium Drought”. It was noted as the worst drought in the country’s history causing an alarming decline in water supplies. Such a developing situation served as an impetus for investing in alternative water sources. By 25 June 2004, the Council of Australian Governments (COAG)<sup>1</sup> arrived at a 108 clause *Intergovernmental Agreement on a National Water Initiative* (Commonwealth of Australia, 2004) which further enhanced and extended the Water Reform Framework. It provided a nationwide framework in managing water for the environment, agriculture and urban use, including water recycling.

In relevance to water recycling, the Agreement committed the States and Territories to the following: 1) develop pricing policies for recycled water and storm water that are aligned with the pricing policies for potable water; and 2) develop national health and environmental guidelines for water sensitive urban designs for recycled water and storm water. To oversee the progress of the Intergovernmental Agreement on a National Water Initiative (NWI), the National Water Commission was subsequently established.

Following this, the ‘Water Smart Australia Program’ was introduced late in 2004 and served as a form of assistance (\$1.5 billion<sup>2</sup>) for states to accelerate the development and uptake of smart technologies and practices with regards to water use. It provided funding towards projects with total costs of approximately \$5 billion. It ended in June 2012 and no future related support was planned (Department of Sustainability Environment, Water, Population and Communities, 2012).

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<sup>1</sup> The COAG was composed of the Prime Minister, state and territory First Ministers and the President of the Australian Local Government Association (ALGA). Its purpose was to manage issues of national significance that require coordination among all Australian Governments. It was replaced in 2020 by the National Federation Reform Council with National Cabinet (Prime Minister, State Premiers and Territory First Ministers) at its centre.

<sup>2</sup> All figures are in Australian dollars.

In support of the NWI, the Australian government also invested another \$12.9 billion to address threats of water scarcity in the future through the “Water for Future” Plan in 2007 (Kiem, 2013). This encompasses investments in water supplies that are not climate-dependent. Within the said plan is the National Urban Water and Desalination Plan (2019) which specifically aimed to assist major cities and towns in their infrastructure projects and support research in desalination, water recycling and stormwater harvesting and reuse. The Millennium Drought resulted in the construction of desalination plants in South-east Queensland, Sydney, Melbourne, Adelaide and two in Perth. Most were completed after the end of the drought and except those in Perth, saw little use before 2017 (Radcliffe and Page, 2020). The National Urban Water Desalination Plan also included funding for five years to the following centres: 1) National Centre for Excellence in Desalination (NCED, 2017) and 2) Australian Water Recycling Centre of Excellence (AWRCoE, 2017). The centres were established in June 2009 and December 2009, respectively.

However, the Australian government’s support on addressing water security diminished over the years. The Water Smart Australia Program ended in June 2012. Following this, the National Water Commission was abolished in 2014.<sup>3</sup> Senator Fifield, during the second reading of the Act in the Senate, explained why the National Water Commission was abolished (Commonwealth of Australia, 2014):

*“Given both the substantial progress already made in water reform and the current fiscal environment, there is no longer adequate justification for a stand-alone agency to monitor Australia’s progress on water reform.”*

The statement above might suggest that the government did no longer see ensuring water security as the government’s priority. In this case, some of the functions of the National Water Commission were passed on to the Productivity Commission, the Bureau of Meteorology and the Department of Environment. In monitoring the progress of water reforms, the Commission had been tasked to assess the implementation of the National Water Initiative every three years. Lastly, the National Urban Water Desalination Plan only lasted until 2016. In the same year, the National Centre for Excellence in Desalination and the Australian Water Recycling Centre of Excellence were also closed (Dillon et al., 2018).

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<sup>3</sup> The National Water Commission was abolished through the *National Water Commission (Abolition) Act 2015 (Cwlth)* (Australian Government, 2015).

### 3. National Guidelines

#### 3.1 Australian Drinking Water Guidelines

The Australian Drinking Water Guidelines (ADWG) serve as the framework for good management of 'drinking water supplies' to ensure its safety as point of use. According to the guiding principles in the most recent version (version 3.5, 2018), the "greatest risks to consumers of drinking water are pathogenic microorganisms" (ADWG, 2018).

*Microbial characteristics of water quality.* Chapter 5 of the Australian Drinking Water Guidelines provides a description of microbial characteristics of water quality and a detailed elaboration of these microorganisms found in drinking water and the risks associated with their presence. The waterborne pathogens were mainly classified as: 1) bacterial pathogens, 2) protozoa, 3) viruses, 4) helminths and 5) cyanobacteria. Bacterial pathogens, protozoa and viruses were highlighted as the main pathogenic organisms of concern.

*Risks associated with waterborne pathogens in drinking water.* In Chapter 5 as well, the Australian Drinking Water Guidelines mentioned that the diseases caused by waterborne pathogens may "vary in severity from mild gastroenteritis to severe and sometimes fatal diarrhoea, dysentery, hepatitis, cholera or typhoid" (ADWG, 2018, p.70).

Meanwhile, factors affecting the change of waterborne infections are specified as follows (ADWG, 2018, p.74):

- Concentration of pathogenic organisms in the water.
- The virulence of the strain.
- The per capita intake of contaminated water.
- The infectious dose of the particular pathogen.
- The susceptibility of individuals.
- The incidence of the infection in the community.

*Nuisance organisms.* Chapter 5 of the Australian Drinking Water Guidelines also discusses the importance of controlling "nuisance organisms". It stated that problems arise when water reservoirs and distribution systems harbour the growth of these organisms. Moreover, it notes that while raw water does not have ample amount of nuisance organisms to cause issues, the water treatment process may promote its growth. If not controlled, the nuisance organisms could cause taste, odour, colour and corrosion problems. The nuisance organisms were identified as the following (ADWG, 2018, p.74).

- prokaryotic bacteria (e.g. planktonic and benthic cyanobacteria or blue-green algae)

- iron, manganese and sulphur bacteria
- actinomycetes and fungi
- eukaryotic organisms such as algae, crustacea and protozoa

*Immunity of the community.* In Section 5.4 of Chapter 5 (page 74), the correlation between waterborne diseases and the level of immunity of a community is discussed. In this case, it is mentioned that a community may have been repeatedly subjected to contaminated water supply, thus making them immune to some waterborne pathogens. The guidelines flagged, however, that immunity might be acquired at the expense of other members who are more prone to diseases such as old-aged residents and children.

*Community consultation.* The Australian Drinking Water Guidelines (ADWG, 2018) mention community involvement and awareness as one of the core elements (element 8) of the framework for drinking water quality (See page 49). While aesthetics (e.g. taste, colour, odour) is also mentioned as a consideration for discussion, the guidelines still note the primacy of public health.

The community consultation strategy, as mentioned in the guidelines, requires the following points (ADWG, 2018, p.50):

- defining the scope of the issue and the potential links with wider issues or problems
- identifying specific interest and stakeholder groups that may be affected and their needs, existing level of knowledge and attitudes on the issues
- presenting factual information to the community, consumers and groups in a form that is accessible, understandable and suitable as a basis for informed discussion
- providing adequate time for consultation
- identifying or developing measures to evaluate the effectiveness of the community consultation process

In terms of communication, the guidelines promote a ‘coordinated consumer information’ program’. The guidelines note that such programme must contain the following (ADWG, 2018, p.51):

- discussion of issues on drinking water quality
- details of the water supply system and the drinking water management system
- incident and emergency response plans
- consumer responsibilities beyond the meter and how drinking water quality may be affected in household distribution and use



- the need for further treatment of water for special purposes
- role and responsibility of the community and protecting water supply
- commercial and industrial consumer responsibilities beyond the meter

Some recommended strategies mentioned in the guidelines were the release of periodic water quality reports, newsletters, notices in bills, workshops and seminars.

### **3.2 Australian Guidelines for Water Recycling**

The water recycling guidelines at the national level were released and produced in tranches. In 2006, the first part was released and was entitled as the ‘Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1)’ (AGWR-MHER, 2006). It serves as the overarching document on water recycling requirements. The second part of the guidelines, entitled ‘Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), Augmentation of Drinking Water Supplies’ (AGWR-MHER-ADWS, 2008) was released in 2008 and highlights the primordial importance of public health in potable reuse. The third part of the guidelines, entitled ‘Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), Managed Aquifer Recharge’ (AGWR-MHER-MAR, 2009) was published in 2009 and serves as the framework for reuse of sewage, greywater and stormwater. The guidelines note that effective implementation of these resources is contingent to an ‘integrated resource management’. The last part of the guidelines, entitled ‘Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Stormwater Harvesting and Reuse’ (AGWR-MHER-SHR, 2009) was also released in 2009<sup>4</sup>.

The Australian Guidelines for Water Recycling are under the auspices of the National Water Quality Management Strategy (NWQMS). The reasons for creating the national guidelines were the following (AGWR-MHER, 2006).

- the earlier national guidelines for water reuse in Australia — the NWQMS Guidelines for Sewerage Systems, Use of Reclaimed Water (NHMRC-ARMCANZ, 2000) — were not sufficiently detailed to provide a nationally consistent approach to treatment and recycling of treated sewage and they are not directly applicable to greywater or stormwater
- state and territory governments had developed their own guidelines, a situation that led to some inconsistencies (in part due to limitations of the national water reuse guidelines) and a lack of uniformity for recycling
- defined criteria for system management were lacking

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<sup>4</sup> Note that combined sewer/stormwater systems have never been adopted in Australia apart from a small area of central Launceston, Tasmania.

- there is a tendency to rely on after-treatment testing as the basis for managing recycled water schemes

The guidelines were considered as ‘authoritative’ references for the implementation and regulation of recycled water schemes in Australia. As such, they are neither prescriptive nor mandatory. Hence, the constitutional autonomy of states to define their own legislative and regulatory framework in terms of water recycling is maintained.

***The Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2) – Augmentation of Drinking Water Supplies***

The second part of the national guidelines, entitled Australian Guidelines for Water Recycling Managing Health and Environmental Risks (Phase 2), Augmentation of Drinking Water Supplies (AGWR-MHER-ADWS, 2008) particularly addresses health-related risks from drinking recycled water. In case useful, a brief description of the other components of the guidelines is provided in Box 1.

The framework of the Phase 2 guidelines adopts the principle of Risk Assessment and Management rather than Risk Avoidance. Twelve elements are identified on which this risk management framework is based. In addition, principles of hazard analysis and critical control point (HACCP) are enshrined in the guidelines. HACCP is defined as a “systematic method to control safety hazards in a process by applying a two-part technique”. The two-part technique is comprised of the following topics: “1) an analysis that identifies hazards and their severity and likelihood of occurrence; and 2) an identification of critical control points and their monitoring criteria to establish controls that will reduce, prevent, or eliminate the identified hazards” (AGWR-MHER-ADWS, 2008, p.138).

**Box 1. Overview of the Australian Guidelines for Water Recycling**

The Australian Guidelines for Water Recycling are part of the National Water Quality Management Strategy. These guidelines were produced in two phases:

Phase 1 establishes a complete set of guidance for the management of health and environmental risks associated with recycled water.

Phase 2 extends on specific aspects of the Phase 1 guidance.

The full version of Australian Guidelines for Water Recycling was developed in Phase 1 and provides:

- generic framework for management of recycled water quality and use that applies to all combinations of recycled water and end uses
- specific guidance on the use of treated sewage and greywater for purposes other than drinking and environmental flows

The overview document provides an introduction for anyone interested in recycling water. The aim is to give readers an idea of the scope and content of the full guidelines and highlight some of the main issues in water recycling.

Meanwhile, Phase 2 is further broken down into three parts, namely: augmentation of drinking water supplies, managed aquifer recharge and storm water harvesting and reuse.

Guidelines for the Augmentation of Drinking Water Supplies extends the guidance given in the Phase 1 guidelines on the planned use of recycled water (treated sewage and stormwater) to augment drinking water supplies. They focus on the source of water, initial treatment processes and blending of recycled water with drinking water sources.

Guidelines for Managed Aquifer Recharge extends the guidance given in the Phase 1 guidelines. The primary focus of this phase 2 document is:

- protection of aquifers
- quality of the recovered water in managed aquifer recharge projects using all water sources, including recycled waters

Guidelines for Stormwater Harvesting and Reuse extends the guidance given in the Phase 1 guidelines to cover the harvesting and reuse of stormwater. The primary purpose of this document is to provide guidance on managing potential public health and environmental risks associated with the reuse of:

- roofwater collected from residential buildings (including industrial buildings)
- urban stormwater from sewerage areas, including stormwater collected from drains, waterways and wetlands

The Australian Guidelines for Water Recycling are currently (during 2020) being reviewed with the aim of updating the sections on process validation, changing the virus reference pathogen to

*norovirus* from the current *rotavirus*, updating pathogen log reduction values based on more recent Australian data on disease burdens and taking steps to bring consistency to both the AGWR and ADWG when discussing 'safety'.

The values stated in the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), Augmentation of Drinking Water Supplies (AGWR-MHER-ADWS, 2008) pertain to "minimum requirements and boundaries for defining safety" (AGWR-MHER-ADWS 2008, p.5). However, requirements to satisfy quality for some purposes such as renal analysis and cleaning of contact lenses are beyond the scope of the guidelines.

The Australian Guidelines for Water Recycling Managing Health and Environmental Risks (Phase 2), Augmentation of Drinking Water Supplies (AGWR-MHER-ADWS, 2008) adopt the principles of the Australian Drinking Water Guidelines but add on some additional aspects. This includes:

- using disability adjusted life years (DALYs) to define safety and concurrently microbial quality which is patterned in the approach described in the World Health Organization (WHO) Guidelines for Drinking Water-Quality (2006)<sup>5</sup> (WHO, 2006)
- health-based performance targets, including required reductions of microbial and chemical hazards
- use of reference pathogens
- more elaborated discussion on the potential of endocrine disrupting activity compared to the drinking water guidelines

According to the guidelines, the safety of drinking water is ensured firstly by defining acceptable or tolerable risk and then using this to identify health-based targets for individual hazards to ensure their management to acceptable levels. Identification of tolerable risk is further classified into two which are: 1) microbial risk and 2) chemical risk. A more detailed discussion of each follows:

- **Microbial risk:** DALYs are the metric used to identify tolerable microbial risk. The use of DALYs help classify the magnitude of impacts on health due to infections (e.g. mild vs. severe; acute vs. chronic). The calculation of the DALYs considers the symptoms due to a specific pathogen and the frequency of occurrence. The tolerable risk in the guideline is  $10^{-6}$  DALYs per person per year, which is patterned with the WHO Guidelines for Drinking Water Quality.

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<sup>5</sup> An updated version was published in 2017 (WHO, 2017a).

- **Chemical risk:** For chemical risk, the Australian Guidelines for Water Recycling Managing Health and Environmental Risks: (Phase 2), Augmentation of Drinking Water Supplies (AGWR-MHER-ADWS, 2008) adopt the approach mentioned in the Australian Drinking Water Guidelines. As such, ‘tolerable risks’ are identified using guidelines values already stipulated in the Australian Drinking Water Guidelines. For chemicals that were not identified in the Australian Drinking Water Guidelines, a method in determining guidelines values were included in Appendix A. This approach is said to be “more conservative” than the one stipulated in the WHO drinking water guidelines wherein guideline values were simply based on concentrations giving rise to “one additional cancer per 100,000 people following lifetime consumption”.

Preventive measures through a multiple barrier approach were also deemed important. Preventive measures were defined as “actions, activities and processes used to ensure that significant hazards are not present in recycled water or are reduced to accepted levels” (AGWR-MHER-ADWS, 2008, p.44). In the guidelines, it was mentioned that measurable performance has two components: 1) demonstrated performance in hazard reduction and 2) sensitivity of operational monitoring. Other important aspects considered as preventive measures are further discussed below:

- **Trade and domestic-waste control:** The guidelines mention the need for water utilities to work hand-in-hand with all industries discharging to sewers and ensure that specific contaminants are not discharged. In this case, water utilities should have the ability “to deny acceptance of trade waste, impose restrictions and enforce requirements on waste generators to install pre-treatment facilities and technologies” (AGWR-MHER-ADWS, 2008, p.10). On the part of agencies managing sewage systems, characterisation of industries and chemical use within sewerage catchments must be in place and industrial and commercial dischargers must be licensed. Moreover, attention must be given to the prevention through on-site controls and pre-treatment.
- **Secondary treatment:** Secondary treatment plays an important role as a ‘barrier’, proving to be a cost-effective means of removing a wide range of organic compounds and achieving a significant level of pathogenic organism removal. The greater the degree of treatment afforded by this treatment stage, the greater the benefit provided.
- **Tertiary treatment:** Examples of tertiary treatment that were mentioned include the following: 1) membrane filtration, 2) nanofiltration, 3) reverse osmosis, 4) activated carbon, 5) advanced oxidation, 6) detention in storages, reservoirs, lakes and aquifers.

### 3.3 Community awareness

The Australian Guidelines for Water Recycling Managing Health and Environmental Risks: (Phase 2), Augmentation of Drinking Water Supplies (AGWR-MHER-ADWS, 2008) included community involvement and awareness as one of the core elements for its framework (Element 8). As such, it notes that *“the aim of consultation needs to be to arrive at a sustainable outcome rather than to seek acceptance of a system preferred by its proponents”* (AGWR-MHER-ADWS, 2008, p.77). The guidelines expect communication as an iterative process. It also recommends that full information must be presented to stakeholders (e.g. alternatives available, costs and risks, status quo information). The complete discussion on community involvement and awareness as stated in the Phase 2 guidelines is provided in Box 2.

### **Box 2. Community Involvement and Awareness**

As discussed in Phase 1 of the Water Recycling Guidelines (NHMRC-ARMCA, 2006), consultation with the community is a vital element in developing recycled water schemes, particularly those involving drinking water augmentation. Surveys have indicated that community concerns increase as the degree and likelihood of personal contact with recycled water rises. For example, use of recycled water for urban or agricultural irrigation has high levels of acceptance (Po et al., 2005), whereas closer contact, including consumption of recycled water, has lower levels of support (Fielding et al., 2019). Proposals to augment drinking water supplies with recycled water also tend to polarise views, with some people strongly supportive and others strongly opposed. Communication needs to involve information provision and education. Consultation will be more effective if participants are well informed.

Public and stakeholder concerns can be very powerful and can mean the difference between acceptance and rejection of recycled water schemes. In some cases, public support has helped schemes to proceed; in other cases, public opposition has stopped schemes from being developed.

The aim of consultation needs to reach a sustainable outcome rather than to seek acceptance of a system preferred by its proponents. Informed deliberations need to include complete information on the status quo, the full range of alternatives available and the costs and risks associated with each of these alternatives. Any issues raised during the consultation process need to be recorded and addressed. Feedback needs to be provided on responses to issues raised during consultation. Communication will necessarily be an iterative process.

Community consultation and education is a specialist area and expert advice should be sought or engaged to assist in designing and implementing processes. A brief overview of issues is provided here. Further guidance is provided in Chapter 6 of Phase 1 of the water recycling

guidelines (AGWR-MHER, 2006). In addition, a number of frameworks have been developed for communicating the issues involved with recycled water. Khan and Branch (2019) summarise recent developments in approaching and introducing potable recycling in various countries, especially USA.

## **A) Community consultation**

### **Assess requirements for effective involvement of the community**

The decision to introduce drinking water augmentation must be aligned with the needs and expectations of stakeholders and the community as a whole. Therefore, to maximise community acceptance, all stakeholders need to be consulted and involved in decision-making processes.

Pre-existing community attitudes will influence the degree of acceptance of proposed schemes. As attitudes are likely to vary from one area to another, acceptance of a scheme in one area will not guarantee acceptance of a similar scheme in another area.

### **Develop a comprehensive strategy for stakeholder engagement and consultation**

Involving stakeholders in an effective way can be complex. A range of methods need to be adopted to engage the community, including:

- stakeholder forums and workshops
- focus groups
- individual discussion
- community workshops
- briefing of the media and individual journalists
- presentations at schools and other educational institutions

In addition, the use of appropriate terminology must be a key cornerstone of any community engagement program. Terms such as 'recycled wastewater' must be avoided and many are now using the term 'Purified Recycled Water' for those applications where the water is used to augment drinking water supplies.

## **B) Communication and education of the community**

### **Develop a two-way communication program**

Effective communication is essential to increase community awareness and knowledge of recycled water quality issues and the various areas of responsibility. The communication needs to be based on a thorough understanding of the diversity of views held by individuals in the community. A community is not a single, uniform entity, but contains groups of people with different levels of understanding and concerns. Communication programs have to be tailored to deal with this diversity.

Methods for communicating include:

- face-to-face presentations
- newsletters
- fact sheets
- free call information services
- public displays
- the media
- internet, compact discs (CDs), digital versatile discs (DVDs) and Universal Serial Bus (USB) Flash Drives

Education has been identified as a key component to any successful community consultation and communication program involving recycled water. Both the Orange County Groundwater Replenishment Scheme, the Water Corporation's Groundwater Replenishment Scheme in Perth, Western Australia and the Singapore NEWater Project have invested heavily in education programs. The Orange County and Perth Schemes have involved broadscale consultation, an effective internet site, distribution of press kits and educational tours of the scheme.

The Singapore NEWater Project was introduced as part of a 'Four Tap Strategy' that involved imported water, seawater desalination, collection and treatment of local surface run-off and water reuse (Lee and Tan, 2016). Currently, 40% of the daily water consumption in Singapore is recycled water, with the majority being used by high-tech industries and a small percentage (1-2%) being used to supplement the raw water supplies stored in surface reservoirs and this figure is expected to increase as necessary.

To raise people's awareness of NEWater, Singapore's National Water Agency, PUB used intensive education campaigns including:

- a documentary feature film
- media briefings and reports



- information briefings at community centres and schools
- establishment and promotion of a NEWater Visitor Centre that showcases the value of water and how it can be safely used and reused after appropriate levels of treatment

NEWater was also distributed via bottles and canisters for public sampling to build confidence in its quality and safety as drinking water.

**Provide information on the need to use recycled water**

Providing information on the need for and benefits of, using recycled water is important in gaining community acceptance of a project. Potential alternatives need to be explored and discussed and these should include an independently verified cost–benefit analysis.

Following are the strategies, agreements and guidelines on water recycling at the Federal level (Table 1).

**Table 1. Strategies, Agreements and Guidelines on Water Recycling (Federal Level)**

Title	Description	Involved agencies
National Water Quality Management Strategy, (1992) (Commonwealth of Australia, 2018)	The strategy aimed to promote sustainability of the use of water supply while ensuring water quality vis-à-vis economic and social development.	Joint initiative between the Commonwealth of Australia, state and territory governments which were covered by the then Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ)
Intergovernmental Agreement on a National Water Initiative (NWI) (2004) (Commonwealth of Australia, 2004)	Provided a nationwide framework in managing water for the environment, agriculture and urban use, including water recycling.	The agreement is between the Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia and the Australian Capital Territory and the Northern Territory. Western Australia and Tasmania subsequently signed.
Australian Drinking Water Guidelines (ADWG, 2018)	Serves as the framework for good management of ‘drinking water supplies’	The AWDG are intended for use by the Australian community and all agencies with responsibilities

	to ensure its safety at point of use.	associated with the supply of drinking water, including catchment and water resource managers, drinking water suppliers, water regulators and health authorities.
Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1)' As of: 2006 (AGWR-MHER, 2006)	Overarching documents on requirements with regards to water recycling.	The guidelines are intended to be used by anyone involved in the supply, use and regulation of recycled water schemes, including government and local government agencies, regulatory agencies, health and environment agencies, operators of water and wastewater schemes, water suppliers, consultants, industry, private developers, body corporates and property managers.
Australian Guidelines for Water Recycling Managing Health and Environmental Risks (Phase 2), Augmentation of Drinking Water Supplies As of: 2008 (AGWR-MHER-ADWS, 2008)	Addresses health risks from drinking recycled water. The 12-element framework of the guidelines follows the principles of hazard analysis and critical control point (HACCP).	The guidelines are intended to be used by anyone involved in the supply, use and regulation of recycled water schemes, including government and local government agencies, regulatory agencies, health and environment agencies, operators of water and wastewater schemes, water suppliers, consultants, industry, private developers, body corporates and property managers.
Australian Guidelines for Water Recycling Managing Health and Environmental Risks (Phase 2), Managed Aquifer Recharge	Serves as the framework for implementing a Managed Aquifer Recharge (MAR) scheme and includes the 12-element Framework for	The guidelines are intended to be used by anyone involved in the supply, use and regulation of recycled water schemes, including government and local government agencies, regulatory

As of: 2009 (AGWR-MHER-MAR, 2009)	implementing such schemes.	agencies, health and environment agencies, operators of water and wastewater schemes, water suppliers, consultants, industry, private developers, body corporates and property managers.
Australian Guidelines for Water Recycling Managing Health and Environmental Risks (Phase 2), Stormwater harvesting and reuse As of: 2009 (AGWR-MHER-SHR, 2009)	Serves as the framework for stormwater harvesting and reuse.	The guidelines are intended to be used by anyone involved in the supply, use and regulation of recycled water schemes, including government and local government agencies, regulatory agencies, health and environment agencies, operators of water and wastewater schemes, water suppliers, consultants, industry, private developers, body corporates and property managers.

**3.4 The future of potable recycling**

As discussed in Radcliffe and Page (2020), three seminal Australian reports in recent years have conducted independent reviews of the international status of potable recycling and where Australia’s policy development and future adoption may lie. The Australian Academy of Technological Sciences and Engineering (ATSE) concluded that advances in the science and engineering of water treatment and recent international developments in DPR prompted consideration of DPR as a potential future component of Australian water supply systems. The potential obstacles or disadvantages for DPR, relative to IPR, were primarily related to public perception and acceptance. Importantly, ATSE (2013) considered that the scientific and engineering hurdles to implementing safe and reliable DPR were manageable. A review of Australian legislation and regulations that existing frameworks for the planning, approval, management and oversight of drinking water quality and recycled water in Australia could accommodate a well-designed and operated DPR project as a water resource management option.

Water Research Australia commissioned a timely and technically robust update on developments in potable recycling to include a summary of key developments and current status of potable

reuse practice and an understanding of the drivers and incentives which have underpinned this progress (Khan and Branch, 2019). The update included an overview of recently produced guidelines and best practice documents and how international and Australian regulators had approached the regulation of potable reuse for the full protection of public health. It was concluded that the incentives for potable reuse – as for any water supply option - will ultimately lie in how the various available water supply options compare among key criteria, such as costs, environmental impacts and social considerations. By international standards, the water quality regulatory landscape in Australia was widely considered to be world-leading. Potable water reuse is not held up by a lack of technical ability to build and design effective schemes, but potentially by other less technical aspects. The authors noted the WHO statement that “the ability to gain public confidence and trust through a productive, two-way engagement process with key stakeholders” is central to the success of any potable reuse project.

The main organisation for Australian urban water utilities, the Water Services Association of Australia (WSAA), also recently reviewed the use of potable water recycling (WSAA, 2019). It aimed to bring together world-wide insights and perspectives regarding community engagement on purified recycled water. The report recognised that purifying recycled water for drinking is becoming commonplace across the globe. Some 35 cities now rely on it (many for decades) and many more are looking at it. The report aimed to assist in the consideration of engagement strategies around the introduction of purified recycled water, encompassing both IPR and DPR.

#### **4. Potable reuse in Queensland**

In 2001, the Queensland Water Recycling Strategy (The State of Queensland, 2001) was published by Queensland’s Environmental Protection Agency. The objective of the QWRS was to “encourage and support the use of water recycling that is safe, environmentally sustainable and cost-effective” (The State of Queensland, 2001, p.8). Based on its mapped action plan, the QWRS suggested developing a “consistent, whole-of-government legislative framework that encourages and facilitates water recycling” (The State of Queensland, 2001, p.38). The QWRS noted that providers found numerous laws administered by different ministries too complex and inconsistent. In this case, these providers called for a simplified, single and harmonised approval process for water recycling.

In 2004, an updated version of the Australian Drinking Water Guidelines (ADWG, 2004) for Queensland was released.<sup>6</sup> The ADWG, as part of the NWQMS, were created with the purpose

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<sup>6</sup> The first version of the Australian Drinking Water Guidelines was published in 1996 by the Agriculture and Resource Management Council of Australia and New Zealand. This was revised in 2004 (as stated in main text). In 2011, the ADWG was updated again to include minor revisions in the monitoring framework and information sheets on

of managing the safety of water for potable use. As compared to its earlier version published in 1996, the updated version revised the section on radiological contaminants. It also included the Framework for Management of Drinking Water Quality which has twelve core elements.<sup>7</sup> The framework emphasised the importance of community consultation in development of policies related to drinking water supply and the application of an acceptable 'risk management approach' to ensure safety.

The State of Queensland developed its own Water Recycling Guidelines (The State of Queensland, 2005) in December 2005, to fulfil its commitments from the Queensland Water Recycling Strategy (The State of Queensland, 2001).<sup>8</sup> It noted that the guidelines were aligned with the national approach associated with the National Water Quality Management Strategy (NWQMS) and was patterned after the then 'draft' National Guidelines for Water Recycling – Managing Health and Environmental Risks in 2005 (The State of Queensland, 2005). The guidelines do not intend to serve as a prescription of water quality standards, but rather, as a form of guidance for water recycling project planners and operators.

Within the Queensland Water Recycling Guidelines, community engagement and the need for a recycled water policy were highlighted. The latter is defined as a "way to document the commitment of an organisation and its members to the responsible management of recycled water and communicate this to others" (The State of Queensland, 2005, p.21). The guidelines mentioned six guiding principles for community engagement, namely: 1) inclusiveness, 2) reaching out, 3) mutual respect, 4) integrity, 5) affirming diversity and 6) adding value. It also mentioned that feedback, evaluation and ongoing engagement must be harnessed in the engagement techniques. In terms of choosing the appropriate engagement strategy, the guidelines mentioned that the following factors must be considered: 1) objectives of the engagement, 2) nature of the target community, 3) political environment, 4) capacity of the community to influence the project, 5) resources available to support the engagement process and 6) presence of a high-level commitment among the project proponents to the proposed community engagement approach.

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sampling and statistics (See Australian Drinking Water Guidelines 2011).The version from 2011 was updated most recently in May 2019.

<sup>7</sup> The twelve elements are listed as follows: 1) Commitment to drinking water quality management; 2) assessment of the drinking water supply system; 3) preventive measures for drinking water quality management; 4) operational procedures and process control; 5) verification of drinking water quality; 6) management of incidents and emergencies, 7) employee awareness and training; 8) community involvement and awareness; 9) research and development; 10) documentation and reporting; 11) evaluation and audit; 12) review and continual improvement.

<sup>8</sup> This was even before the Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1) was published.

Congruent to the 2004 Australian Drinking Water Guidelines (as stated in the Water Recycling Strategy), the Queensland Government also promotes the use of a risk-based Recycled Water Management Plan together with a multiple barrier approach. In cases wherein a proponent of a water recycled scheme is ambivalent on the need for such plan, consultation of their proposal with regional offices of the Queensland Environmental Protection Agency or Queensland Health could be undertaken” (The State of Queensland, 2005, p.22).

Following is more detailed information on the legislation in the state of Queensland. This is also included in Table 2.

#### **4.1 General regulations**

The *Water Act* (2000) of Queensland provides a system for the planning, use and allocation of water. Under the Act, regulations pertinent to the provision of water and sewerage services are provided. Moreover, it notes that “water service” also encapsulates water recycling. As such, water authorities or local government bodies owning infrastructure which provides recycled water services should be registered as a water service provider. The requirements they had to submit include the following: 1) Strategic Asset Management Plan, 2) Annual Reports and 3) Customer Service Standards. The agency administering the *Water Act 2000 (Qld)* is the Department of Natural Resources, Mines and Energy (DNRME).

Meanwhile, the *Plumbing and Drainage Act 2002 (Qld)* (The State of Queensland, 2002) provides a framework for the licensing of plumbers and drainers. It also provides a regulation on the design and operation of on-site sewerage facilities (e.g. sewage treatment works with peak design capacity of <21 equivalent persons or EP). As stated in the Act, approval of the following activities is in the hands of the local government: 1) installations works for on-site sewerage facilities and 2) treatment, recycling and separation of greywater from blackwater. The Act is administered by the Department of Local Government, Planning, Sport and Recreation. The Plumbing and Drainage Act of 2002 was eventually repealed and replaced by *Plumbing and Drainage Act, 2018 (Qld)* with generally similar functions (The State of Queensland, 2018).

Meanwhile, the Queensland Plumbing and Wastewater Code of 2019 (The State of Queensland, 2019) was designed to “provide performance solutions to meet the statutory requirements of the Plumbing and Drainage Act 2018” (The State of Queensland, 2019, p.4). The code provides standards for water quality based on the intended use of water. It also mentions that the level of treatment would indicate on whether water can be reused internally (e.g. washing machines), or for irrigation purposes only.

The *Water Supply (Safety and Reliability) Act 2008 (Qld)* (WSSRA, 2008) (version as of 1 July 2019) provides regulations to ensure the safety and reliability of the water supply and reflects some of the provisions of the *Water Act 2000 (Qld)*. The impetus for creating the said Act was the government's plan to increase drinking water supply through recycled water and at the same time, increase the confidence on the supply of water (Power, 2010). In the most recent version of the Act, recycled water was defined as the following: 1) sewage or effluent source from a service provider's sewerage; and 2) wastewater, other than water mentioned in item 1. Similar to what was mentioned in the *Water Act 2000 (Qld)*, water providers who aim to augment drinking water supplies are required to have an approved recycled water management plan. Audit reports on the recycled water providers are also required (See Division 2, Section 106).

Sewage treatment is implied in any discussion on recycled water as it is part of the overall system to produce the required quality of recycled water for whatever the end use proposed. Australia has very comprehensive Guidelines for the production of recycled water for a wide range of end uses; each State and its Health Authorities take note of these when applying their own requirements for recycled water quality, including the on-going management of the same (Ian Law, *pers.comm*, 4 July 2020).

A validation programme for a recycled water scheme means a documented programme about how the plant or equipment used for the treatment of recycled water under the scheme are to be tested to show that its quality consistently meets that relevant to the scheme and for which it has been included in the overall treatment scheme (Schedule 3, page 386).

Under the *Water Supply (Safety and Reliability) Act 2008 (Qld)* (WSSRA, 2008), it was noted that regulators can declare a recycled water scheme to be "critical" given the following reasons: 1) to meet essential water supply needs of the community or industry; and 2) to ensure proper management of risks to public health posed by the supply of recycled water under the scheme (See Section 301:1).

#### **4.2 Environmental regulations**

The principal legislations for water recycling in Queensland are the *Environmental Protection Act 1994 (Qld)* (EPA, 1994) and the *Environmental Protection Regulation 2019* (EPR, 2019). Under these regulations, water recycling could be considered as an "environmentally relevant activity (ERA)". As such, water recycling activities were required to have a development approval from the Environmental Protection Agency (EPA). In 2009, a subordinate legislation of the *Environmental Protection Act 1994 (Qld)*, entitled the *Environmental Protection (Water) Policy 2009 (Qld)* (EPWP, 2009), mentioned that local governments "must" provide environmental plans concerning water management (e.g. sewage management, trade waste management, urban

stormwater quality management) – which include wastewater recycling, effluent management, sewerage system overflows and biosolids management (See Part 6, Division 2). The Act also discussed in Part 7 Section 25, some guidelines on promoting community awareness on issues about water quality, as well as to involve the community in water quality management. In particular, it recommended the plan to include the following (See Part 7, Division 25, pp. 19-20):

- a) a description of the issues about water quality
- b) ways to raise community awareness and understanding about water quality policy, planning and management
- c) ways to improve levels of community consultation in relation to water quality management, including consultation carried out under this policy
- d) ways to better inform the community of issues about water quality management

The Environmental Protection (Water) Policy 2009 (EPWP, 2009) also mentioned that a ‘healthy waters management plan’ may concurrently be developed and implemented in order to help decide ways to improve the quality of the water (See Division 3, Section 24). In Part 4 Section 11, it mentioned that community consultation must take place in defining environmental values for water. Should there be ambient monitoring present, the results must be published in the Department of Environment and Resource Management website.

The Environmental Protection (Water) Policy 2009 (EPWP, 2009) was repealed and replaced by the Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPWWBP, 2019). In this current version, the section on the requirement for local governments to provide environmental plans has been removed. Only the option of having a ‘healthy water management plan’ was retained. In Part 7, Section 17 of the *Environmental Protection (Water) Policy 2009 Act (Qld)*, ‘community awareness and involvement’ were mentioned. The specific elements mentioned in Section 17 are provided in Box 3.

**Box 3. Community Awareness and Involvement**

(1) This section applies if the chief executive decides to develop and implement a plan to—

- (a) raise community awareness of issues about water quality
- (b) involve the community in water quality management

(2) The chief executive must consider including in the plan—

- (a) a description of the issues about water quality



- (b) ways to raise community awareness and understanding about water quality policy, planning and management
- (c) ways to improve levels of community consultation in relation to water quality management, including consultation carried out under this policy
- (d) ways to better inform the community of issues about water quality management

At the time of writing this book chapter, Seqwater was developing a consultation programme on potable recycled water (Water Source, 2020).

### 4.3 Health regulations

An earlier legislation pertinent to health and recycled water is the *Workplace Health and Safety Act 1995 (Qld)* (WHSa, 1995). Under this Act, recycled water could be ‘loosely’ considered as a “substance” of which employers are obliged to ensure that it is properly used. Inappropriate use pertains to a situation wherein the ‘substance’ is used without appropriate information or advice on usage.<sup>9</sup> This implies that the suppliers of the water are compelled to provide customers with all relevant information on possible contaminants that could be found in the recycled water (The State of Queensland, 2005).

The Queensland Government produced the *Water Supply (Safety and Reliability) Act 2008 (Qld)* (WSSRA, 2008) on 30 June 2008. The Act regulated both drinking and recycled water supply and quality within the State of Queensland. It also relied upon Schedule 3B in the Public Health Regulation 2005.

The Workplace Health and Safety Act was repealed and superseded by the *Work Health and Safety Act 2011 (Qld)* (WHSa, 2011). Similar to the previous version (WHSa, 1995), recycled water could also be ‘loosely’ considered as a ‘substance’ which requires employers to ensure that it is allocated for the intended use. Likewise, it is under the duty of persons conducting businesses to provide adequate information to each person who is provided with the design for the purpose of giving effect to it concerning (Section 22: 4):

- (a) each purpose for which the plant, substance or structure was designed
- (b) the results of any calculations, analysis, testing or examination, including, in relation to a substance, any hazardous properties of the substance identified by testing

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<sup>9</sup> There is no strict definition of the substance mentioned in the law. However, it stipulated in Section 34(A) that: *A supplier of a substance for use at a workplace has an obligation to – a) take all reasonable steps to ensure the substance is safe and without risk to health when used properly; and b) to ensure the substance is accompanied by relevant information for the substance.*

- (c) any conditions necessary to ensure that the plant, substance or structure is without risks to health and safety when used for a purpose for which it was designed or when carrying out any activity mentioned

Compliance of recycled water schemes with the *Public Health Act 2005 (Qld)* (PHA, 2005) is mandatory. Under the Public Health Act, supplying water that is 'not fit for use' is considered an offence. As such, it noted that "*a drinking water service provider must not supply drinking water that the provider knows, or reasonably ought to know, is unsafe*" (See Subdivision 2, Section 57E). The maximum penalty is 3,000 penalty units or 2 years imprisonment.

Meanwhile, under the Public Health Regulation 2018 (Part 9, Section 53) (PHR, 2018) the standards for the recycled water to be used for drinking purposes were provided. The said regulation stipulates the following: 1) testing of recycled water meant to augment drinking supply must be tested for the presence of each required parameter at the frequency required under the management plan for water; and 2) the samples of the water must satisfy the required parameters for it to be considered safe. The scope of the provisions for this regulation are contingent to that of the *Water Supply (Safety and Reliability) Act (2008) Qld*. Complete information on Part 9, Section 53 of the foregoing regulation is in Box 4.

**Box 4. Quality Standard for recycled Water intended to Augment a Supply of Drinking Water**

- (1) Recycled water that is intended to augment a supply of drinking water must be tested for the presence of each required parameter at the frequency required under the management plan for the water.
- (2) Each sample of the water must—
  - (a) for a microorganism stated in schedule 6, part 1— contain less of the microorganism than the value stated opposite the microorganism in schedule 6, part 1
  - (b) for a chemical parameter stated in schedule 6, part 2— not contain more of the parameter than the value stated opposite the parameter in schedule 6, part 2
  - (c) for an ADWG parameter— not contain more of the parameter than the guideline value for health for the parameter stated in the physical and chemical guideline table
  - (d) not contain detectable viral, bacterial or protozoan pathogens
- (3) Each sample of the water must comply with the guideline value for radioactivity stated in the radiological guideline table.

(4) Subsections (2) and (3) apply to water tested for a microorganism, parameter or pathogen or for radioactivity, whether or not the management plan for the water required the water to be tested for the microorganism, parameter or pathogen or for radioactivity.

(5) In this section—

**ADWG parameter—**

(a) means a parameter for which a guideline value for health is stated in the physical and chemical guideline table; but

(b) does not include a microorganism or chemical parameter stated in schedule 6

**Required parameter** means each parameter of the following types of parameter that the water is required to be tested for under the management plan for the water—

(a) a microorganism

(b) a chemical parameter

(c) an ADWG parameter

(d) a pathogen

(e) radioactivity

**Table 2. Strategies, Guidelines and Legislations on Water Recycling in Queensland as of 2020**

Title	Description	Involved agencies
Queensland Water Recycling Strategy 2001 (The State of Queensland, 2001)	<p>Its objective was to encourage and support the use of water recycling that is safe, environmentally sustainable and cost-effective.</p> <p>Called for a consistent, whole-of-government legislative framework for water recycling.</p>	Identified the need of suppliers and customers of recycled water for a model agreement.

<p>Queensland Water Recycling Guidelines (The State of Queensland, 2005)</p>	<p>Set as a form of guidance for water recycling project planners and operators; non-prescriptive.</p>	<p>As mentioned in the document, state government agencies that can provide advice on water recycling included the following.</p> <p><b>For Queensland Government Agencies:</b></p> <p>Department of Environment and Science, Queensland Health, Department of Natural Resources, Mines and Energy, Department of Agriculture and Fisheries, Department of Local Government, Racing and Multicultural Affairs, Office of Industrial Relations.</p> <p><b>For Commonwealth government agencies:</b></p> <p>Department of Agriculture, Water and the Environment</p>
<p>The Plumbing and Drainage Act 2002 was eventually repealed by <i>Plumbing and Drainage Act of 2018 (Qld)</i> (The State of Queensland, 2018)</p>	<p>Provides a regulation on the design and operation of on-site sewerage facilities.</p>	<p>The Department of the Housing and Public Works is said to oversee the <i>Plumbing and Drainage Act of 2018 (Qld)</i></p>
<p><i>Environmental Protection Act of 1994 (Qld)</i> As of: 20 August 2020 (EPA, 1994)</p>	<p>Required the approval of EPA for water recycling schemes as it is considered as an environmentally relevant activity.</p>	<p>The <i>EPA Act (Qld) 1994</i> (20 August 2020) is to be administered, as far as practicable, in consultation with and having regard to the views and interests of, industry, Aborigines and Torres Strait Islanders under Aboriginal</p>

		tradition and Island custom, interested groups and persons and the community generally.
<i>Workplace Health and Safety Act 2011 (Qld)</i> As of: 14 September 2020 (WHS Act, 2011)	Requires employers to ensure that the recycled water is properly used; inappropriate use pertains to a situation when the recycled water is used without available appropriate information or advice on usage.	The Act places the primary health and safety duty on a person conducting a business or undertaking (PCBU). Duties are also placed on officers of a PCBU, workers and other persons at workplace.
<i>Water Act 2000 (Qld)</i> As of: 27 August, 2020 (Water Act, 2000)	Contains regulations pertinent to the provision of water and sewerage services.	The administering agencies include the Department of Natural Resources, Mines and Energy (DNRME), Department of Environment and Science.
<i>Water Supply (Safety and Reliability) Act 2008 (Qld)</i> As of: 25 May 2020 (WSSRA, 2008)	It provides a regulatory framework by providing recycled water and drinking water quality, primarily for protecting public health within the State of Queensland.	The administering agency is the Department of Natural Resources, Mines and Energy.
<i>Public Health Act 2005 (Qld)</i> As of: 20 August 2020. (PHA, 2005)	Complements the <i>Water Supply (Safety and Reliability) Act 2008 (Qld)</i> . (WSSRA, 2008)  Under the Public Health Act, supplying water that is 'not fit for use' is considered an offence.	The Act is to be administered and enforced by the State and not by local governments for State public health risks; and by the local governments and not by the State for local government public health risks. It can also be administered in partnership.
Queensland Plumbing and Wastewater Code of 2019 As of: 1 July 2019	Designed to "provide performance solutions to meet the statutory requirements of the	The administering agency is the Department of Housing and Public Works.

(The State of Queensland 2019)	Plumbing and Drainage Act 2018".	
Public Health Regulation As of: 30 June 2017 (PHR, 2005)  Note: The 2005 version of Public Health Regulation expired on 31 August 2018. This was superseded by the 2018 Public Health Regulation (PHR, 2018) made under the Public Health Act 2005, Health Act 1937 and State Penalties Enforcement Act 1999	Standards for the quality of drinking water and types of recycled water are provided.	Administering agency is the Queensland Health.

**4.4 The Case of Toowoomba**

The ‘Water Futures Initiative’ was initiated in July 2005 as a response to water scarcity issues encountered by the City of Toowoomba. As part of the initiative, it was planned that 5000ML/y of reclaimed water from the Wetalla Water Reclamation Plant would be treated to a 6-star standard<sup>10</sup> using an Advanced Water Treatment Plant utilizing ultrafiltration, reverse osmosis and ultraviolet disinfection and advanced oxidation. The purified water would be piped to Cooby Dam, where it would be mixed with catchment water, before being pumped to the Mt. Kynoch Water Treatment Plant. It would receive further treatment, along with water from Cressbook and Perseverance dams. The total capital cost was projected to be \$68 million (Toowoomba City Council, 2006).

The initiative resulted on a policy document that was not aimed for public communication (WHO, 2017). When looking closely into the document, it merely included a description of the water treatment process and on why it was imperative to undertake this initiative in Toowoomba. It did not provide an outline on the communications strategy that the government would carry out.

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<sup>10</sup> The “star standard” pertains to a Water Quality Star Rating System devised by the Australian Water Association to measure water purity. It ranges from no stars (domestic and industrial sewage) to 6-star water quality (suitable for kidney dialysis machines and pharmaceutical manufacturing). Drinking water is 5-star quality (Toowoomba City Council, 2006, p. 35).

In opposition to the Water Futures Initiative, the Citizens Against Drinking Sewage (CADS) group in Toowoomba was formed. Given that the Water Futures Initiative was not aimed for the public, the CADS used it as a leverage to be the first one to convey negative sentiments about water recycling even before the state government was able to present its own information campaign. Eventually, the Commonwealth Government, under the administration of The Hon John Howard as Prime Minister, announced on 24 March 2006, that its potential funding contribution of \$22.9 million for the project, would depend on the outcome of a referendum. On 29 July 2006, results of the referendum reflected that 62 percent of the residents voted against the proposed water recycling scheme.

Following the cancellation of the project due to the referendum's outcome, Diane Thorley, the mayor of Toowoomba released an article about it (Thorley, 2006). Based on the article, the government's campaign to convince people to vote for 'yes' in support of water recycling was 'technically' accurate as it was backed with empirical evidence. On the other hand, the opponents who vouched for a 'no' vote set their campaign using three themes: 1) fear, 2) doubt and 3) hope. Statements such as 'there are reports that say they can't take hormones, chemotherapy drugs or the AIDS virus out' and the 'Council was lying and councillors and staff were getting kickbacks' casted 'doubt' into the community (Thorley, 2006). While these statements were not necessarily supported by evidence, they were effective in instigating 'fear'. The opponents offered 'hope' by stating that there were other 'alternative water sources'.

Despite the public opposition which consequently led to the abortion of potable reuse in Toowoomba, a pipeline was opened in 2010 which was intended to connect the Wivenhoe Dam, Brisbane's principal water source, to Lake Cressbrook in Toowoomba in order to address the city's increasing water demand (Toowoomba Region, 2020). As such, the pipeline also connects Toowoomba City to the same water sources as the Southeast Queensland Water Grid. This also implies that in moments of severe drought (e.g. when Southeast Queensland's overall dam levels drop below 40 percent), recycled water might also be pumped into Toowoomba.

Based on the Toowoomba Region's official website (Toowoomba Region, 2020a), the Toowoomba region is using around 1230ML of recycled water per year, but for the sole purpose of irrigating sports fields and golf courses. It is also utilised for power generation, dust suppression and coal washing. The recycled water was classified as "Class C"<sup>11</sup> which is deemed fit for irrigating public areas and sport grounds but not for drinking or bathing.

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<sup>11</sup> Based on Public Health Regulation 2005, Class C recycled water has an *E. coli* value of less than 1,000 cfu/100mL found in 95% of the samples taken for a 12-month period.

#### **4.5 Western Corridor Recycled Water Scheme (WCRWS)**

The Western Corridor Recycled Water Scheme was a water recycling scheme to treat wastewater effluent from Brisbane and Ipswich at three advanced water treatment plants at Bundamba, Luggage Point and Gibson Island. The recycled water system was originally managed by WaterSecure, the trading name of the Queensland Manufactured Water Authority, a statutory authority of the Government of Queensland. The purified recycled water was pumped to Swanbank power station (located within the South East Queensland region defined for the National Water Account) and Tarong power station (located outside the South East Queensland region as defined for the National Water Account) from August 2007 to September 2008 to provide cooling water previously supplied from Lake Wivenhoe. The system was designed to discharge purified recycled water into Lake Wivenhoe to supplement drinking water supplies when Lake Wivenhoe storage dropped to a trigger level of 40 percent capacity (Australian Government Bureau of Meteorology, n/d).

Between 2000 and 2006, water supply planning for South East Queensland was the responsibility of the SEQ (South East Queensland) Regional Water Supply Strategy, with decision making of 19 parties. In July 2006, the state government of Queensland initiated the Western Corridor Recycled Water Scheme, given the pressing water emergency during that time (Carr et al., 2012). The quick delivery of the scheme was made possible by the “expediting provisions” of the *State Development and Public Works Organisation Act 1971 (Qld)* (The State of Queensland 1971).

The government had committed to hold a plebiscite in SEQ to gauge public sentiment about the possible use of Indirect Potable Reuse. This plebiscite had been supported by the South-east Queensland Water Recycling Plebiscite Bill 2006. It was expected to take place in March 2007, but it was eventually cancelled (Radcliffe, 2015). A press release from the Queensland Government on January 28, 2007, noted a statement from Premier Peter Beattie where he explains that purified recycled water would be a ‘permanent and ongoing part of South-East Queensland drinking supply’ and therefore, there would not be a vote on this topic. In particular, the Premier noted that the decision was triggered by the information provided by Deputy Premier Anna Bligh and the Queensland Water Commission on the worsening water situation (Queensland Government, 2007). The Premier and Minister for Trade also highlighted the impact of climate change in the region - suggesting that rainfall patterns may no longer be appropriate for future planning purposes. The Queensland Water Commission had indicated strong support from the community (80 percent) on augmenting water supplies with purified recycled water. It had also formally recommended that emergency use of purified recycled water should be triggered when combined dam levels were below at least 40 percent. In support of the project, in April 2007, the Commonwealth Government of Australia formally approved a \$408 million



funding for the scheme under the 'Water Smart Australia Program' (Parliament of Australia, 2007).

The WCRWS was completed in December 2008. It includes the following advanced treatment water plants: 1) Bundamba, 2) Gibson Island and 3) Luggage Point. The plants derive water from six wastewater treatment plants in Brisbane and Ipswich (ATSE, 2013). According to Seqwater (2018a), the following process occurs at the plants:

*Treated wastewater is filtered and then passed through a number of processes including membrane filtration, reverse osmosis and ultraviolet advanced oxidation to produce purified recycled water. The purified recycled water is then pumped to Wivenhoe Dam, where it blends with rainwater runoff stored in the dam. Water is then treated again at water treatment plants downstream at Mt Crosby, before being delivered to homes and businesses. The advanced water treatment plants can produce about 180 million litres a day or about 20% of current demand.*

In 2008 it started raining and the urgency and willingness-to-pay for operating the project, as well as the public acceptance for it, started changing. As mentioned by Carr et al. (2012), a series of decisions were taken 'to reduce and potentially shift the cost burden through small rebates (\$80 per household) from state budget and local government and consideration of the potential to decommission the WCRWP.' In addition, the *Water Supply (Safety and Reliability) Act 2008 (Qld)* (WSSRA, 2008) came into effect in the middle of the completion of the treatment plants. The regulatory requirements were more complex and detailed on the operation and control of process units and interactions between entities within the Scheme such as WaterSecure, Veolia Water Australia and the alliances that represented 16 international leading construction, engineering, project management and water services companies (Roux et al., 2010). They also made necessary changes in contractual arrangements that had important cost implications (Carr et al., 2012).

On 5 December 2010, one of the two Bundamba recycling plants was put on standby mode indefinitely, as a consequence of merging two bulk water entities, namely: 1) Seqwater and 2) WaterSecure. The purpose was said to be for streamlining operations and also for cost-efficiency (Queensland Government, 2010a).

Following this, the Gibson Island facility experienced significant technical issues resulting in the delay of its commissioning. The facility was closed in December 2012 which removed 100 megalitres per day and reduced the total WCRWS capacity from 232 megalitres per day to 132 megalitres per day (Queensland Audit Office, 2013, p.37).

In April 3 2014, a press release noted that the state government of Queensland [during Premier Campbell Newman regime] was already in a decision gridlock in terms of determining the future of the Western Corridor Recycled Water Scheme (Queensland Government, 2014). Three options were considered at this time, namely: 1) closing the project completely 2) selling it to the private sector, or 3) keeping it on standby mode unless drought occurs (Queensland Government, 2014).

On March 31 2015, the Western Corridor Recycled Water Scheme (WCRWS) was put into care and maintenance with an expectation of being remobilised within a two-year notice period (WSAA, 2019; Seqwater, 2018a). As part of the remobilisation programme, the 'WCRWS Remobilisation and Restart Program Plan' was created in 2017 (Seqwater, 2018a). The plan outlined the activities for the remobilisation process, together with risk assessment activities. The plan also noted the importance of 'demonstration plants' as part of a community engagement programme to encourage acceptance. However, only the advanced water treatment plant located at Luggage Point was planned for recommissioning.

A Seqwater's Annual Report 2017-18 indicates that the Western Corridor Recycled Water Scheme did not produce any purified recycled water (PRW) for the financial year 2017-2018. On 28 May 2018, the Queensland Water Supply Regulator approved to resume supply under the WCRWS but for purpose of electricity generation (Seqwater 2018b). Seqwater's Operational Plan 2018-19 indicated that it had a plan to carry out an education and engagement programme for the period 2018-19 (Seqwater, 2018c).

There are a series of reasons for the low utilisation of the Western Corridor Recycled Water Scheme. These include economic and political ones. On the economic side, a Seqwater report focusing on South East Queensland's Water Security Program in 2017 mentions that the reason why WCRWS was put on hold was due to the higher cost of recycled water as compared to surface water sources in South East Queensland (Seqwater, 2017). An earlier report from the Queensland Audit Office (2013) supports this statement, as it noted that for the WCRWS, "benefits were overstated" and less rigor was applied in the assessment process. It was also mentioned that during the construction and operation phases of the scheme, the costs were higher than originally planned. The lesson from this, as the report mentions, is to take a comprehensive approach in assessing costs and benefits, whether or not it is an emergency response measure.

Politically, differing views were the result of local, state and federal level elections that were held during the planning, construction and implementation phases of the project (Carr et al., 2012). A recent example can be read in the Redland City Bulletin of 1 June 2020, where a MP publicly

disagrees with State Natural Resources Minister on the use of recycled wastewater for potable purposes (Redland City Bulletin, 2020).

## **5 Western Australia**

As early as 1995, the Water Authority of the Australia released a strategy entitled 'Perth's Water Future: A Water Supply Strategy for Perth and Mandurah to 2021'. The strategy emphasised the need for 'groundwater replenishment' as an alternative source for water (Carr and Marsden, 2012). In 1995 as well, the State Government of Western Australia restructured its management strategy in the State's water supply, thereby separating the following functions: 1) water service provision and 2) management of water resources (Sharp, 1997). Accordingly, in 1996, the Water Authority of Western Australia was separated into three bodies (Sharp, 1997, p.13):

- the Water Corporation which is responsible for service delivery
- the Office of Water Regulation ("OWR") which regulates the service providers
- the Water and Rivers Commission ("Commission") which is responsible for resource allocation and protection

The need for alternative water sources became more pronounced in 2001, due to severe drought periods in the region. For instance, the inflow of water to Perth's dams cascaded from a long-term average of 338 GL/year in the period 1911-1974, to an average of 92.7 GL/year in the period 2001-05 (University of New South Wales, 2015). Climate variability in addition to population increase have added pressure on water supply.

In 2003, the Government of Western Australia released the 'State Water Strategy' (Department of the Premier and Cabinet, 2003) which targeted to increase recycled water used in Australia by 20 percent by 2012 (Department of the Premier and Cabinet, 2003). The State Water Strategy incorporated inputs from community members, which include those who took part of the series of Water Forums in the State of Western Australia and insights from delegates of the Water Symposium which took place at the Parliament House in 7-9 October 2002. As mentioned in the document, "without the involvement of the community, industry and local government we [they] cannot solve Western Australia's water shortage" (Department of the Premier and Cabinet, 2003, p.2).

The strategy continued through the 'State Water Plan of 2007' (Department of the Premier and Cabinet, 2007). The plan had also identified water recycling as one of the priority actions for water resource management in Western Australia (i.e. Priority 1: 'Use and recycle water wisely'). It also noted that state-wide wastewater reuse increased from 2000 to 2006 by 2.6 percent and

13.6 percent, respectively. In the development process of the State Water Plan, public consultation took place. For instance, as mentioned in the plan, the State Government of Western Australia convened the State Water Forum in December 2005 that met several times, workshops and meetings, to engage directly with stakeholders including interest groups and end-users. There were also public submission periods on the following documents (Department of the Premier and Cabinet, 2007, p.9):

- Draft Water Policy Framework (April 2006).
- Draft Blueprint for Water Reform in Western Australia (July 2006).
- Draft State Water Plan (October 2006).

There was a total of more than 25 community workshops and 160 submissions received during the consultative period for the State Water Plan in 2007 (Department of the Premier and Cabinet, 2007). The Plan reflects final decisions made by the Government considering the inputs received.

In 2008, the Western Australian Government released the State Water Recycling Strategy (Department of the Premier and Cabinet, 2008). The document mentioned that ‘recycling’ is a priority for the government. The plan was said to continue the goals stated in the State Water Strategy released in 2003. The strategy noted that the Western Australian Government is “*committed to testing under local conditions, to be sure that this approach is appropriate for our [their] population and environment.* (Department of the Premier and Cabinet, 2008, p.3).” As such, the three-year trial of the groundwater replenishment was included and highlighted. During the development of the Strategy, community consultation from the Perth community also took place. In this case, a survey was conducted (sample size: 410) to assess the attitude and understanding of the public with regards to water recycling. The survey found the following (Department of the Premier and Cabinet, 2008, p.3):

- Overall community support for water recycling was very high, with 91 per cent of greater Perth metropolitan residents supportive of water recycling.
- The community prioritized the increased use of recycled water for industry, followed by households (for non-drinking purposes) and public open space.
- 92 percent agreed that the state government should require more water recycling by industry.

Later on, in 2011, the requirements for recycled water schemes in WA were outlined in the Guidelines for the non-potable uses of recycled water in Western Australia (Department of Health, 2011). The guidelines were aligned with the Australian Guidelines for Water Recycling.

These Guidelines relate to the Public Health Act of 1911, thereby highlighting specific sections of the Act pertinent to regulating the use of recycled water. To be congruent to the Act, the guidelines considered recycled water as “sewage”. The guidelines note that the Department of Health was responsible in setting conditions of approval for recycling water schemes and the use of recycled water in Western Australia.

The Guidelines also stipulate recycled water quality minimum validation requirements, classifying them by exposure risk from “high to extra low”. In all validations, monitoring the influent and effluent of a minimum of six samples, taking place for a minimum of six weeks. For high exposure classification, an extra minimum requirement to measure bacterial concentrations of *E. coli*, *Coliphage* and *Clostridia* was required. For all other classifications, just *E. coli* concentrations would suffice.<sup>12</sup>

### **5.1 General regulations**

As stipulated in the *Western Australia Water Services Licensing Act of 1995 (WA)* (Government of Western Australia, 1995a), licensing of water service providers, both for potable and non-potable use, sewerage and irrigation and drainage services are taken from the Economic Regulation Authority. In the same year of 1995, the Water Corporation was created through the *Western Australia Water Corporation Act 1995 (WA)* (Government of Western Australia, 1995b). The Act states that Water Corporation shall serve as a water service provider. It is owned by the State Government of Western Australia and is accountable to its sole shareholder, which is the Minister of Water.

In 2012, the licensing and regulatory frameworks were updated and incorporated into the *Water Services Act of 2012 (WA)* (Government of Western Australia, 2012). Similar to Water Services Licensing Act of 1995, the updated version also stipulated that licenses must go through the Economic Regulation Authority. The Water Services Act’s provisions do not seem to have been designed to target the quality of drinking water. In other words, it did not include provisions which are specifically aimed at ensuring the quality of drinking supplies. The quality of drinking water could only be ensured by licensed operators (for potable water), who are required to have a Memorandum of Understanding (MoU) with the Department of Health.

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<sup>12</sup> As mentioned in the guidelines, the “DOHWA [Department of Health Western Australia] will prepare a Commissioning Validation Sampling Program based on the proposed treatment train and the identified CCPs [critical control points]. The operational parameters of each critical control point and their corresponding operational targets will be monitored during commissioning validation. The CCPs will vary depending on the type of system in use and processes and will need to be adjusted during commissioning validation to correct any failure or inefficiency of the system to achieve the operational targets. No approval to use will be granted until the system is producing the water quality expected for the intended end-use(s)” ( Department of Health (WA), 2011, p. 32).

## 5.2 Environmental regulations

Based on the *Western Australia Environmental Protection Act of 1986 (WA)* (Government of Western Australia, 1986), wastewater treatment plants (with outputs of more than 100 m<sup>3</sup>/day) are required to obtain approval for infrastructure and a license to discharge to the environment. The approval process should indicate that the activity is a recycled water scheme. This is then forwarded to the Department of Health for its perusal. Conditions for the discharge are contained in the license.

## 5.3 Health regulations

The primary legislation that used to regulate wastewater management was the *Western Australia Health Act of 1911 (WA)* (as of 6 December 2013) (Government of Western Australia, 1911). Under the Act, sewage was defined as “any kind of sewage, nightsoil, faecal matter or urine and any waste composed wholly or in part of liquid” and puts the responsibility on managing waste on the local government. The Act was eventually repealed and replaced by the *Public Health Act of 2016 (WA)* (Government of Western Australia, 2016).

Meanwhile, specific guidelines on greywater usage, both in sewerred and unsewerred areas were provided in the *Code of Practice for the Reuse of Greywater in Western Australia (2010)* (Government of Western Australia, 2010).

A list of strategies, plans, guidelines and legislation that are relevant to water recycling in the State of Western Australia are provided in Table 3.

**Table 3. Strategies, Plans, Guidelines and Legislation on Water Recycling in Western Australia**

<b>Title</b>	<b>Description</b>	<b>Involved Agencies</b>
State Water Strategy (2003) (Department of the Premier and Cabinet, 2003)	Targeted to increase recycled water in Australia to 20 percent by 2012.	Mainly involves the Water Corporation with regards to water recycling.
State Water Plan (2007) (Department of the Premier and Cabinet, 2007)	The plan identified water recycling as one of the priority actions for water resource management in Western Australia.	Mainly involves Water Corporation and Department of Water with regards to water recycling.

State Water Recycling Strategy 2008 (Department of the Premier and Cabinet, 2008)	The document mentioned that 'recycling' is a priority for the government. The plan was said to continue the goals stated in the State Water Strategy released in 2003.	Mainly involves Water Corporation and Economic Regulatory Authority with regards to water recycling.
Guidelines for the non-potable Uses of Recycled Water in Western Australia (2011) (Department of Health, 2011)	Included the requirements for recycled water schemes in Western Australia. However, its scope was limited to non-potable uses of recycled water.	Mainly involves Department of Health and Economic Regulation Authority for approval and licensing of recycling schemes. Other agencies with regulatory role may also include local government, Department of Water, Department of Environment and Conservation, Department of Planning, Environmental Protection Agency.
<i>Environmental Protection Act 1986 (WA)</i> As of: 1 January 2019 (Government of Western Australia, 1986)	Stipulates that wastewater treatment plants are required to obtain approval for infrastructure and license to discharge to the environment.	Mainly involves Department of Health and the Environmental Protection Authority.
<i>Health Act 1911 (WA)</i> As of: 6 December 2013 (Government of Western Australia, 1911) The Act was repealed and replaced by <i>Public Health Act 2016 (WA)</i> . As of: 22 July 2019 (Government of Western Australia, 2016)	<i>Health Act 1911 (WA)</i> provides general framework for management of waste (e.g. wastewater management) in order to ensure public health safety.	Mainly involves the Department of Health as administering agency.
Code of Practice for the Reuse of Greywater in Western Australia As of: 2010	Provides guidelines on greywater usage both in sewerred and unsewerred areas.	Responsibilities are mainly on local government or Department of Health (for approval of all

(Government of Western Australia, 2010)		greywater reuse systems used in single dwellings).
<i>Water Services Act of 2012 (WA)</i> As of: 19 November 2018 (Government of Western Australia, 2012)	Stipulates that water service providers must obtain a license from the Economic Regulation Authority.	Mainly involves Economic Regulation Authority and Department of Health for administering Agencies.
<i>Water Corporation Act 1995 (WA)</i> (Government of Western Australia, 1995b)	An Act establishing the Water Corporation.	Involves the creation of the Water Corporation as the principal supplier of water, wastewater and drainage services.

**5.4 Groundwater Replenishment Scheme (GWRS)**

As early as 1995, groundwater replenishment had been identified as a possible source to augment water supplies in a key water source planning document, ‘Perth’s Water Future Report’ (Western Australian Government, 1995). According to the Government of Western Australia, the report was prepared for over 3 three years and involved “*active and on-going consultation*” with both the community and industry. The strategy canvassed all possible options to secure water supplies for Perth and Mandurah, in which groundwater was identified as a “*continuing and increasingly important source of Perth’s future water needs leading directly to a declining reliance on dams*” (Western Australian Government, 1995).

In 2000, there was 100GL of unlicensed use of groundwater from 130,000 domestic bores used by 30% of Perth’s population to access its unique form of sub-surface storage from natural percolation through the coastal sandplain. This unmetered domestic supply was used for irrigating home gardens, public spaces and for industrial use.

In 2002, the Water Corporation developed a proposal to supply Perth with 45GL of groundwater from the South West Yarragadee aquifer, 100 km south of Perth. Residents of the south-west (including Bunbury and Busselton, towns independent of the WA Water Corporation) were surveyed for their views and values (Nancarrow et al., 2003). As the proposal involved taking water to Perth, Perth householders’ views on the proposal were also examined. There was strong disagreement with the water export proposal by the southwest community. Only 12% directly agreed with it, with 8% being unsure. Those originally opposed to the proposal were more inclined to change their minds if future certainty could be guaranteed. Less than a third of the Perth sample absolutely agreed with the water export proposal and less than half the total sample supported the proposal even given the possibility of total sprinkler bans (43% of the total sample) or increased water prices (47%). Support for the proposal markedly increased to almost



two-thirds of the total sample if the future needs of the southwest could be guaranteed. Overall, Perth respondents considered the export of Blackwood groundwater for Perth use to be less than fair to the people of the southwest and to be the least favoured future water resource, along with storing wastewater in aquifers for future use. Recycling options and desalination were the most favoured sources of the seven offered for consideration. The proposal to pipe groundwater from the south-west did not proceed (Radcliffe, 2004).

As a consequence, in 2004, the Water Corporation commenced engagement with regulators and the community regarding groundwater replenishment as a potential water source. In 2005, Western Australia's Environmental Protection Agency conducted an assessment to determine issues and necessary procedures to implement a scheme on groundwater replenishment (Environmental Protection Agency of Western Australia, 2005). Upon the recommendations and support of Western Australia's Environmental Protection Agency, the Water Corporation started planning for the groundwater replenishment trial in 2006 with the goal of gathering information on the *"technical, health, environmental and social aspects of such a scheme"* (University of New South Wales, 2014, p.4)<sup>13</sup>. In 2007, annual telephone surveys commenced in order to measure community understanding and concerns regarding groundwater replenishment. Attitudes are further tracked through 'visitor feedback forms' to measure awareness (Water Corporation, 2013a).

Since 2008, the Water Corporation also started to release media statements to improve positive community perception on recycled water. They are listed in the Final Report of the Groundwater Replenishment Trial (Water Corporation, 2013b). The first one, released in April 2008, was the "Water Forever Options" paper which was opened for public comment. In this paper authored by Dr. Jim Gill, who was the CEO of the Water Corporation during that time, groundwater replenishment was mentioned as the *"favoured future water source option"* (Water Corporation, 2013b).<sup>14</sup>

In November 2010, the first demonstration plant was created in Beenyup, Perth, Western Australia and was named as the Groundwater Replenishment Trial (GWRT). In the trial, treated wastewater from the Beenyup Wastewater Treatment Plant underwent the necessary process and quality based on the Australian Guidelines for Drinking Water. In 2011, the trial was highlighted in the Water Corporation's strategy entitled "Water Forever: Whatever the

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<sup>13</sup> Water Corporation is the state-owned corporation that manages Perth's water supply.

<sup>14</sup> In the course of the Groundwater Replenishment Trial, there were a total of seventeen (17) media statements released by the Water Corporation or the Government Media Office. Media sentiment on groundwater replenishment as well as the trial stage has been overall favourable, with 60% of 430 media articles showing positive views; the others were neutral and the remainder being a small number of unfavourable views (Water Corporation, 2013b).

Weather”. In the said strategy, it mentioned that the trial was needed to ensure water security in the region. The strategy also mentioned that the following activities were carried out to promote community support for groundwater replenishment: 1) extensive community engagement programme; and 2) custom-built Visitor Centre at Beenyup (Water Corporation, 2011, p.5).

Based on a ministerial statement in March 2012, overall support for groundwater replenishment increased to 74% (4% increase) since the first pulse survey conducted in 2010 (Western Australian Government, 2012). By end of 2012, the Groundwater Replenishment Trial was completed, thereby fulfilling three objectives: 1) provide technical feasibility, 2) establish a framework for policy and regulation and 3) ensure enough community (Perth) and government support (Water Corporation, 2013a). Agencies involved in overseeing the trial are the Department of Health, Department of Water and Department of Environmental Regulation.

In August 2013, the Western Australian Government announced that groundwater replenishment would be the “*the next new climate independent water source for Perth*” (Carr and Marsden, 2012, p.8). As such, the full-scale Groundwater Replenishment Scheme was announced. The Water Corporation also released a document entitled ‘Groundwater Replenishment Scheme: Communications Strategy 2013-2016’ (Water Corporation, 2013a). The document outlines the action plan with the corresponding timeline for communicating the Groundwater Replenishment Scheme. The strategy included newsletters, communication materials, visitor centre tours, community open days and events, as well as social media platforms among others. The stakeholder engagement approach was said to follow a ‘two-step’ communication strategy wherein opinion leaders are informed first before the broader community. In terms of community engagement, addressing two primary issues were highlighted, namely water quality and recycled water use. Meanwhile, in building trust, a face to face approach was mentioned to be preferred over mass communication methods.

In 2014, the Groundwater Replenishment Trial was decommissioned and the approval to construct the Groundwater Replenishment Scheme (Stage 1) was obtained (Hamilton, 2019). In 2014 as well, the guidelines that must be followed for monitoring the Groundwater Replenishment Scheme were outlined in the Memorandum of Understanding of Wastewater services and Groundwater Replenishment between the Department of Health and Water Corporation (October 2014) (WWS/GWR MoU). The Memorandum of Understanding is included as Appendix E of the document ‘Application: License to Operate (Water Corporation, 2017) and represents supporting documentation.

The Department of Health (DoH) was tasked to review the performance of the treatment. The Department of Health and Water Corporation, as stated in the MoU, were mandated to develop and implement public education programmes. The Water Corporation is also tasked to provide an Annual Wastewater Services Quality Report, to be submitted to the Department of Health. The MoU is said to evolve over time.

The Recycled Water Quality Parameters are stated in the Binding Protocol 2 section of the MoU (Water Corporation, 2017, pp.93-103). The basis of the parameters were the following documents:

- Premier’s Collaborative Research Project (PCRP) – “Characterising treated wastewater for drinking purposes following reverse osmosis treatment” (Department of Health, 2009).
- Australian Guidelines for Recycled Water: Managing Health and Environmental Risk (Phase 2) Augmentation of Drinking Water Supplies (AGWR-MHER-ADWS, 2008).
- Australian Drinking Water Guidelines (ADWG, 2011).
- Data collected through the Groundwater Replenishment Trial (2010-2012).

Recycled Water Quality Indicators were also set as a Binding Protocol in the MoU. These refer to chemicals or pathogens corresponding to a bigger group of chemicals or microbiological hazards having the same characteristics and that also exist as Recycled Water Quality Parameters. As these are included as “binding protocols”, the documents which reflect the foregoing items do not necessarily have to be publicly available as they might contain operationally sensitive information relevant to the GWRT’s security and intellectual property.

The MoU also included a section for ‘public education and reporting’. In this case, the Department of Health and the Water Corporation were tasked to develop and implement programmes aimed at educating the public regarding wastewater services. In addition, the Water Corporation was tasked to produce an Annual Wastewater Services Quality Report to be submitted to the Department of Health (Water Corporation 2017 - See Appendix E, page 12).

In July 2016, the decision to expand the Groundwater Replenishment Scheme - Stage 1 was made. The plant can recharge up to 28 billion litres of recycled water into groundwater supplies in the deep Leederville and Yarragadee aquifers each year through onsite bores (Water Corporation, 2020). Construction of Stage 1 of the plant was from October 22, 2014, up to July 2016. On July 14, 2016 as well, Water Authority announced the expansion of the Groundwater Replenishment Scheme (also referred as Stage 2). The construction process for expansion began

in late 2017 and was expected to be finished by mid-2019 (Hamilton, 2019). At the time of writing this chapter the construction of the Stage 2 of the scheme was nearing completion.

## 6 Communication as a Policy Instrument

Community consultation, information, education and engagement initiatives are essential elements for public acceptance of potable water reuse projects. As such, it is necessary that they are formally part of policy instruments that should be considered when planning and executing a project.

In Australia in general and in the states of Queensland and Western Australia in particular, a number of plans, guidelines and strategies on environmental protection, drinking water and water recycling, refer to the importance of community involvement (see Table 4).

**Table 4. Policy documents that refer to Communication Strategies**

Federal/State/ Utility	Title of the document/ Type of document	Basic Description of information wherein the topic on communication was including
Commonwealth of Australia	Australian Drinking Water Guidelines (ADWG, 2004; 2011; 2018)	Highlighted ‘community involvement and awareness’ as a core element (cited as Element 8) of the framework for drinking water quality.  Included guidelines for a ‘community consultation strategy’  Promoted a ‘coordinated consumer information programme’ and provided guidelines for such programme.
Commonwealth of Australia	Australian Guidelines for Water Recycling Managing Health and Environmental Risks, Augmentation of Drinking Water Supplies (Phase 2) (ADWG-MHER-ADWS, 2008)	Similar to the AWDG, the guidelines also noted ‘community involvement and awareness’ as one of the core elements for its framework.  It noted that the ‘ <i>aim of consultation needs to be to arrive at a sustainable outcome rather than to seek acceptance of a system preferred by its proponents</i> ’.

State of Queensland	Queensland Water Recycling Guidelines 2005 (The State of Queensland, 2005)	Highlighted the need for community engagement for recycled water policy and mentioned six guiding principles.  Also provided a list of factors that must be considered in choosing the appropriate engagement strategy.
State of Queensland	Environmental Protection (Water) Policy 2009 (EPWP, 2009)	Provided some recommendations on promoting community awareness on issues about water quality, as well as to involve the community in water quality management.
State of Queensland	Environmental Protection (Water and Wetland Biodiversity) Policy 2019 (EPWWBP, 2019)	It refers to the way release of wastewater or contaminants to waters must be dealt following an order of preference.
State of Western Australia	Perth's Water Report 1995	The report was processed for three years with corresponding inputs from active stakeholder consultation.
State of Western Australia	State Water Strategy 2003 (Department of the Premier and Cabinet, 2003)	The strategy incorporated inputs from community members, which included those who took part in a series of Water Forums in the State of Western Australia and insights from delegates of the Water Symposium which took place at the Parliament House in 2002.
State of Western Australia	State Water Plan 2007 (Department of the Premier and Cabinet, 2007)	In the development process of the plan, public consultations took place. This included insights generated from the State Water Forum in 2005 and direct engagement with end-users and interest groups and public submission of documents.
State of Western Australia	State Water Recycling Strategy 2008	During the development of the strategy, community consultation also took place. A survey to assess the attitude and

	(Department of the Premier and Cabinet, 2008)	understanding of the public with regards to water recycling was conducted.
State of Western Australia	Water Forever Whatever the Weather (Water Corporation, 2011)	Mentions the extensive community engagement programme and custom-built visitor centre at Beenyup that were implemented to encourage support for the groundwater replenishment programme.
State of Western Australia (Groundwater Replenishment Scheme)	Groundwater Replenishment Scheme: Communication Strategy (2013-2016) (Water Corporation, 2013a)	Outlined the action plan with the corresponding timeline for communicating the Groundwater Replenishment Scheme.
State of Western Australia (Groundwater Replenishment Scheme)	Memorandum of Understanding of Wastewater Services and Groundwater Replenishment between the Department of Health and Water Corporation (October 2014) (Water Corporation, 2017).	Includes a section on 'public education and reporting'

Consideration of community involvement (including policymakers and the media in addition to affected and neighbouring population) as a core element of policy instruments is not enough. Information, education and engagement strategies have to be planned, implemented and their effectiveness have to be assessed and improved case by case.

In the case of the Western Corridor Recycled Water Scheme (WCRWS), while it is mentioned that public views were overwhelmingly positive, reports indicate that communication, information, education and engagement strategies were few. Roux et al. (2010) mention that the Western Corridor Recycled Water's Project Management Group was responsible for land acquisition, environmental approvals, corporate communications and high-level community consultation. In

2008, the final progress report of the Queensland Government mentions a proactive community engagement that resulted in minimal complaints, strong relationships with neighbouring communities and significant community investment through the WCRW Grants Program (Queensland Government Department of Infrastructure and Planning, 2008).

Regarding views of the public on the project, Price et al. (2010) report findings of a study supported by South East Queensland Urban Water Security Research Alliance. Four telephone surveys were carried out between November 2007 and December 2008. The report indicates a relatively high support for the scheme along the four surveys. However, it also mentions that majority of the respondents expressed their preference to drink water that did not include reused water if another alternative existed. Regarding the public support to the project, the study indicates that it is possible to build a support base, but that maintaining it represents a major challenge. Therefore, that it is very important that community trusts the government’s capacity to deliver safe water supply, that perceives the project to be of low risks, and that its implementation is fair. A significant element is that water reuse projects are presented as part of a water security strategy that will benefit the population in the long-term.

As much as communication, engagement and acceptance were important, at the end, even with favourable public views, the operation of the Western Corridor project was cancelled.

Regarding the Groundwater Replenishment Scheme in Western Australia, communication strategies were extensive and planned and implemented carefully. They were also given the importance they deserved to obtain and to maintain the support of the community on the project. Levels of community and stakeholder engagements implemented by the Water Corporation from 2013-2016 are presented in Table 5 (Water Corporation, 2013b).

**Table 5. Levels of Community and Stakeholder Engagement**

<b>Inform</b>	<b>Consult</b>	<b>Involve</b>	<b>Collaborate</b>	<b>Empower</b>
Provide balanced and objective information to assist understanding.	Obtain community views	Work directly with community to ensure concerns and aspirations are understood and considered.	Partner with community in decisions including the development of alternatives and the identification of	Place final decision-making in the hands of the community.

			the preferred solution	
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<b>Issue for Engagement</b>	<b>Level of engagement</b>	<b>Timing</b>	<b>Decision scope for stakeholders and the community</b>
Trust in Water Corporation to deliver and operate GWRS: Water quality, Recycled water use	Consult	Jan 2013- Dec 2016	Work with the community and key stakeholders to address the two most common concerns voiced through communication activities and surveys undertaken during the Ground Water Replenishment Trial.
State Government Announcement	Inform	June/July 2013	Advise key stakeholders and the broader community of the State Government decision.
Environmental Approvals	Involve	June 2013- Sept 2013	Identify opportunities and provide the community with the information they need to provide their views throughout the approvals period.
Construction Impacts	Consult	Jan 2014 – Dec 2015	Work with the community to identify and mitigate potential construction impacts.
Operations	Consult	2016 +	To be addressed in a separate plan when the strategy for ongoing operations of the scheme is determined.



There has been an interest of the utility to measure community understanding and concerns regarding groundwater replenishment and to follow how attitudes are changing with the objective to measure awareness.

The several projects developed in Australia with the purpose to diversify sources of water such as recycling and desalination plants and related infrastructure have resulted in very large investments. When the infrastructure was not used for the purpose for which it had been planned, it caused considerable criticism as the projects have resulted in high costs for the consumers (Radcliffe, 2015).

## **7 Lessons Learnt**

Australia's experiences on recycling water for potable purposes provide numerous lessons. Water scarcity has driven water recycling to augment water resources for potable and non-potable purposes. Australia has developed a very robust governance and policy framework to regulate it with the priority of protecting human health and the environment.

Results have been mixed. South East Queensland's projects have been built but water has not flowed to Wivenhoe dam so far. Even then, the cases analysed show the relevance of project planning and execution with full consideration of governance and regulatory aspects, all-stakeholder engagement (including policymakers, affected and neighbouring communities and the media) and political support. The Western Corridor project was conceived in a state of urgency, if not near-panic. Short-time frames can lead to lack of understanding of project benefits and costs by any of the groups and can result either in project cancellation or under-utilisation.

Planning, support and communication-wise, the Groundwater Replenishment Scheme (GWRS) has proven to be more robust. Community engagement started in 2004 and continued over a decade with the support of a community advisory panel composed of health professionals, ecological activists and members of the public. Moreover, the utility which has virtually a state-wide mandate, maintained a communication channel with policymakers and community members, to keep them informed and engaged on the project. One significant result of this engagement has been the bi-partisan political support exhibited for the scheme.

Very important was that Water Corporation in Perth followed the perceptions of the community with the objective to measure their awareness and attitudes via annual telephone surveys and/or visitor centre feedback forms. This provided the utility with information on the views and concerns of the public, which could be invaluable for planning purposes (Water Corporation, 2013a).

Water reuse for potable purposes has numerous benefits and holds great potential. It can face policy, regulatory, communication and political challenges if not planned properly. However, if planned and implemented properly, it can provide a reliable source of clean water for all uses. Given population growth, increasing demand and impacts of climate change, it will become more necessary with time. City governments, water utilities and population have to be ready for it.

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## **References**

ADWG. (2004). Australian Drinking Water Guidelines. Australia Government, National Health and Medical Research Council, Natural Resource Management Ministerial Council. Available at: <https://www.eh.org.au/documents/item/735> [Accessed 30 October 2020].

ADWG. (2011). Australian Drinking Water Guidelines. Australia Government, National Health and Medical Research Council, Natural Resource Management Ministerial Council. Available at: [https://www.clearwatervic.com.au/user-data/resource-files/Aust\\_drinking\\_water\\_guidelines.pdf](https://www.clearwatervic.com.au/user-data/resource-files/Aust_drinking_water_guidelines.pdf) [Accessed 30 October 2020].

ADWG. (2018). Australian Drinking Water Guidelines. Australia Government, National Health and Medical Research Council, Natural Resource Management Ministerial Council. Available at: <https://www.nhmrc.gov.au/about-us/publications/australian-drinking-water-guidelines> [Accessed 13 October 2020].

AGWR-MHER. (2006). Australian Guidelines for Water Recycling: Managing Health and Environmental Risk (Phase 1). Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers' Conference. Available at: <https://www.waterquality.gov.au/sites/default/files/documents/water-recycling-guidelines-full-21.pdf> [Accessed 29 October 2020].

AGWR-MHER-ADWS. (2008). Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), Augmentation of Drinking Water Supplies. Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers' Conference. Available at: <https://www.waterquality.gov.au/sites/default/files/documents/water-recycling-guidelines-augmentation-drinking-22.pdf> [Accessed 29 October 2020].

AGWR-MHER-MAR. (2009). Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2), Managed Aquifer Recharge. Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers' Conference. Available at:

<https://www.waterquality.gov.au/sites/default/files/documents/water-recycling-guidelines-mar-24.pdf> [Accessed 29 October 2020].

AGWR-MHER-SHR. (2009). Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 2): Stormwater Harvesting and Reuse. Environment Protection and Heritage Council, the Natural Resource Management Ministerial Council and the Australian Health Ministers' Conference. Available at:

<https://www.waterquality.gov.au/sites/default/files/documents/water-recycling-guidelines-stormwater-23.pdf> [Accessed 29 October 2020].

ATSE (Australian Academy of Technological Sciences and Engineering). (2013). Drinking Water through Recycling - the Benefits and Costs of Supplying Direct to the Distribution System.

Available at: <https://www.atse.org.au/wp-content/uploads/2019/04/drinking-water-through-recycling-full-report.pdf> [Accessed 13 October 2020].

Australian Government. (2015). National Water Commission (Abolition) Act 2015, No. 63, 2015. Federal Register of Legislation. Available at:

<https://www.legislation.gov.au/Details/C2015A00063>. [Accessed 6 November 2020].

Australian Government Bureau of Meteorology. (n/d). Western Corridor Recycled Water

Scheme. Available at: <http://www.bom.gov.au/water/awid/id-822.shtml> [Accessed 13 October 2020].

AWRCoE. (2017). Australian Water Recycling Centre of Excellence project reports. Available at:

<https://webarchive.nla.gov.au/awa/20170218032926/http://www.australianwaterrecycling.com.au/research-publications.html> [Accessed 31 October 2020].

Carr, R., Marsden, J. and Jacob, P. (2012). Case Study #1 (of 3) – South East Queensland Western Corridor Recycled Water Project, Queensland: Australian Water Recycling Centre of Excellence. Available at:

<http://vuir.vu.edu.au/32227/1/Case%2BStudy%2B1%2B%E2%80%93%2BWestern%2BCorridor%2BRecycled%2BWater%2BProject.pdf> [Accessed 13 October 2020].

Commonwealth of Australia. (2004). Intergovernmental Agreement on a National Water Initiative. Canberra: Commonwealth of Australia and the Governments. Available at: <https://www.pc.gov.au/inquiries/completed/water-reform/national-water-initiative-agreement-2004.pdf> [Accessed 29 October 2020].

Commonwealth of Australia. (2014). Forty-fourth parliament first session – Fourth period [Parliamentary Debates]. Available at: [https://parlinfo.aph.gov.au/parlInfo/download/chamber/hansards/ac24fb2b-74f6-47ad-bf9f-61ebf6a29462/toc\\_pdf/Senate\\_2014\\_09\\_25\\_2861\\_Official.pdf;fileType=application%2Fpdf](https://parlinfo.aph.gov.au/parlInfo/download/chamber/hansards/ac24fb2b-74f6-47ad-bf9f-61ebf6a29462/toc_pdf/Senate_2014_09_25_2861_Official.pdf;fileType=application%2Fpdf) [Accessed 5 November 2020].

Commonwealth of Australia. (2018). National Water Quality Management Strategy. Canberra: Commonwealth of Australia and the Governments. Available at: <https://www.waterquality.gov.au/sites/default/files/documents/nwqms-charter.pdf> [Accessed on 15 October 2020].

Department of Health. (2009). Premier’s Collaborative Research Program (2005-2008). Characterising treated wastewater for drinking purposes following reverse osmosis treatment. Technical Report. Western Australia Government. Available at: [https://ww2.health.wa.gov.au/~/\\_media/Files/Corporate/general%20documents/water/Groundwater%20replenishment/PCRP%20Chapter1-5.pdf](https://ww2.health.wa.gov.au/~/_media/Files/Corporate/general%20documents/water/Groundwater%20replenishment/PCRP%20Chapter1-5.pdf) [Accessed 5 November 2020].

Department of Health. (2011). Guidelines for the non-potable uses of recycled water in Western Australia. Western Australia Government. Available at: [https://ww2.health.wa.gov.au/~/\\_media/Files/Corporate/general-documents/water/Recycling/Guidelines-for-the-Non-potable-Uses-of-Recycled-Water-in-WA.pdf](https://ww2.health.wa.gov.au/~/_media/Files/Corporate/general-documents/water/Recycling/Guidelines-for-the-Non-potable-Uses-of-Recycled-Water-in-WA.pdf) [Accessed 5 November 2020].

Department of the Premier and Cabinet. (2003). Securing our water future: A state water strategy for Western Australia. Perth: Government of Western Australia. Available at: [https://www.water.wa.gov.au/\\_data/assets/pdf\\_file/0012/4314/82417.pdf](https://www.water.wa.gov.au/_data/assets/pdf_file/0012/4314/82417.pdf) [Accessed 30 October 2020].

Department of the Premier and Cabinet. (2007). State Water Plan 2007. Perth: Government of Western Australia. Available at: [https://www.water.wa.gov.au/\\_data/assets/pdf\\_file/0015/4524/74923.pdf](https://www.water.wa.gov.au/_data/assets/pdf_file/0015/4524/74923.pdf) [Accessed 30 October 2020].

Department of the Premier and Cabinet. (2008). State Water Recycling Strategy: An Overview. Available at: [https://www.water.wa.gov.au/\\_data/assets/pdf\\_file/0016/1627/80011.pdf](https://www.water.wa.gov.au/_data/assets/pdf_file/0016/1627/80011.pdf) [Accessed 14 October 2020].

Department of Sustainability Environment, Water, Population and Communities. (2012). Water Smart Australia Program Review and Lessons Learnt Final Report. Canberra: Department of Sustainability Environment, Water, Population and Communities. Available at: <https://webarchive.nla.gov.au/awa/20140312075649/http://www.environment.gov.au/system/files/resources/97e840af-6406-49f2-8b43-af94ca0e7699/files/water-smart-review-report.pdf> [Accessed 29 October 2020].

Dillon, P., Palmer, N., Vertessy, R., and Radcliffe, J. (2018). Research investment in the Australian urban water industry: Towards an optimal level and a funding model. Water Source. Available at: <https://watersource.awa.asn.au/technology/research/research-investment-in-the-australian-urban-water-industry/> [Accessed 13 October 2020].

EPA. (1994). Environmental Protection Act 1994. State of Queensland. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-1994-062> [Accessed 18 October 2020].

Environmental Protection Agency of Western Australia. (2005). Strategic Advice on Managed Aquifer Recharge using Treated Wastewater on the Swan Coastal Plain. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.110.4478&rep=rep1&type=pdf> [Accessed 14 October 2020].

EPR. (2009). Environmental Protection Regulation 2009. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/2019-09-01/sl-2019-0155> [Accessed 1 September 2019]

EPR. (2019). Environmental Protection Regulation 2019. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/2019-09-01/sl-2019-0155> [Accessed 29 October 2020].

EPWP. (2009). Environmental Protection (Water) Policy 2009. Available at: <https://www.legislation.qld.gov.au/view/pdf/asmade/sl-2009-0178> [Accessed 29 October 2020].

EPWWBP. (2019). Environmental Protection (Water and Wetland Biodiversity) Policy 2019. Available at: <https://www.legislation.qld.gov.au/view/whole/html/asmade/sl-2019-0156> [Accessed 29 October 2020].

Fielding, K.S., Dolnicar, S. & Schultz, T. (2019). Public acceptance of recycled water, *International Journal of Water Resources Development*, 35:4, 551-586, DOI: 10.1080/07900627.2017.1419125

Government of Western Australia. (1911). Public Health Act of 1911. Western Australia. Available at: [https://www.legislation.wa.gov.au/legislation/prod/filestore.nsf/FileURL/mrdoc\\_25565.pdf/\\$FILE/Health%20Act%201911%20-%20%5B16-a0-01%5D.pdf?OpenElement](https://www.legislation.wa.gov.au/legislation/prod/filestore.nsf/FileURL/mrdoc_25565.pdf/$FILE/Health%20Act%201911%20-%20%5B16-a0-01%5D.pdf?OpenElement) [Accessed 30 October 2020].

Government of Western Australia. (1986). Environmental Protection Act 1986. Available at: [https://www.legislation.wa.gov.au/legislation/statutes.nsf/main\\_mrtitle\\_304\\_homepage.html](https://www.legislation.wa.gov.au/legislation/statutes.nsf/main_mrtitle_304_homepage.html) [Accessed 5 November 2020].

Government of Western Australia. (1995a). Water Services Licensing Act of 1995 (WA). Available at: [https://www.slp.wa.gov.au/statutes/swans.nsf/\(DownloadFiles\)/Water+Services+Licensing+Act+1995.pdf/\\$file/Water+Services+Licensing+Act+1995.pdf](https://www.slp.wa.gov.au/statutes/swans.nsf/(DownloadFiles)/Water+Services+Licensing+Act+1995.pdf/$file/Water+Services+Licensing+Act+1995.pdf) [Accessed 23 November 2019].

Government of Western Australia. (1995b). Western Australia Water Corporation Act 1995. Available at: [https://www.slp.wa.gov.au/statutes/swans.nsf/\(DownloadFiles\)/Water+Corporation+Act+1995.pdf/\\$file/Water+Corporation+Act+1995.pdf](https://www.slp.wa.gov.au/statutes/swans.nsf/(DownloadFiles)/Water+Corporation+Act+1995.pdf/$file/Water+Corporation+Act+1995.pdf) [Accessed 30 October 2020].

Government of Western Australia. (2010) Code of Practice for the Reuse of Greywater in Western Australia. Available at: <https://ww2.health.wa.gov.au/~media/Files/Corporate/general%20documents/water/Waste%20water/COP-Greywater-Reuse-2010.pdf> [Accessed 30 October 2020].

Government of Western Australia. (2012). Water Services Act of 2012. Available at: [https://webarchive.nla.gov.au/awa/20190417141753/http://www8.austlii.edu.au/cgi-bin/viewdb/au/legis/wa/num\\_act/wsa201224o2012221/](https://webarchive.nla.gov.au/awa/20190417141753/http://www8.austlii.edu.au/cgi-bin/viewdb/au/legis/wa/num_act/wsa201224o2012221/) [Accessed 30 October 2020].

Government of Western Australia. (2016). Public Health Act of 2016. Available at: [https://healthywa.wa.gov.au/Articles/N\\_R/Public-Health-Act-2016#:~:text=The%20new%20Public%20Health%20Act,health%20of%20all%20Western%20Australians](https://healthywa.wa.gov.au/Articles/N_R/Public-Health-Act-2016#:~:text=The%20new%20Public%20Health%20Act,health%20of%20all%20Western%20Australians) [Accessed 30 October 2020].

Hamilton, S. (2019). Perth's Groundwater Replenishment Scheme – From Concept to Reality. Available at: <https://www.waterra.com.au/publications/document-search/?download=1730> [Accessed 16 January 2019].

Khan, S. and Branch, A. (2019). Potable Water Reuse –What Can Australia Learn from Global Experience? WaterRA Project 3039. Water Research Australia: Adelaide. Available at: <https://www.waterra.com.au/publications/document-search/?download=1806> [Accessed 6 November 2020].

Kiem, A.S. (2013). Drought and water policy in Australia: Challenges for the future illustrated by the issues associated with water trading and climate change adaptation in the Murray-Darling Basin. *Global Environmental Change* 23: 1615-1626. doi.org/10.1016/j.gloenvcha.2013.09.006

Lee, H. and Tan, T.P. (2016). Singapore's experience with reclaimed water: NEWater. *International Journal of Water Resources Development* 32:4, 611-621, DOI:10.1080/07900627.2015.1120188

Nancarrow, B.E., Kaercher, J. D., Po, M. and Syme, G.J. (2003). Social values and impact study – South West Yarragadee Blackwood Groundwater Study. The results of the South West and Perth Community Surveys. Australian Centre for Water in Society, CSIRO Land and Water, Perth, July 2003. Available at: [https://www.water.wa.gov.au/\\_data/assets/pdf\\_file/0010/4510/45759.pdf](https://www.water.wa.gov.au/_data/assets/pdf_file/0010/4510/45759.pdf) [Accessed 30 October 2020].

National Urban and Water Desalination Plan. (2019). Australian Government, Department of Agriculture, Water and the Environment. Available at: <http://www.agriculture.gov.au/water/urban/completed-programmes/national-urban-water-and-desalination-plan> [Accessed 30 October 2020].

NCED. (2017). National Centre of Excellence in Desalination, Presentation, Adelaide, 17 December 2012. Available at: <https://webarchive.nla.gov.au/awa/20170215131148/http://desalination.edu.au/> [Accessed 31 October 2020].

NHMRC and ARMCANZ (National Health and Medical Research Council and Agriculture and Resource Management Council of Australia and New Zealand). (2000). Guidelines for Sewerage Systems, Use of Reclaimed Water. National Water Quality Management Strategy, NHMRC and ARMCANZ, Canberra.

Parliament of Australia. (2007). \$408 Million for South East Queensland Water [Press Release, 24 April 2007]. Available at: [https://parlinfo.aph.gov.au/parlInfo/download/media/pressrel/J6VM6/upload\\_binary/i6vm64.pdf;fileType=application%2Fpdf#search=%22media/pressrel/J6VM6%22](https://parlinfo.aph.gov.au/parlInfo/download/media/pressrel/J6VM6/upload_binary/i6vm64.pdf;fileType=application%2Fpdf#search=%22media/pressrel/J6VM6%22) [Accessed 29 October 2020].

PHA. (2005). Public Health Act 2005. State of Queensland, Australia. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2005-048> [Accessed 5 November 2020].

PHR. (2005). Public Health Regulation 2005. State of Queensland, Australia. Available at: <https://www.legislation.qld.gov.au/view/pdf/2017-06-30/sl-2005-0281> [Accessed 5 November 2020].

PHR. (2018). Public Health Regulation 2018. State of Queensland, Australia. Available at: <https://www.legislation.qld.gov.au/view/pdf/asmade/sl-2018-0117> [Accessed 18 October 2020].

Po, M., Nancarrow, B. E., Leviston, Z., Poter, N. B., Syme, G. J., and Kaercher, J. D. (2005). Predicting Community Behaviour in Relation to Wastewater Reuse: What Drives Decisions to Accept or Reject? CSIRO Water for a Healthy Country Flagship report. Perth: Australia. Available at: [http://www.clw.csiro.au/publications/consultancy/2005/WfHC\\_Predicting\\_Reuse\\_Behaviour.pdf](http://www.clw.csiro.au/publications/consultancy/2005/WfHC_Predicting_Reuse_Behaviour.pdf) [Accessed 5 November 2020].

Power, K. (2010). Recycled water use in Australia: regulations, guidelines and validation requirements for a national approach. National Water Commission, Waterlines Report 26, Canberra: Australia. Available at: [http://www.geo-processors.com/downloads/Power-2010-Recycled\\_Water\\_Use\\_Aust.pdf](http://www.geo-processors.com/downloads/Power-2010-Recycled_Water_Use_Aust.pdf) [Accessed 29 October 2020].

Price, J., Fielding, K., Leviston, Z., Bishop, B., Nicol, S., Greenhill, M., and Tucker, D. (2010). Community Acceptability of the Indirect Potable Use of Purified Recycled Water in South East



Queensland: Final Report of Monitoring Surveys. Urban Water Security Research Alliance Technical Report No. 19. (Griffith University and The University of Queensland). Available at: <http://www.urbanwateralliance.org.au/publications/UWSRA-tr19.pdf> [Accessed 20 October 2020].

Productivity Commission. (2017). National Water Reform Productivity Commission Inquiry Report, Canberra: Commonwealth of Australia. Available at: [https://www.pc.gov.au/data/assets/pdf\\_file/0007/228175/water-reform.pdf](https://www.pc.gov.au/data/assets/pdf_file/0007/228175/water-reform.pdf) [Accessed 6 November].

Queensland Audit Office. (2013). Report to Parliament 14: 2012-13. Brisbane: Australia. Available at: [https://www.gao.qld.gov.au/sites/default/files/reports/rtp\\_maintenance\\_of\\_water\\_infrastructure\\_assets.pdf](https://www.gao.qld.gov.au/sites/default/files/reports/rtp_maintenance_of_water_infrastructure_assets.pdf) [Accessed 29 October 2020].

Queensland Government. (2007). SEQ Will Have Purified Recycled Water but No Vote: Premier, 28 January 2007. Available at: <https://statements.qld.gov.au/statements/45341> [Accessed 13 October 2020].

Queensland Government. (2010a). Water reforms save money for householders. Joint Ministerial Statement, December 5 2010. Available at: <https://statements.qld.gov.au/statements/63914> [Accessed 13 October 2020].

Queensland Government. (2014). Water schemes costing Queenslanders dearly. Joint Statement. Available at: <https://statements.qld.gov.au/statements/74426> [Accessed 4 November 2020].

Queensland Government Department of Infrastructure and Planning (2008). Final Progress Report. Western Corridor Recycled Water Project: Stage 2. A Water Smart Australia Project. Available at: <https://www.cooranbongwater.com.au/media/filecontent/wsa-qld-08-final-report.pdf> [Accessed 4 November 2020].

Radcliffe, J.C. (2004). Water Recycling in Australia. Australian Academy of Technological Sciences and Engineering. Melbourne: Australia. Available at: <https://www.atse.org.au/wp-content/uploads/2019/01/water-recycling-in-australia.pdf> [Accessed 30 January 2020].

Radcliffe, J. C. (2015). Water recycling in Australia – during and after the drought. *Environmental Science: Water Research & Technology*, 1:5, 554-562. DOI:10.1039/C5EW00048C

Radcliffe, J.C. and Page, D. (2020). Water Reuse and recycling in Australia: history, current situation and future perspectives. *Water Cycle* 1: 19-40. DOI:10.1016/j.watcyc.2020.05.005

Redland City Bulletin. (2020). Natural Resources Minister Anthony Lynham quashes Oodgeroo MP Mark Robinson's wastewater claims 1 June 2020. Available at: <https://www.redlandcitybulletin.com.au/story/6773865/mps-water-woes-rejected/> [Accessed 14 October 2020].

Roux, A., Robillot, C., Walker, T., Hester, B. (2010). The Western Corridor Recycled Water Project - Challenges in Ensuring Water Quality on a large Indirect Potable Reuse Scheme. *Proceedings of the Water Environment Federation*, 6566-6579. DOI:10.2175/193864710798207314

Seqwater. (2017). Water for life South East Queensland's Water Security Program 2016-2046. Brisbane: Australia. Available at: <https://www.seqwater.com.au/sites/default/files/2019-08/Water%20for%20life%20Water%20Security%20Program.pdf> [Accessed 30 October 2020].

Seqwater. (2018a). Purified recycled water. Available at: <https://www.seqwater.com.au/sites/default/files/2019-08/2018%20Purified%20Recycled%20Water%20Fact%20Sheet.pdf> [Accessed 13 October 2020].

Seqwater. (2018b). 2018 Water Security Program Annual Report. Available at: <https://www.seqwater.com.au/sites/default/files/2019-08/2018%20Water%20Security%20Program%20Annual%20Report%20.pdf> [Accessed 30 October 2020].

Seqwater. (2018c). Operational Plan 2018-19, Available at: <https://www.parliament.qld.gov.au/documents/tableOffice/TabledPapers/2019/5619T1647.pdf> [Accessed 30 October 2020].

Sharp, C. (1997). Report of the standing committee on ecologically sustainable development in relation to the quality of Perth's water supply. Western Australia Legislative Council. Perth: Australia. Available at: [https://www.parliament.wa.gov.au/Parliament/commit.nsf/\(Report+Lookup+by+Com+ID\)/7B21240B59CB407548257831003E946E/\\$file/sd009rp.pdf](https://www.parliament.wa.gov.au/Parliament/commit.nsf/(Report+Lookup+by+Com+ID)/7B21240B59CB407548257831003E946E/$file/sd009rp.pdf) [Accessed 30 October 2020].

The State of Queensland. (1971). State Development and Public Works Organisation Act 1971. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-1971-055> [Accessed 29 October 2020].

The State of Queensland. (2001). Queensland Water Recycling Strategy. Environment Protection Agency, October. Available at: [https://web.archive.org/awa/20040712223430mp\\_/http://www.epa.qld.gov.au:80/publications/p00549aa.pdf/Queensland\\_water\\_recycling\\_strategy\\_an\\_initiative\\_of\\_the\\_Queensland\\_Government.pdf](https://web.archive.org/awa/20040712223430mp_/http://www.epa.qld.gov.au:80/publications/p00549aa.pdf/Queensland_water_recycling_strategy_an_initiative_of_the_Queensland_Government.pdf) [Accessed 29 October 2020].

The State of Queensland. (2002). Plumbing and Drainage Act 2002. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/2017-07-03/act-2002-077> [Accessed 7 November 2019].

The State of Queensland. (2005). Queensland Water Recycling Guidelines. Queensland Government Environmental Protection Agency. Brisbane: Australia. Available at: <https://www.hort360.com.au/wordpress/wp-content/uploads/2015/03/Queensland-Water-Recycling-Guidelines-Dec-2005.pdf> [Accessed 29 October 2020].

The State of Queensland. (2018). Queensland Plumbing and Drainage Act 2018. Available at: <https://www.legislation.qld.gov.au/view/html/asmade/act-2018-017> [Accessed 15 October 2020].

The State of Queensland. (2019). Queensland Plumbing and Wastewater Code 2019. Available at: [https://www.hpw.qld.gov.au/\\_data/assets/pdf\\_file/0019/3943/queenslandplumbingandwastewatercode\\_26march2019.pdf](https://www.hpw.qld.gov.au/_data/assets/pdf_file/0019/3943/queenslandplumbingandwastewatercode_26march2019.pdf) [Accessed 16 January 2019].

Thorley, D. (2006). Toowoomba recycled water poll. Reform 89. Available at: <http://www.austlii.edu.au/au/journals/ALRCRefJl/2006/37.pdf> [Accessed 13 October 2020].

Toowoomba City Council. (2006). Water futures: Securing a safe and sustainable supply of water for our future. Available at: <http://www.valscan.com.au/TCC-WaterFuturesLORES.pdf> [Accessed 13 October 2020].

Toowoomba Region. (2020a). Recycled water use on golf courses. Available at: <https://www.tr.qld.gov.au/environment-water-waste/water-supply-dams/responsible-water->

[use-as-a-business/7626-what-you-need-to-know-about-class-c-recycled-water](#) [Accessed 29 October 2020].

Toowoomba Region. (2020b). Wivenhoe Pipeline FAQs. Available at: <https://www.tr.qld.gov.au/environment-water-waste/water-supply-dams/dams-bores/13661-wivenhoe-pipeline-faqs> [Accessed 30 October 2020].

University of New South Wales. (2014). Global potable reuse case study 7: Beenyup Groundwater Replenishment Trial. Australian Water Recycling Centre of Excellence. Sydney: Australia. Available at: <https://webarchive.nla.gov.au/awa/20170224094750/http://www.water360.com.au/wp-content/uploads/2015/07/WQ-Case-Study-7-Beenyup-GWRT-1008151.pdf> [Accessed 14 October 2020].

University of New South Wales. (2015). Water quality and public health: Risks and prevention, health assessments and global potable use case studies. Australian Water Recycling Centre of Excellence. Sydney: Australia. Available at: <https://webarchive.nla.gov.au/awa/20170224094640/http://www.water360.com.au/wp-content/uploads/2015/07/Water-Quality-and-Public-Health-100815.pdf> [Accessed 30 October 2020].

Water Act. (2000). State of Queensland. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2000-034/lh> [Accessed 5 November 2020].

Water Corporation. (2011). Water forever: Whatever the Weather. Water Corporation. Perth: Australia. Available at: <https://www.watercorporation.com.au/-/media/WaterCorp/Documents/Our-Water/Sustainability-and-Innovation/Securing-Supply/Perth-10-year-water-supply-strategy.pdf> [Accessed 30 October 2020].

Water Corporation. (2013a). Groundwater Replenishment Scheme Communications Strategy 2013-2016. Water Corporation. Perth: Australia. Available at: [https://consultation.epa.wa.gov.au/seven-day-comment-on-referrals/perth-groundwater-replenishment-scheme/supporting\\_documents/Appendix%2012%20Communication%20Strategy%202013%202016.pdf](https://consultation.epa.wa.gov.au/seven-day-comment-on-referrals/perth-groundwater-replenishment-scheme/supporting_documents/Appendix%2012%20Communication%20Strategy%202013%202016.pdf) [Accessed 30 October 2020].

Water Corporation. (2013b). Groundwater Replenishment Trial: Final Report. Water Corporation. Perth: Australia. Available at: [https://consultation.epa.wa.gov.au/seven-day-comment-on-referrals/perth-groundwater-replenishment-scheme/supporting\\_documents/Appendix%20%20Groundwater%20Replenishment%20Final%20Report.pdf](https://consultation.epa.wa.gov.au/seven-day-comment-on-referrals/perth-groundwater-replenishment-scheme/supporting_documents/Appendix%20%20Groundwater%20Replenishment%20Final%20Report.pdf) [Accessed 30 October 2020].

Water Corporation (2017). Application: Licence to Operate. Advanced water recycling plant. Available at: [https://www.der.wa.gov.au/images/documents/our-work/licences-and-works-approvals/Applications/L9034\\_ap2.pdf](https://www.der.wa.gov.au/images/documents/our-work/licences-and-works-approvals/Applications/L9034_ap2.pdf) [Accessed 30 October 2020].

Water Corporation. (2020). Groundwater replenishment scheme. Available at: <https://www.watercorporation.com.au/Our-water/Groundwater/Groundwater-replenishment> [Accessed 30 October 2020].

Water Services Association. (2020). All options on the table. Urban water supply options for Australia. Available at: <https://www.wsaa.asn.au/news/new-report-all-options-table-urban-water-supply-options-australia> [Accessed 6 November 2020].

Water Source. (2020). Community acceptance for indirect potable reuse (27 April). Available at: <https://watersource.awa.asn.au/community/engagement/community-acceptance-for-indirect-potable-reuse/> [Accessed 18 October 2020].

Western Australian Government. (1995). Strategy outlining future options for Perth/Mandurah water supplies [Press Release 5 June 1995]. Available at: <https://www.mediastatements.wa.gov.au/Pages/Court/1995/06/Strategy-outlining-future-options-for-PerthMandurah-water-supplies.aspx> [Accessed 28 December 2019].

Western Australian Government. (2012). Three out of four support full water recycling [Press Release, 23 March 2012]. Available at: <https://www.mediastatements.wa.gov.au/Pages/Barnett/2012/03/Three-out-of-four-support-full-water-recycling.aspx> [Accessed 28 December 2019].

WHO (World Health Organization). (2006). Guidelines for Drinking-water Quality. First addendum to third edition, Volume 1 Recommendations. Available at: [https://www.who.int/water\\_sanitation\\_health/dwq/gdwq0506.pdf](https://www.who.int/water_sanitation_health/dwq/gdwq0506.pdf) [Accessed 29 October 2020].

WHO (World Health Organization). (2017). Potable Reuse: Guidance for Producing Safe Drinking-Water. Available at: <https://apps.who.int/iris/bitstream/handle/10665/258715/9789241512770-eng.pdf;jsessionid=50B8EE377C1C133AFE2D6FE3D4E51287?sequence=1> [Accessed 13 October 2020].

WHS Act. (1995). Workplace Health and Safety Act 1995. Available at: <https://www.legislation.qld.gov.au/view/pdf/repealed/current/act-1995-025> [Accessed 5 November 2019].

WHS Act. (2011). Work Health and Safety Act 2011. Available at: <https://www.legislation.qld.gov.au/view/pdf/inforce/current/act-2011-018> [Accessed 29 October 2020].

Willett, E., (2009). Promoting efficient and effective water trading across the Murray-Darling Basin. Australian Competition and Consumer Commission. Sydney: Australia. Available at: <https://www.accc.gov.au/system/files/Promoting%20efficient%20and%20effective%20water%20trading%20across%20the%20Murray-Darling%20Basin.pdf> [Accessed 29 October 2020].

WSAA (Water Services Association of Australia). (2019). All Options on the Table. Lessons from the Journeys of Others. Available at: <https://www.wsaa.asn.au/publication/all-options-table-lessons-journeys-others> [Accessed 13 October 2020].

WSSRA. (2008). Water Supply (Safety and Reliability) Act 2008. Available at: <https://www.legislation.qld.gov.au/view/whole/html/inforce/current/act-2008-034> [Accessed 18 October 2020].

### **ADDITIONAL READINGS**

Australian Government Initiative. (n.d.). Australian Guidelines for Water Recycling. Available at: <https://www.waterquality.gov.au/guidelines/recycled-water> [Accessed 31 October 2020].

Australian Government Department of the Environment, Water, Heritage and the Arts. (2008). Annual Report 2007-08. Canberra: Commonwealth of Australia. Available at: [https://web.archive.org/awa/20140311175136mp\\_/http://www.environment.gov.au/system/files/resources/ecc4fa4a-04b3-421a-8410-155842ad351d/files/vol1-full.pdf](https://web.archive.org/awa/20140311175136mp_/http://www.environment.gov.au/system/files/resources/ecc4fa4a-04b3-421a-8410-155842ad351d/files/vol1-full.pdf) [Accessed 31 October 2020].

Department of the Environment. (n.d.). Australian Water Recycling Centre of Excellence. Available at: <https://webarchive.nla.gov.au/awa/20140312063638/http://www.environment.gov.au/node/24298> [Accessed 31 October 2020].

Department of the Environment. (n.d.). National Centre for Excellence in Desalination, Australia. Available at: <https://webarchive.nla.gov.au/awa/20140312063553/http://www.environment.gov.au/node/24281> [Accessed 31 October 2020].

Department of Agriculture, Water and the Environment. (n.d.). National Urban Water and Desalination Plan. Available at: <https://www.agriculture.gov.au/water/urban/completed-programmes/national-urban-water-and-desalination-plan> [Accessed 31 October 2020].

Department of Agriculture, Water and the Environment. (n.d.). Water Smart Australia Program. Available at: <https://www.agriculture.gov.au/water/urban/completed-programmes/water-smart#:~:text=The%20%241.5%20billion%20Australian%20Government's,in%20water%20use%20across%20Australia> [Accessed 31 October 2020].

The State of Queensland. (2006). South-east Queensland Water Recycling Plebiscite Bill 2006. Available at: [http://classic.austlii.edu.au/au/legis/qld/bill\\_en/sqwrbp2006491/sqwrbp2006491.html](http://classic.austlii.edu.au/au/legis/qld/bill_en/sqwrbp2006491/sqwrbp2006491.html) [Accessed 31 October 2020].

Victoria University. (2014a). Water reuse and communities toolkit module 1: Community perceptions and barriers to water reuse. *Australian Water Recycling Centre of Excellence*. Sydney: Australia. Available at: <https://webarchive.nla.gov.au/awa/20170228161138/http://water360.com.au/wp-content/uploads/Community-Perceptions-and-Barriers-to-Water-Reuse.pdf> [Accessed 31 October 2020].

Victoria University. (2014b). Water reuse and communities toolkit module 2: Community understanding of risk and safety in relation to recycled water. *Australian Water Recycling Centre of Excellence*. Sydney: Australia. Available at: <https://webarchive.nla.gov.au/awa/20170302031750/http://australianwaterrecycling.com.au/literatureretriev.aspx?id=147762> [Accessed 31 October 2020].

Victoria University. (2014c). Water reuse and communities toolkit module 3: Considering water reuse with culturally diverse communities. *Australian Water Recycling Centre of Excellence*. Sydney: Australia. Available at: <https://webarchive.nla.gov.au/awa/20170228161226/http://water360.com.au/wp->

[content/uploads/considering-water-reuse-with-culturally-diverse-communities.pdf](#) [Accessed 31 October 2020].

Victoria University. (2014d). Water reuse and communities toolkit module 4: Understanding customer attitudes and segments. *Australian Water Recycling Centre of Excellence*. Sydney: Australia. Available at:

<https://webarchive.nla.gov.au/awa/20170228161159/http://water360.com.au/wp-content/uploads/module-4-understanding-customer-attitudes-and-segments-100815.pdf>

[Accessed 31 October 2020].

Victoria University. (2014e). Water reuse and communities toolkit module 5: The influence of water scarcity on public willingness to consider water reuse. *Australian Water Recycling Centre of Excellence*. Sydney: Australia. Available at:

<https://webarchive.nla.gov.au/awa/20170302031812/http://australianwaterrecycling.com.au/literatureretriev.aspx?id=147765> [Accessed 31 October 2020].

Water Quality Australia. (2018). Charter: National Water Quality Management Strategy. *Department of Agriculture and Water Resources*. Canberra: Australia. Available at:

<https://www.waterquality.gov.au/sites/default/files/documents/nwqms-charter.pdf> [Accessed 31 October 2020].