ADVANCING THE ADOPTION OF DIVERSE WATER SUPPLIES IN AUSTRALIA:

A SURVEY OF STAKEHOLDER PERCEPTIONS OF INSTITUTIONAL DRIVERS AND BARRIERS

A CASE STUDY OF BRISBANE, MELBOURNE AND PERTH

Rebekah Brown and Megan Farrelly
Report No. 07/04 - September 2007

MONASH University

National Urban Water Governance Program

Advancing the Adoption of Diverse Water Supplies in Australia:

A Survey of Stakeholder Perceptions of Institutional Drivers and Barriers

A Case Study of Brisbane, Melbourne and Perth

Brown, Rebekah (Rebekah Ruth)

Farrelly, Megan (Megan Anne)

September 2007
ISBN 978-0-9804298-0-0

PREFERRED REFERENCING FOR REPORT:

Brown, R. R. and Farrelly, M. A., (2007) *Advancing the Adoption of Diverse Water Supplies in Australia: A Survey of Stakeholder Perceptions of Institutional Drivers and Barriers*. Report No. 07/04, National Urban Water Governance Program, Monash University, September 2007, ISBN 978-0-9804298-0-0

DISCLAIMER:

This research was funded by the Victorian Water Trust, Municipal Association of Victoria, Smart Water Fund (established and operated by City West Water, Melbourne Water, South East Water, Yarra Valley Water and the Department of Sustainability and Environment), Western Australian Planning Commission, Department of Water (WA), Water Corporation (WA), Brisbane City Council, Moreton Bay Waterways and Catchment Partnership (South East Queensland Healthy Waterways Partnership), City of Armadale (WA) and the Maroochy Shire Council (Qld).

The opinions expressed in this report are those of the authors and do not necessarily represent those of the funding partners.

ACKNOWLEDGEMENTS

Our appreciation goes to Jodi Clarke and Nina Keath who participated in the design and management of the online questionnaire survey tool. Particularly, our thanks are extended to Chris Lee from South East Water, Gavin Blakey from Brisbane City Council and Alison Luobikis from the Water Corporation for their considerable efforts with helping to design and administer the questionnaire survey.

Thanks must also go to our steering committee members and industry experts who piloted our online questionnaire survey instrument - a number of times for some, and also for their assistance in reviewing this document. Your feedback has been valuable.

Furthermore, our thanks also go to Peter Morison for his detailed review of the draft document.

Some of the statistical data analysis was supported by Dr Lisel O'Dwyer, to whom we also extend our thanks.

Finally, our thanks go to each survey respondent. All of the 1041 respondents helped generate powerful insights into the current drivers and barriers to advancing sustainable urban water management across Australia.

Rebekah Brown and Megan Farrelly.

CONTACT DETAILS:

Dr Rebekah Brown – Program Leader

Dr Megan Farrelly – Research Fellow

nuwgp@arts.monash.edu.au

National Urban Water Governance Program
School of Geography and Environmental Science
Faculty of Arts, Monash University
Clayton VIC 3800

www.urbanwatergovernance.com

Advancing the Adoption of Diverse Water Supplies in Australia: A Survey of Stakeholder Perceptions of Institutional Drivers and Barriers

A case study of Brisbane, Melbourne and Perth

National Urban Water Governance Program
Monash University

September 2007

Report No. 07/04

Rebekah Brown and Megan Farrelly

Preface

The National Urban Water Governance Program comprises a group of social science research projects that are examining the changing governance of Australian urban water management. This interim data report is part of the first stage in a broader program of research aimed at investigating and identifying the institutional factors most important for enabling Water Sensitive Australian Cities. While the analysis in this report is mostly descriptive, future reports will provide analysis that is more detailed.

Throughout 2006 and 2007, the Program focused on collecting various types of data from urban water professionals including online survey data (reported here), oral histories of the sector, interviews and focus groups with contemporary urban water professionals and associated stakeholders, industry and scientific literature reviews and project case studies.

This data report is one of two presenting the quantitative, online questionnaire survey data which focuses on understanding professional receptivity to diverse water supplies within the urban water sector. The other interim data report focuses on professional receptivity to urban stormwater quality management and should be read in conjunction with this report. Further, an Executive Summary Report has been published and provides a general overview of the key findings from each of the two data reports.

All Program publications are freely available on our website www.urbanwatergovernance.com.

The complete analysis of all the types of data collected within each case study city will be presented in three case study reports, which will culminate in one final comparative report on the Program's institutional analysis across the three case study cities. These reports will be release throughout 2008.

Table of Contents

List of Figures

List of Tables

Acronyms

NUWGP	National Urban Water Governance Program
SUWM	Sustainable Urban Water Management
TWCM	Total Water Cycle Management
UWM	Urban Water Management
Vic	Victoria
WA	Western Australia
Qld	Queensland

Glossary of Terms

Direct Potable Reuse: Highly treated sewage that is directly discharged into an existing water supply augmentation point (i.e. supply catchment reservoir).

Existing Sites: Refers to re/development areas within established suburbs of a metropolitan region. This includes housing extensions, building redevelopment etc.

Fit-for-purpose: Water use relates to the use of alternative sources of water for activities that best match the quality of water needed. For example, lower quality water should be used for activities that do not require high quality water (i.e. not using potable water for flushing toilets).

Greenfield Sites: New urban development areas typically located on the periphery of existing metropolitan areas.

Indirect Potable Reuse: Highly treated sewage that is discharged upstream of the existing water supply source allowing for additional treatment.

Perception: Defined by the New Shorter Oxford Dictionary in a number of ways including: ‘the state of being or process of becoming aware or conscious of a thing, specifically through any of the senses’

Receptivity: Draws from research on ‘innovation and technology transfer policy’ studies and provides strategic guidance on the focus of ‘change interventions’ required to enable the adoption of new technologies and practices. Furthermore, the New Shorter Oxford Dictionary defines ‘receptivity’ as ‘having the quality or capacity for receiving esp, able, willing, or quick to receive impressions, new ideas’

Total Water Cycle Management: Recognises that our water services – including water supply, sewerage and stormwater management – are interrelated and linked to the well-being of our catchments and receiving waterway environments (including surface and sub-surface). It involves making the most appropriate use of water from all stages of the water cycle that best delivers social, ecological and economic sustainability

1.0 INTRODUCTION

This report presents a comparative assessment of the 'receptivity' of urban water professionals across Brisbane, Melbourne and Perth to a range of water supply sources, uses and technologies. The assessment is based on the findings of an online survey of 1041 urban water professionals conducted between October and November 2006. This research forms part of the *National Urban Water Governance Program* (the Program) focused on identifying current institutional barriers and drivers, and the future institutional ingredients for advancing more sustainable urban water futures. Contrasting professional perspectives and experiences between Brisbane, Melbourne and Perth is the focus of the Program's research because these cities:

1) share similar drivers for re-examining their water management options including drought, climate change, waterway degradation and increasing populations; and
2) collectively represent the breadth of differing urban water governance structures and systems across Australian cities.

This is in addition to differences in traditional water supply sources, where Perth's supply is predominantly sourced from confined aquifers (groundwater), and Melbourne and Brisbane sourced from surface, freshwater systems.

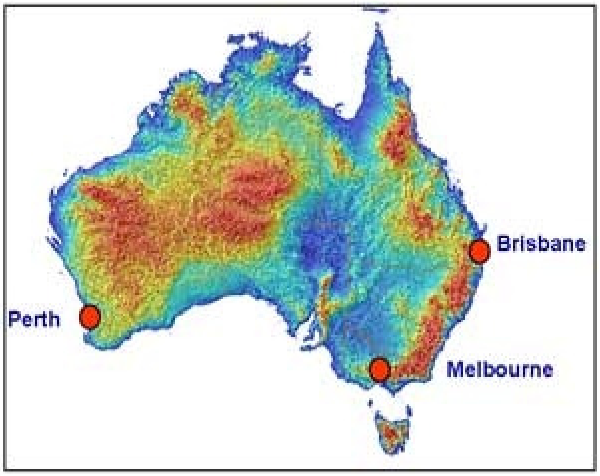


Figure 1.1: Case Study Cities Location Map

It is hoped that this research will inform the design of current and ongoing national, state and local reform efforts, as well as improving the targeting of various policy programs and capacity development interventions. Australian cities, like others around the world, have been subjected to a number of significant national reform efforts over the last 15 years or so. In the mid-1990s the Australian Government in collaboration with State Governments, initiated a process of sectoral reform with the objective of improving the efficiency, regulation and of delivery of urban water services, which remains ongoing (McKay, 2005). More recently, the National Water Initiative[1] was launched to undertake further reforms in water management (rural and urban). In relation to cities, this national reform also involves review of the suitability of current administrative arrangements and assessment of industry capacity building and training needs, as set out in Clause 92 of the National Water Initiative outlining action directed at 'Innovation and Capacity Building to Create Water Sensitive Australian Cities'.

It is the proposition of this research that to ensure the success of such reform efforts, incorporating the knowledge and perspectives of professionals currently working within urban water sector is essential. However, so far, there has been limited research that draws explicitly from these experiential insights, and an understanding the institutional factors that encourages or prevents professionals, and/or their

1 The National Water Initiative is an intergovernmental agreement formalised on the 25th June 2004 between the Commonwealth Government and State Governments, available at: http://www.coag.gov.au/meetings/250604/iga_national_water_initiative.pdf. (CoAG, 2004: pg 20)

organisations, from advancing the practice of SUWM. This report, and others produced by the Program[2], is an attempt to address this knowledge gap. Through directly capturing the perspectives and experiences of practitioners from different organisations and disciplines, this report provides a broad statistical understanding of the perceived drivers and barriers to adopting a diverse water supply approach.

This report includes an assessment of professional:

- receptivity to a range of water sources including: rainwater, greywater, stormwater, sewage, seawater, water trading and new dams;
- perceptions of community, state politician and organisational receptivity to advancing the range of water sources;
- receptivity to a range of 'uses' for non-traditional water supplies including: drinking, indoor household, outdoor household, public open space, environmental flows, industry and nothing, and
- ratings of the perceived impact of a list of institutional factors that could constrain and/or enable the uptake of non-traditional water supply technologies including rainwater tanks, on-site greywater systems, third-pipe stormwater systems, third-pipe wastewater systems, indirect potable reuse schemes, and direct potable reuse schemes.

1.1 Drivers and Barriers to Advancing SUWM: What Do We Know?

Despite broad acknowledgement in both the research and practitioner literature that SUWM, as a philosophical and ideological approach, is required across cities worldwide, change in the sector remains slow and as history suggests, is often in response to crises. The current drivers for implementing SUWM practices in Australia are linked to the need to accommodate an increasing demand for water, based on projected population figures (Birrell *et al*., 2005), the potential impact of climate variability (Howe *et al*., 2005), aging and degraded water infrastructure (Engineers Australia, 2005) and ongoing waterway degradation. These issues are in addition to the current vulnerabilities of cities in providing a reliable future water supply given the ongoing drought conditions across Australia.

Notwithstanding the current water-scarce context as a driver for change across Australia, when considering potential alternative water source technologies as solutions, the drivers for new practices become far less certain. Fuelling the uncertainty is the current scientific debate and public concern in relation to a) the adequacy of alternative supply sources such as wastewater and stormwater, and b) the perceived effectiveness and efficiency of managing alternative sources at different technological scales (from the more traditional, centralised supply systems through to decentralised technologies).

The heart of these debates reflects the current dilemma of how to address the real and perceived 'risks', and who should be responsible for these risks? These 'risks' relate to protecting current societal values around providing water supply security, maintaining public health, ensuring economic efficiency,

[2] This report should be read in conjunction with: *Advancing Urban Stormwater Quality Management in Australia: A Survey of Stakeholder Perceptions of Institutional Barriers and Drivers*, and is publicly available along with other Program research reports at www.urbanwatergovernance.com

and protecting and enhancing the physical environment. To understand the strength of the drivers and barriers to different water source options and their associated technologies, our survey tested the perceptions of urban water professionals on how i) community acceptance, ii) environmental outcomes, and iii) public health outcomes, will enable and/or constrain their application as part of a diverse water supply approach. In addition, professional perspectives on the current level of technical feasibility and affordability of different water supply technologies at different scales were tested.

It is now well accepted in the literature that the most significant barriers to advancing SUWM are *social* and *institutional*, rather than purely technological (for example, Maksimović and Tejada-Guibert, 2001). Indeed, Wong (2006) considers that without an improved understanding of the socio-institutional barriers and drivers, advancing SUWM will be difficult. This leads us to the question – what constitutes a socio-institutional barrier and driver in relation to SUWM? To begin, one must understand the definition of an institution. Cortner *et al.* (1998), considered an institution to be the cumulative expression of the formal and informal rules and norms that shape the interactions of humans with each other and with the environment. To this, we would further separate out both built and natural aspects of the 'environment' given the focus of this research is on cities. As such, a socio-institutional barrier would be one that is generally influenced by political, social, legal, administrative, managerial and/or human resource factors (Lee, 1999:186).

Several commentators have attempted to explain the resistance to shifting to SUWM practices within Australia. For example, Hatton MacDonald and Dyack's (2004) review of institutional impediments to water conservation and reuse found the 'overarching' barrier is a lack of coordination among policies and regulations that govern conservation and reuse. Likewise, Brown (2005) argued that the fragmented administrative framework constrains the way urban water management is implemented, which in turn limits the development of institutional learning. Mitchell (2004:16) also observed that current institutional structures are "known to constrain integration and innovation". The national environmental industry lobby (The Barton Group) has also identified a 'lack of trust' and 'inappropriate risk transfers' among stakeholder organisations as key factors retarding the implementation of SUWM across Australia (The Barton Group, 2005). There has also been Australian programs of research that have identified community concerns, such as the 'yuck' factor, to the personal use of non-traditional water sources (see Nancarrow *et al.* 2002; Marks 2004)

Overall, barriers that have been identified broadly cover insufficient professional skills and knowledge, organisational resistance, lack of political will, limited regulatory incentives and unsuitable institutional capacity and arrangements (see, for example, Mouritz, 1996; Mitchell, 2004; Brown, 2005; Rauch *et al.*, 2005; Wong, 2006). These institutional barriers are typical of those observed in cities throughout the developed world (see Brown and Farrelly 2007a). Importantly, there is also an increasing and diverse group of international commentators who have identified the problem of institutional inertia and its significant impact on the transition towards SUWM (see, Mouritz, 2000; Lundqvist *et al.*, 2001; Vlachos and Braga, 2001; Hatton MacDonald and Dyack, 2004; Saleth and Dinar, 2005; Brown *et al.,* 2006a; Brown and Farrelly, 2007a).

While the scope of socio-institutional drivers and barriers are being increasingly characterised in the literature, there is little empirical and/or statistical evidence to establish their significance.

Therefore, *this report presents the perspectives of urban water professionals on these prescribed socio-institutional factors, and how these factors may constrain and/or enable the application of a particular, non-traditional water supply technology*.

1.2 Understanding the 'Receptivity' of Urban Water Professionals

To test the professional community's readiness to develop a diverse water source approach, the social research model of 'receptivity' was employed to guide the analysis. The model of receptivity, originally devised by Jeffrey and Seaton (2003/2004), draws from 'innovation and technology transfer policy' studies and offers an important institutional and policy perspective for understanding possible change ingredients for the 'mainstreaming' of an innovative technology and/or process. The concept is based on the perspective that 'change interventions', such as new technologies and practices, are most likely to be successful when the policy programs to support new practices are designed from the perspectives of the 'users' or 'recipients'. Hence, understanding the current levels of 'receptivity' of individuals and/or organisations is a critical starting point.

As shown in Figure 2.1, receptivity can be considered to comprise four key attributes from the 'users' perspective including (Brown and Keath, 2007):

- *Awareness:* the recipient is aware that a problem needs to be addressed and that a range of possible solutions exist.
- *Association:* the recipient identifies enough associated benefits with their own current agenda so that they will expend the necessary effort to address the problem.
- *Acquisition:* the recipient must have ready access to the necessary skills, resources and support to be able to address the problem.
- *Application:* the recipient should be exposed to an appropriate set of enabling incentives, such as regulatory and market incentives, to assist in implementing the new solution.

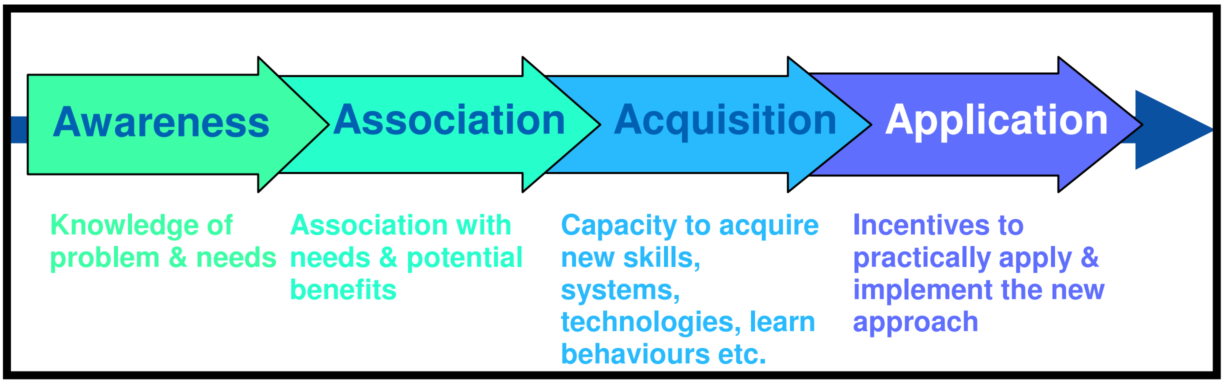


Figure 1.2: Model of Receptivity
Adapted from: Jeffrey and Seaton (2003/04); Brown and Keath (2007).

The idea behind receptivity is that, for change to successfully occur, such as moving from an 'idea' through to mainstream on-ground operation (i.e. the implementation of a new technological solution), the recipient (i.e. an individual and/or organisation and/or region etc.) needs to represent each of these four attributes in relation to the newly proposed practice. Recent work by Brown and Keath (2007) highlighted that many existing water reform programs focus on the awareness (i.e. education campaigns) and application stages (i.e. new regulations and policies), but often do not target the association (influencing values) and acquisition (capacity building) stages.

Table 1.1 provides an example of the four receptivity attributes for the application of urban stormwater quality treatment technologies from a local government perspective (Brown and Keath, 2007). Thus, the role of the strategist, policy maker and/or capacity builder, is to understand the current receptivity level of their audience through testing the strengths of these four attributes and to invest effort in targeting the receptivity deficits. It is essential that any program of change investigates the pre-existing receptivity across the range of stakeholders to inform new interventions.

Table 1.1: Definition and Examples of the Four Phases of the Receptivity Model

Phase	Definition	Example –Local Govt. Engineering Unit
Awareness	Knowledge of a problem and a range of possible innovative solutions	– Knowledge of waterway health degradation – Knowledge of stormwater treatment technologies
Association	Recognition of the importance of this knowledge and being able to relate it to current needs	– Knowledge and recognition that waterways offer important ecological and social functions that should be preserved – Knowledge and recognition that stormwater treatment technologies contribute to improving waterway health and amenity – Knowledge of the future financial and time savings and possible environmental benefits resulting from the implementation of these stormwater treatment technologies today
Acquisition	Capacity to develop and/or acquire new skills, systems, processes and behaviours to apply the innovative solutions	– Ability to seek reliable support (financial, human, technical) and guidance (access to expertise) to help install, operate and maintain the stormwater treatment technologies
Application	Motivation and incentives to practically apply and implement the new approach	– Knowledge and understanding of relevant (internal and external) policies, regulations and processes that assist in the application of stormwater treatment technologies by local governments

1.3 Institutional Arrangements at Time of Survey

The Australian urban water sector is undergoing various institutional reforms under the direction of the National Water Initiative, and concurrently, state governments are revising water policies and plans to reflect the need for a greater diversity of supply sources. As change was projected to occur throughout the course of this research a context report was compiled for each case study city (Brisbane, Melbourne and Perth) detailing the governance arrangements, biophysical environment and water infrastructure status as of October 2006. The following provides a brief overview of the institutional framework in Brisbane, Melbourne and Perth, when the questionnaire was made available in October and November 2006. Further detailed reports case study city context reports can be found at the Program's website, www.urbanwatergovernance.com.

1.3.1 Brisbane

The City of Brisbane is located on the southeast coast of Queensland on the Brisbane River. Building on a current population exceeding 950,000, Brisbane is the fastest growing capital city in Australia. The city is located on a coastal plain traversed by over 800 km of waterways and is subjected to periodic drought. Brisbane's potable water supply comes from surface water sources and mainly contained in three major reservoirs. The reservoirs and their catchments are managed on a regional basis within South East Queensland (SEQ) by SEQWater (Figure 1.3). However, Brisbane City Council, the largest local government authority in Australia, is responsible for managing water supply, wastewater and stormwater services for the whole metropolitan area. As water management becomes more regionalised, Brisbane City Council is working closely with state and regional bodies (Figure 1.3).

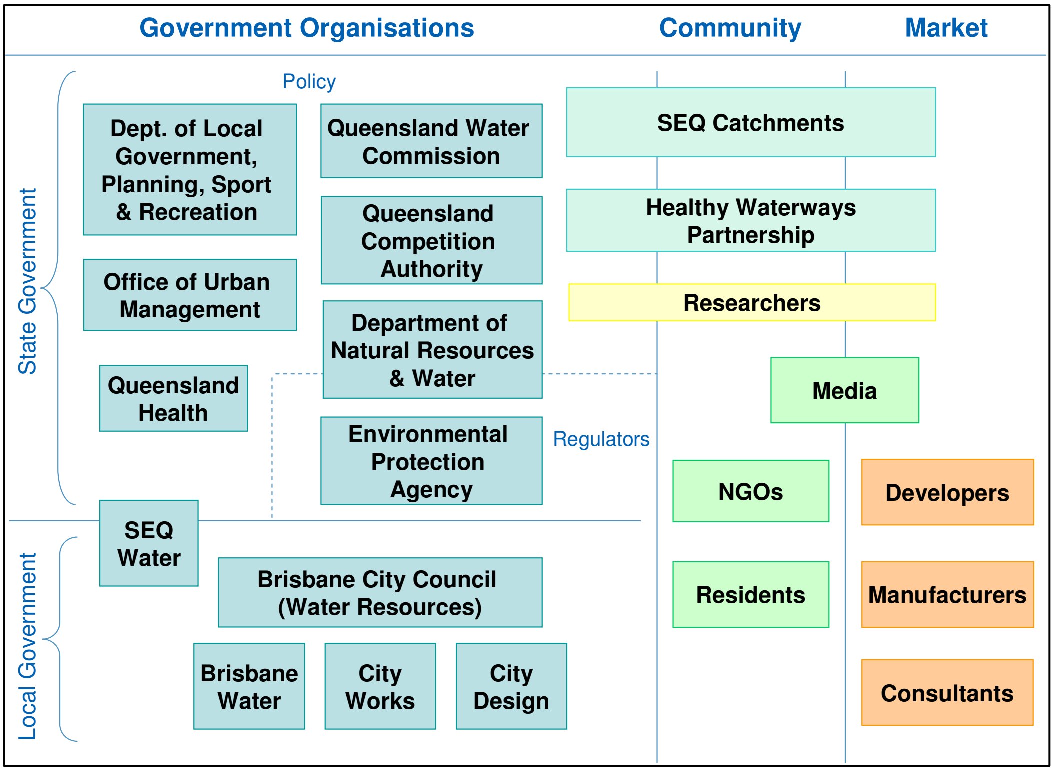


Figure 1.3: Institutional Arrangements for Water Management in Brisbane as of October 2006

Catchment management, water quality and waterway health are responsibilities shared between state government, local government, non-governmental organisations and SEQWater, and facilitated with the assistance of partnership organisations (Figure 1.3). In response to the longest drought on record in Brisbane, the Queensland Government established the Queensland Water Commission to oversee water security and demand management. In addition, new dams, desalination plants, recycled water and groundwater sources were considered as part of a regional 'water grid' for SEQ.

Drivers for Brisbane include recurrent drought conditions, climate change predictions, waterway health issues, and consistent increases in population. These have resulted in state government, local government, government-owned corporations, and non-governmental organisations working towards greater water security. Total Water Cycle Management and Water Sensitive Urban Design are current approaches to sustainable urban water management that are shaping organisational change and design standards within the City of Brisbane. A range of policies and planning requirements are encouraging the adoption of these approaches in new urban developments.

1.3.2 Melbourne

Melbourne is the second largest city in Australia, with a population of 3.6 million. The population relies upon surface water supplies sourced from catchments east of the city. There are nine major supply reservoirs within the region with a total design capacity of 1,773 GL. The two main wastewater treatment plants at the bottom of the catchment treat most of the city's wastewater before discharging a minimum of secondary treated effluent to Port Phillip Bay and Bass Strait. Currently these wastewater treatment plants recycle approximately 11% of the annual flow. The stormwater system is separate from the wastewater system and includes drainage infrastructure that is largely untreated and directed to receiving waterways within the city.

The Victorian government sets the water policy and regulatory framework agenda for the urban water cycle, stipulates water business obligations, and monitors and audits water business performance. Melbourne Water is a single bulk water wholesaler and is responsible for water supply headworks, regional drainage and wastewater treatment services (Figure 1.4). There are three retail water and sewerage businesses, all remaining under the corporatised ownership of the State government (Figure 1.4). Local government is responsible for local drainage networks and stormwater systems maintenance and connect to the regional drainage systems owned by Melbourne Water. A major restructure of Victorian local government occurred in the early 1990s, resulting in the reduction in the number of councils from 210 to 79 across the State.

The land use planning system and responsibilities determined by the *Planning and Environment Act 1987* are shared between state and local government authorities. The State determines the State Planning Policy Framework and the Victorian Planning Provisions. Local government, as the local planning authority, determines the Local Planning Policy framework in line with the State framework, part of the local planning scheme and, as Responsible Authority, determines planning permit applications.

Melbourne is currently facing a significant water supply challenge, with ongoing dry weather conditions and reduced inflows into the water storages. Water storages are currently around 42% as the summer weather approaches and as a consequence, the Victorian Government has recently introduced Stage 2 water restrictions, restricting household water use for outdoor activities.

Urban stormwater runoff is a significant source of pollution contributing to the degradation of Port Phillip Bay and Melbourne's waterways, including the lower sections of the city's major rivers, the

Yarra and Maribyrnong Rivers. As of October 2006, the Victorian Planning Provisions have been amended (*Clause 56: Residential Subdivisions*) which now mandates Water Sensitive Urban Design criteria to be considered in all residential subdivisions.

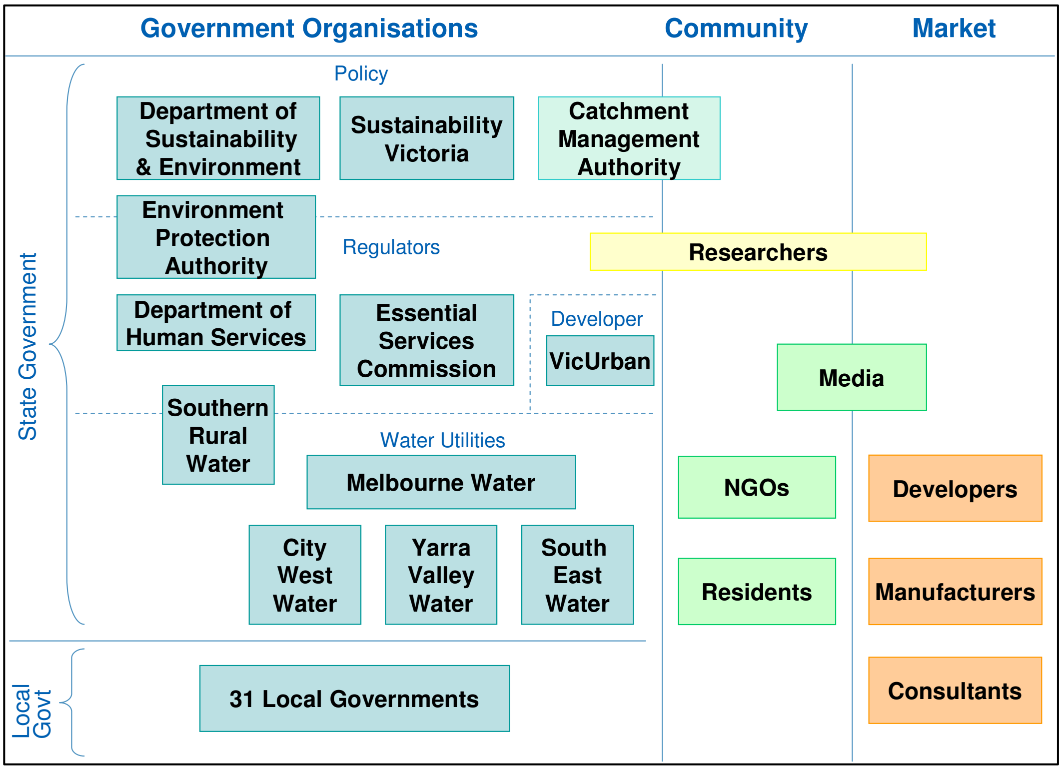


Figure 1.4 Institutional Arrangements for Water Management in Melbourne as of October 2006

1.3.3 Perth

Perth is the fourth largest city in Australia, carrying a population of approximately 1.5 million and experiencing the highest growth rate of Australian cities (2.1% in 2006). Situated along the Swan River, Perth experiences a Mediterranean climate, characterised by hot, dry summers and mild, wet winters. The city is located on a sandy coastal plan along the Swan River and its groundwater resources provide the principal potable water supply for the city and are supplemented with surface water as part of the Integrated Water Supply Scheme (IWSS). The IWSS consists of a network of dams and weirs, reservoirs, bores, treatment plants, pumping stations and water mains. In addition to this, unregulated backyard groundwater bores (not accounted for in the IWSS and is unregulated) also represents a significant proportion of Perth's urban water supply budget.

Overarching policy, regulation and planning are provided by the State Government through various agencies and have been the subject of significant and ongoing reform efforts over the last 10 years. The recently established Department of Water has the lead strategic, policy and regulation role (Figure 1.5). The State Government-owned Water Corporation, established in 1996 and one of Australia's largest water service providers, supplies water, sewerage and drainage services to Perth. In addition, there are a number of industries that also hold entitlements to bulk water supply. Local government typically partners the Water Corporation in managing the stormwater system as well as delivering functions in land use planning (Figure 1.5).

Persistent climatic change since the mid-1970s has significantly reduced rainfall in the region, resulting in a 50% decrease in surface water flowing to the major reservoirs. This phenomenon, in combination with the booming economy and rapid population growth, has resulted in water security and waterway quality issues. To tackle this issue, the state government has established a collaborative initiative known as the Southern River Catchment Integrated Land and Water Management Plan.

The government's guiding strategy, *Securing our water future – A water strategy for Western Australia 2003,* identifies new and alternative sources of water to increase water security for Perth. As a result of the strategy, the city possesses Australia's first desalination plant, a major industrial water recycling plant, as well as a trial to increase water supply using Managed Aquifer Recharge schemes. Notwithstanding the additional infrastructure, Level 4 water restrictions prevail.

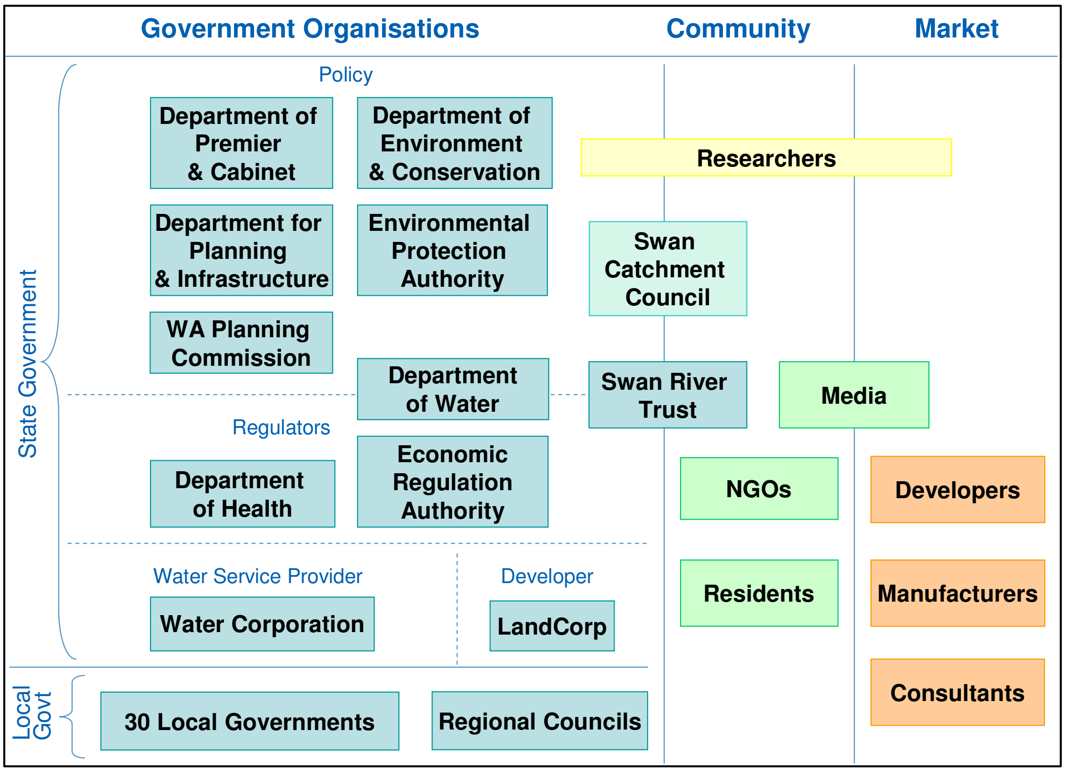


Figure 1.5 **Institutional Arrangements for Water Management in Perth as of October 2006**

1.4 Outline of the Report

The structure of the report is outlined in Table 1.2. The research draws on the concept of receptivity (described in Section 1.2) and as such, the report presents the data in relation to the professional community's association, acquisition and application to improving urban stormwater management practices. The research design and methods are outlined in Chapter 2 and Chapters 3 to 8 present the findings from the online survey.

Table 1.2: **Chapter Outline and Description of Report Content**

Chapter	Heading	Description of Content
Chapter 1	Introduction	Presents the context and purpose behind the report, which is to provide insights into the socio-institutional barriers preventing the urban water industry of Australia from advancing SUWM practices.
Chapter 2	Methods	Describes how the online questionnaire survey instrument was designed and how the social science concept of 'receptivity' is used as a research framework and analysis tool. Outlines the statistical methods used for data analysis.
Chapter 3	Association with Diverse Water Supply Sources and Uses	Details the perceptions of industry professionals regarding the importance of pursuing diverse water supply options and their fit-for-purpose uses.
Chapter 4	Factors Influencing the Uptake of Rainwater Tanks & On-site Greywater Systems	Highlights the perceived importance, and key drivers and barriers to pursuing on-site technology adoption.
Chapter 5	Factors Influencing the Uptake of Third-pipe (Stormwater & Wastewater) Technologies	Presents the importance of, and key barriers and drivers to, pursuing third-pipe systems in greenfield and existing areas.
Chapter 6	Factors Influencing the Uptake of Indirect and Direct Potable Reuse Schemes	Details how important pursuing indirect and direct potable reuse schemes are to professionals and highlights the key drivers and barriers to adopting the associated technologies.
Chapter 7	Perceptions of Institutional Arrangements and Stakeholder Commitment to Total Water Cycle Management	Focuses on the perceived effectiveness of current institutional arrangements and reveals professionals' perceptions about stakeholder commitment to 'total water cycle management'.
Chapter 8	Projected Implementation Timeframes	Emphasises the projected development timeframes for adopting diverse water sources in case study cities as identified by urban water professionals.
Chapter 9	Concluding Remarks	Briefly summarises the document and details the next phase of the Program's research plan.

2.0 METHODS

The design of this social research is based on a comparative quantitative survey of urban water professionals across Brisbane, Melbourne and Perth. While the research reported here has value on its own, it contributes to a broader multi-method approach also involving semi-structured face-to-face interviews and documentation analysis to understand how urban water professionals perceive their current institutional context. The following sections provide an overview of the design and administration of the online survey instrument, the statistical analyses undertaken and the demography of the survey respondents.

2.1 Survey Instrument

The development phase of the survey[3] involved a number of pilot processes to test its design and 'usability'. It was important that the survey made sense to the user and did not take too long to complete, but at the same time, it needed to elicit the necessary data for a receptivity analysis. With the scope of the research focused on the total water cycle, the original questionnaire was designed as two separate online surveys, one focussed on future water source supplies and the other on urban stormwater quality management and treatment technologies. Following a detailed pilot process with over 50 industry experts from each of the three cities, the feedback resulted in the two surveys being amalgamated (as many respondents perceived this was perpetuating the traditional approach that isolates the components of the water cycle). Other feedback led to the addition of an 'I don't know' response category to the standard Likert-response categories and an improvement in the overall user-friendliness of the survey.

The next stage involved securing the appropriate ethics approval from Monash University to administer the survey and identifying an appropriate tool for allowing respondents, from Brisbane, Melbourne and Perth, to have simultaneous access to the questionnaire. An online questionnaire internet site called *Survey Monkey*[4] was chosen because it provided efficient and effective data management capabilities. To increase the survey response rate, prior to the online survey going live, the heads of relevant organisations, steering committee representatives and partner organisations, were contacted and asked to encourage their staff to participate in this survey.

The final survey was made available online in October 2006 and remained open until 24 November 2006[5]. Appendix A presents the questionnaire, including the introductory and explanatory statements. Each case study city was presented with a slightly different questionnaire to accommodate the inherent variability within their institutional arrangements and conventional water sources[6] (see Section 1.3). The survey was presented in three major sections including demography, alternative

[3] See Appendix A for a copy of the survey
[4] Survey Monkey www.surveymonkey.com
[5] The original closing date was the 10th November 2006 but was extended until the 24th November 2006.
[6] For example, each city has different government agencies responsible for similar actions, such as the Department of Sustainability and Environment in Victoria, the Department of Water and the Department of Conservation and Environment in Western Australia and the Department of Natural Resources and Water in Queensland.

water source questions, and stormwater quality questions. The seven demographic questions, as detailed in Section 2.3, focused on which stakeholder group the respondent represented, the main type and field of work the respondent was responsible for, their professional background/training, and the length of time in a) their current position and b) the urban water industry.

As summarised in Table 2.1, the different themes of the diverse water sources survey were designed to test professional perspectives to a range of water sources (including: rainwater, greywater, stormwater, sewage, seawater, water trading and new dams – Theme A) and to a range of different technologies at different scales (Theme C). This was to identify distinctions in receptivity which may be related to the scale of the technology, as a potential barrier, rather than the actual water source or vice versa. In Theme A, professionals were also asked to identify the range of 'uses' they deemed suitable for the range of water source options including drinking, indoor household, outdoor household, public open space, environmental flows and industry practices. This data helps assess the professionals' receptivity to uses and contextualises their overall receptivity to different sources and technology types (Theme C).

Professionals were asked to contrast their perceptions of the importance of a particular water source in relation to their perception of the importance the community, state politician's and their organisation places on pursuing a range of water sources (Theme A). This was to test how professionals feel their perspective aligns with their socio-political context, and to identify whether professionals feel supported by the perceived agenda of their own organisation. In addition, this data could be used in future assessments of how well urban water professionals understand the perspectives of the community that they serve, by comparing these results against existing data on community receptivity to diverse water supply sources.

To ensure the survey was a user-friendly length, not all water supply technologies were tested and as technological scale is an issue identified in the literature, it was decided to test a range of technological scales. The technology selection included rainwater tanks, on-site greywater systems (decentralised), third-pipe stormwater systems, third-pipe wastewater systems (precinct), indirect potable reuse schemes, and direct potable reuse schemes (centralised). Therefore, some existing technologies were not included in the survey such as sewer mines and desalination plants; however, both sewage and seawater were tested as a source and for potential uses. Further, Theme D also asked the respondents to rate what they perceived to be the impact of a range of institutional factors that could constrain and/or enable the uptake of these non-traditional water supply technologies. The factors identified in the literature that were tested included:

- socio-political context factors including perceived 'community acceptance', 'public health outcomes' and 'environmental outcomes';
- human resource factors of perceived 'technical feasibility' and 'professional knowledge';
- current 'management arrangement' context and 'government policy';
- formal rules including 'regulation and approval processes' and 'property access rights', and
- costs including 'capital' and 'maintenance'.

In addition, each survey respondent was asked to rate the level of stakeholder commitment, from their perspective, for each significant organisation in relation to each case study city (Theme E).

Table 2.1: Survey Instrument: Major Themes Tested

Survey Instrument		
Theme		**Description**
A	Supplementing Conventional Water Supply	Two areas of focus: 1) Determines professional perceptions on the importance of pursuing diverse water supply sources and asks their point of view regarding what 'their organisation', 'the community' and 'state politicians' also consider as important. 2) Assesses what professionals perceive are the appropriate uses for specific alternative water source options.
B	Timeframes for Future Water Sources	The question asked what the projected timeframes for development of eight diverse water source options would be to supplement conventional supplies.
C	Technologies for the Future	The questions sought to identify how important professionals perceived it was to adopt six different diverse water source technologies (e.g. rainwater tanks, third-pipe systems).
D	Factors Influencing Water Recycling & Reuse	The question asked what influence 12 factors had on implementation of treatment technologies at local, precinct and regional scales. Factors included community perception, capital and maintenance costs, technical feasibility and performance, professional knowledge and expertise, government policy, management arrangements and responsibilities, regulation and approval processes, property rights, environmental outcomes, public health outcomes and social amenity.
E	Stakeholder Commitment	Two questions were posed in this section. 1. Respondents were asked to rate the level of commitment to total water cycle management from organisations involved in the urban water sector. 2. Respondents were asked to rate the effectiveness of current institutional arrangements for achieving total water cycle management.

The structure of the survey design was explicitly based on testing the 'receptivity' of professionals in urban water management as discussed in Section 1.2. Table 2.2 shows how each of the survey themes (as shown in Table 2.1) have been analysed in relation to the logic of the receptivity model which includes awareness, association, acquisition and association attributes (see Figure 1.2). This generic model of receptivity has been adapted here based on current understandings of institutional capacity in the urban water sector (see Brown *et al.,* 2006) and applied to the design of the online survey. Based on the target audience being urban water professionals, the survey did not ask questions on 'awareness', for it was assumed a high level of awareness regarding the problem and potential solutions existed. Therefore, the survey focuses on understanding the level of urban water professionals' 'association' and 'acquisition' to a range of alternative water sources and technologies (Table 2.2). It is more difficult to test 'application' without actual data of real on-ground implementation rates in each city (which to date is not readily available). Therefore, professionals were asked to anticipate implementation timeframes of different technologies as well as identify any technologies that they perceived to be current practice.

Table 2.2: Using the Logic of the Receptivity Model to help Design Survey Questions and Structure Data Analysis

<table>
<tr><th>AWARENESS</th><th>ASSOCIATION</th><th>ACQUISITION</th><th>APPLICATION</th></tr>
<tr><td rowspan="5">Assumed there is widespread knowledge and understanding of the water supply problem within the professional community</td><td>Importance of Alternative Water Sources (Theme A)</td><td rowspan="2">Adequacy of current Institutional arrangements (Theme E)</td><td rowspan="4">Implementation timeframes for technologies becoming mainstream practice (Theme B)</td></tr>
<tr><td>Importance of Technology Types (Theme C)</td></tr>
<tr><td>Appropriate uses for alternative water source options (Theme A)</td><td rowspan="2">Influencing factors:
– Capital & Maintenance Costs
– Technical Feasibility & Performance
– Professional Knowledge &Expertise
– Government Policy
– Management Arrangements & Responsibilities
– Regulation and Approval Processes
– Property Access Rights
(Theme D)</td></tr>
<tr><td>Influencing factors:
– Community Perceptions
– Environmental Outcomes
– Public Health Outcomes
(Theme D)</td></tr>
<tr><td colspan="3">Perceived Stakeholder Commitment (Theme E)</td></tr>
<tr><td colspan="4">Note //
Theme A, B, C, D and E relate to the Questions described in Table 3</td></tr>
</table>

2.2 Analysis Framework and Limitations

The survey was designed to elicit a mix of ordinal (ranked data) and nominal (categorical) data, with an emphasis on the former. The best way to analyse and present ordinal data is to compile absolute frequency graphs (percentage responses) for each question and to conduct cross-tabulation tests in relation to demographic variables. Likert-scale response categories were generally used for this allows respondents to select their preference along a continuum. However, these categories also create some difficulty in analysing the differences between, for example, 'slightly prevents' and 'strongly prevents'. Therefore, chi-square tests were relied upon for the analysis because they determine whether two categorical measures are related, and if there is an association (link) between two value sets (perceptions or opinions in this report). By using chi-square tests, the data could also be examined for any statistically significant differences among specified variables. For example, how do local government, state government and water utility professionals' responses differ from each other for a specific question, or does having more experience in the urban water sector mean there are differences in perception/opinion?

The next stage in the data analysis involved hypothesis testing through statistical inference and co-relationship testing. As part of an external data validation process, absolute response frequencies were compiled and presented to the National Urban Water Governance Program's steering committee members and other industry representatives in December 2006. This workshop also provided an opportunity to develop the basis for statistical inference and co-relationship testing. This process involved identifying categories from the demographic data to identify differences, if any, amongst respondents. Through a process of data testing, and trial and error, the list of demographic variables needed some recoding and respondent 'groups' created. The major demographic categories and inferential statistical tests included:

- **Level in organisation**: respondents were grouped based on the position held in their organisation: junior, middle, senior or executive.
- **Field of work**: respondents were grouped by their main field of work undertaken including stormwater, water supply, sewage, total water cycle management, land development, administration, information technology and 'other'.
- **Professional Group**: using the demographic data, respondents were grouped into the following three categories to identify differences of opinion based on professional background and training: 1) Engineering and Science, 2) Planning, Humanities, Urban Design and Landscape Architecture and 3) 'Others' including education, law, trades (see Section 2.3.4).
- **Experience in urban water management**: respondents were grouped based on the length of their experience in the urban water sector, ranging from 0-1, 2-5, 6-10, 11-15, 16-20 and 20 plus years.
- **Government Status**: respondents were grouped according to whether they represented state government, local government or non-government organisations and tested for significance in response trends.
- **Stakeholder Group**: water utility respondents in each city were separated out to compare their point of view with 'others' (all other respondents).
- **'Optimist versus Pessimist'**: respondents were grouped according to their responses about envisaged timeframes for implementation of relevant technologies. An optimist indicated that a technology was either already integral and/or would be developed over next 15 years, while a pessimist was any respondent who identified a technology would be implemented from 15 to 30 plus years.
- **'Focus versus Stake' in urban water management:** respondents were grouped based on whether the stakeholder group they represented had either a core 'focus' or a 'stake' (i.e. not core business) in urban water management.

Table 2.3 presents only a selection of the breadth of chi-square tests undertaken for each case study; a full list of chi-square tests undertaken is located in Appendix C. Also, where possible, data were examined using Spearman rank correlation coefficient, which is designed to test the direction and strength of the relationship between two variables, effectively identifying whether one variable has an influence on another set of variables. If the R value is zero then there is no correlation, if the number is -1 then perfect negative correlation and +1 is the direct opposite (perfect positive correlation) between the two sets of data.

Table 2.3: A Selection of Chi-square Tests Undertaken on Data Collated from the Online Questionnaire Survey

A tick indicates where a test was undertaken.

Question from Survey	VARIABLES TESTED				
	Level in Organisation	Field of work	Professional Group	Experience in UWM	Stakeholder Group
How important is [alternative water source] to supplementing conventional supplies?					
Stormwater	✓		✓	✓	✓
Sewage	✓		✓	✓	✓
Rainwater	✓		✓	✓	✓
Greywater	✓		✓	✓	✓
Seawater	✓		✓	✓	✓
Who thinks [alternative water source(s)] is suitable for drinking?					
Greywater	✓	✓	✓	✓	✓
Rainwater	✓	✓	✓	✓	✓
Stormwater	✓	✓	✓	✓	✓
Seawater	✓	✓	✓	✓	✓
Sewage	✓	✓	✓	✓	✓
Who thinks [alternative water source(s)] is appropriate for all uses?					
Greywater	✓	✓	✓	✓	✓
Sewage	✓	✓	✓	✓	✓
Stormwater	✓	✓	✓	✓	✓

A full listing of chi-square tests undertaken is located in Appendix C.

There are a number of limitations with relying on a survey instrument designed to collect a quantitative ‘snapshot in time’ of the broad statistical trends and expectations of professional receptivity to diverse water sources and the application of related technologies. Thus, the data does not provide in-depth explanations regarding *why* professional respondents identified, for example, ‘management arrangements and responsibilities’ as a major impediment to advancing SUWM. Nor does the data provide insights into the current and ongoing changes occurring in the industry, such as the institutional reform underway in South East Queensland or the development of a desalination plant in Perth.

Other limitations of the research data collection and analysis techniques relate to interpreting and explaining the professional perceptions of other stakeholder groups including ‘their organisations’, ‘the community’ or ‘state politicians’. Without qualitative investigation of these types of results only a superficial interpretation can be developed. While the participation rate in a survey such as this was very successful, it was originally hoped to capture 100 respondents per city. It remains difficult to specifically establish the representativeness of these survey findings in relation to the urban water sector because, while there are absolute human resource numbers available per organisation, there is a lack of information on the specific number of urban water professionals and their relevant disciplines. Moreover, readily available information on the current implementation rates of the technologies tested limited our scope to determine the accuracy of the respondents' assessment of current implementation rates.

These limitations have been addressed as much as possible through a series of validation processes with the Program's organisational partners and other industry experts.

2.3 Who are the Survey Respondents?

To understand the 'professional' demography of survey respondents, the questionnaire asked the following:

1. Which stakeholder group do you represent?
2. At what level are you positioned within your organisation's hierarchy?
3. Broadly, what is the main type of work that you do?
4. Which area of water management do you primarily work in?
5. What is your primary professional background and training?
6. How long have you been working in your current position?
7. How many years experience do you have working in the area of urban water management?

The representation achieved from stakeholder groups in Brisbane, Melbourne and Perth is presented below. Overall, there is good representation from the breadth of organisations involved in urban water management. Indeed, the percentage weightings of respondents from the various organisations reflect the day-to-day operating environment in urban water management. For example, those organisations with a major responsibility for urban water management are well-represented such as the water utilities/retailers and local governments, whereas organisations with an 'interest' (stake) in urban water management (such as the health and economic regulators and researchers) are less well-represented in total numbers. Following presentation of the stakeholder group breakdown for each city, the overall population characteristics are highlighted including respondents' field of work, length of experience in UWM and position (level) in their organisation.

2.3.1 Brisbane Stakeholder Groups

As shown below in Figure 2.1, the majority (over 37 per cent) of survey respondents were from Brisbane City Council. Other local governments of the South East Queensland region were the next well-represented 'organisation' (with 13 per cent of respondents), followed by consultants (12 per cent), the Maroochy Shire Council (10.7 per cent) and the Department of Natural Resources and Water (with almost 9 per cent of respondents). Despite fewer responses from other stakeholder groups, the survey achieved a good cross-section of relevant stakeholder groups involved in the urban water sector.

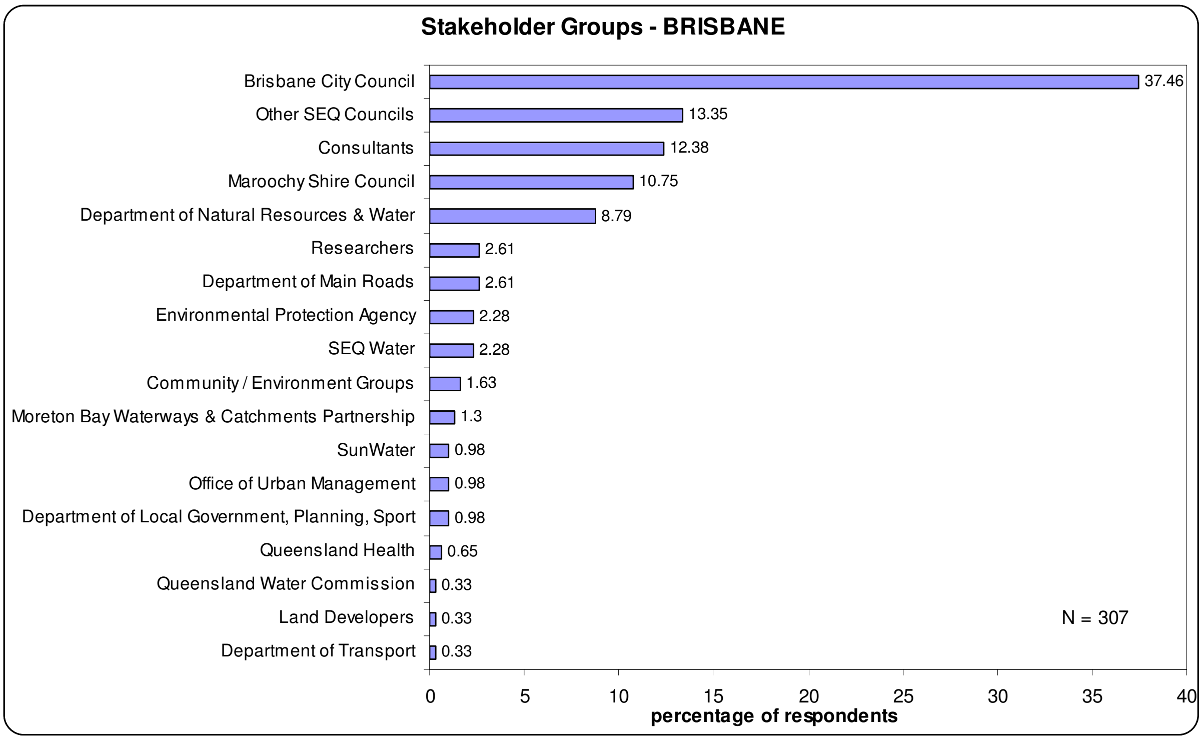


Figure 2.1: Stakeholder Groups Represented by Questionnaire Respondents from Brisbane

2.3.2 Melbourne Stakeholder Groups

The water utilities of metropolitan Melbourne were well represented[7], in particular, South East Water with 26.6 per cent of respondents (Figure 2.2). Overall, 39.4 per cent of respondents represented the water businesses of Melbourne. Consultants (16.7 per cent), local government (15.8 per cent) and the Department of Sustainability and Environment (7 per cent) were also well represented (Figure 2.2). Like the Brisbane survey, while there are fewer respondents from other categories, a good cross section of stakeholder groups was achieved.

2.3.3 Perth Stakeholder Groups

Respondents were predominantly from the only water utility in Perth, the Water Corporation, with 32 per cent of respondents (Figure 2.3). The next well-represented stakeholder group were Consultants (at 15 per cent) and local government representatives (with 14 per cent). Figure 2.3 also highlights a substantial contribution from individuals representing the State Departments for Planning and Infrastructure, and Water. Across the three cities, Perth has the largest contribution from the stakeholder group 'Land Developers', representing eight per cent of all respondents (Figure 2.3).

[7] City West Water nominated to be represented by the other metropolitan Melbourne water retailers: Yarra Valley Water and South East Water.

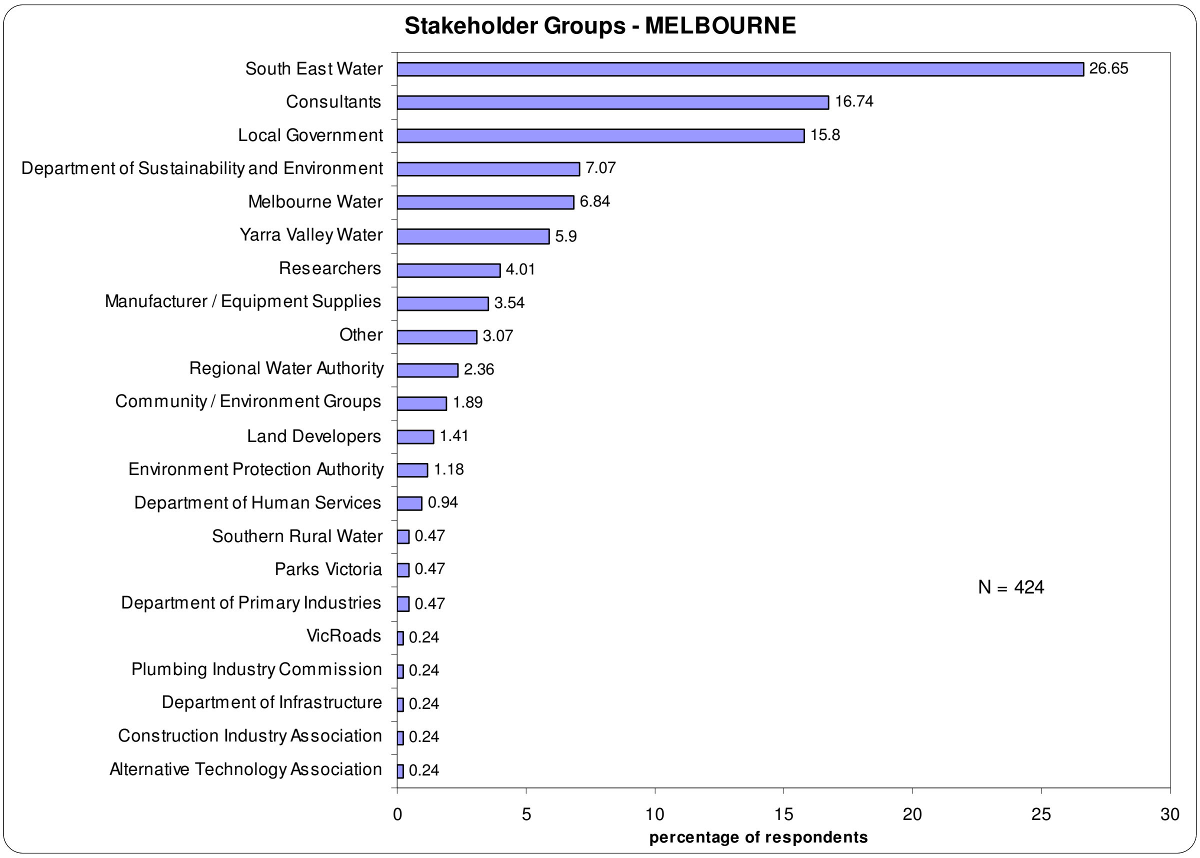


Figure 2.2: **Stakeholder Groups Represented by Questionnaire Respondents from Melbourne**

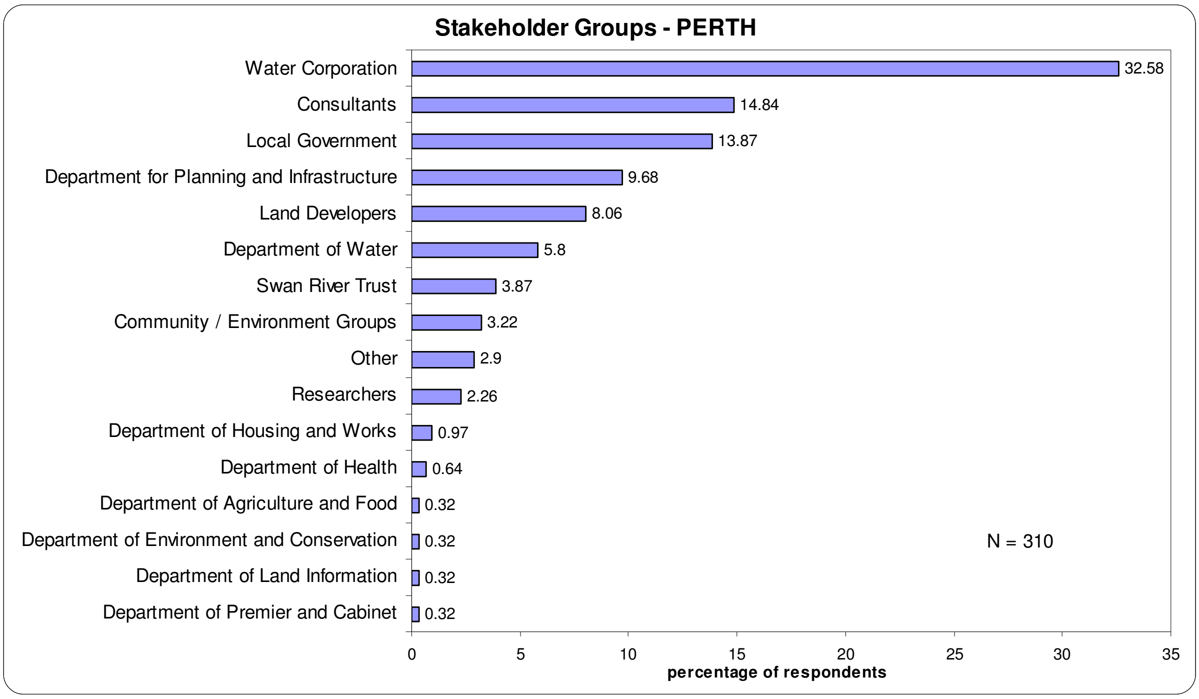


Figure 2.3: **Stakeholder Groups Represented by Questionnaire Respondents from Perth**

2.3.4 Overall Respondent Population

Across the three cities, the distribution of stakeholder groups as represented by respondents generally reflects the comparative level of involvement in the urban water sector. The overall respondent population was dominated by individuals with a professional background or training in engineering and/or science, the 'hard' sciences (Figure 2.4). On the other hand, there was a smaller representation of individuals with a background or training in 'softer' social sciences including economics and planning. Note that respondents could identify more than one formal area of professional training as reflected in the higher number of overall responses.

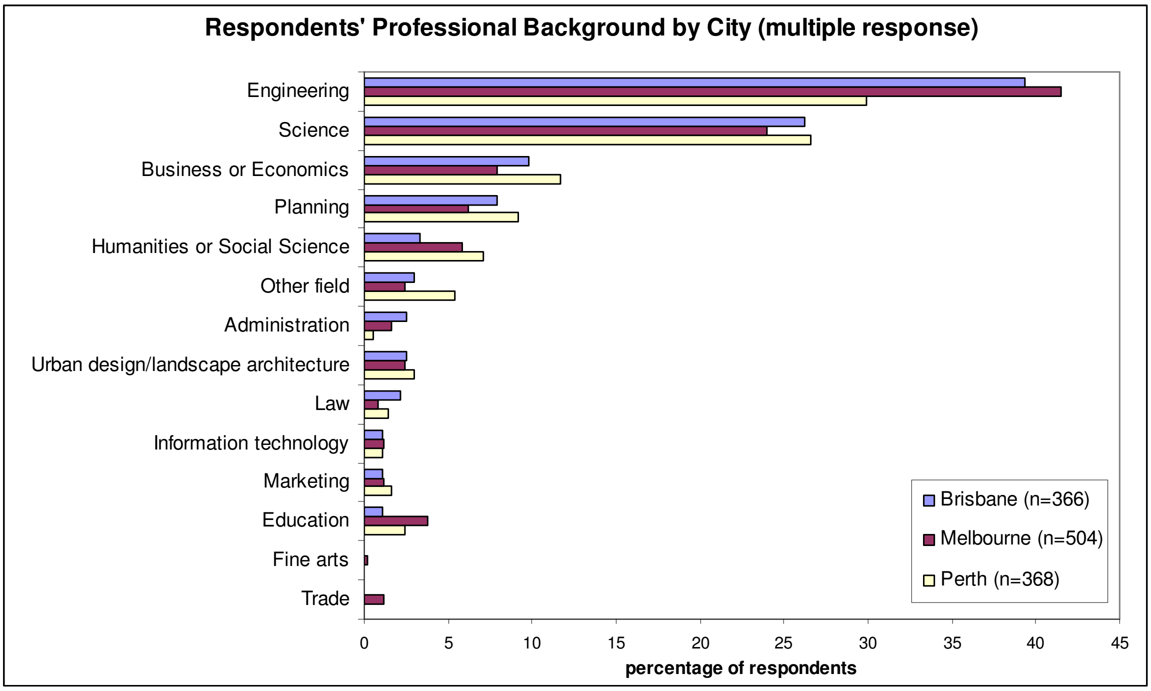


Figure 2.4: Professional Background and Training of Respondents from Brisbane, Melbourne and Perth

Figure 2.5 indicates that the majority of respondents (almost 70% in each city) have only been in their current position for 0-1 to 2-5 years. However, this somewhat masks the overall level of experience respondents have achieved in the urban water sector, as recent institutional reforms may have led to internal restructuring of various organisations. Indeed, Figure 2.6 demonstrates that the survey did capture a considerable number of individuals with over 11 years experience in urban water management and five per cent of respondents who have 20 plus years experience. Similarly, these results are also reflected in the level of position respondents hold within their organisation, where the majority of respondents have either middle or senior management roles, and between 10-15 per cent of respondents have executive positions (Figure 2.7). In Perth, for example, over 75 per cent of respondents held middle to senior positions (Figure 2.7).

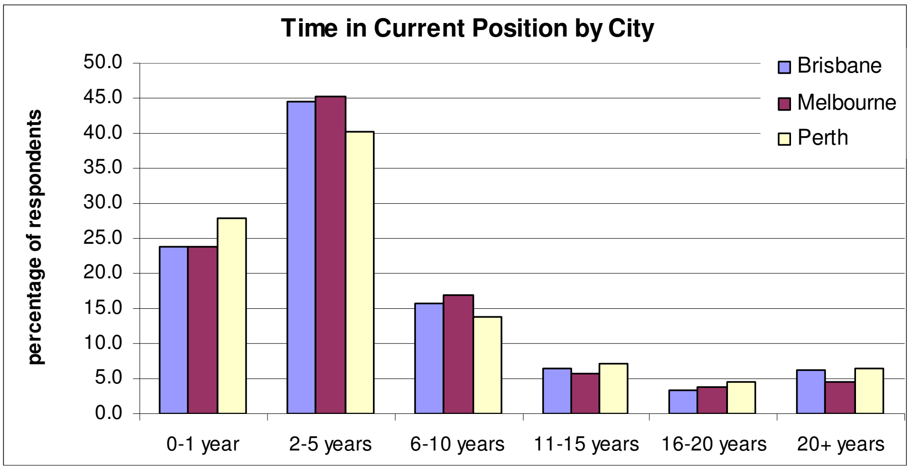


Figure 2.5: **The Length of Time Respondents have held their Current Position in Brisbane, Melbourne and Perth**

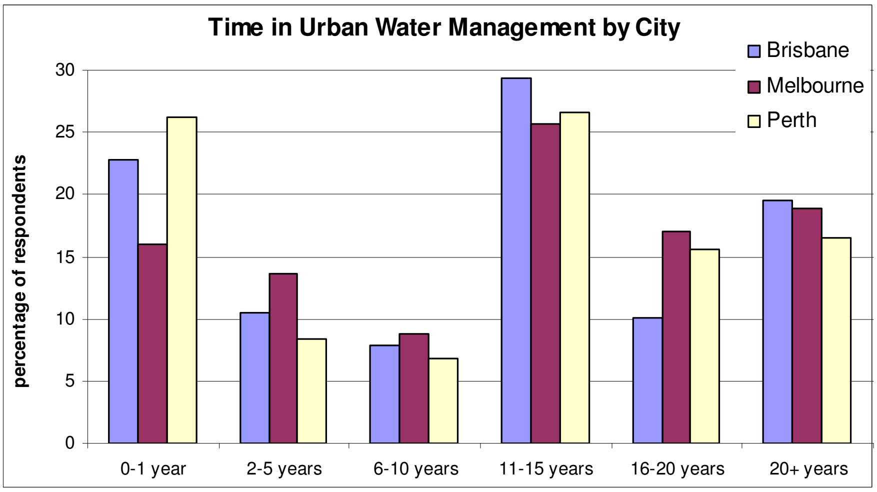


Figure 2.6: **The Length of Time Respondents have been Involved in Urban Water Management in Brisbane, Melbourne and Perth**

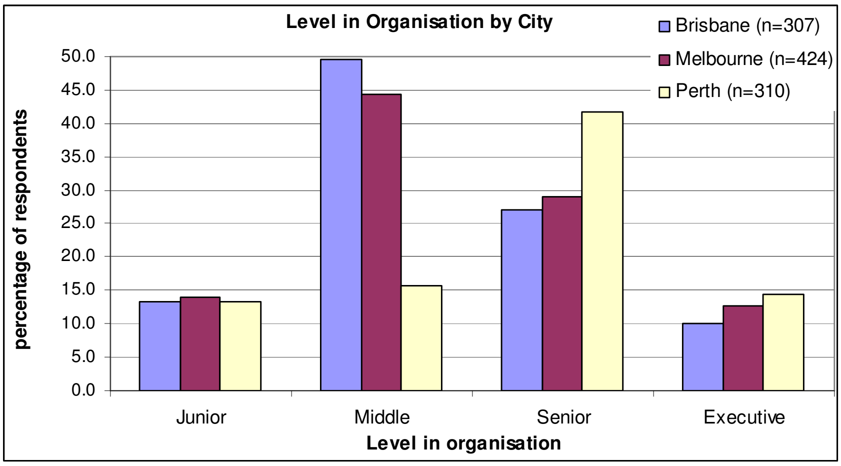


Figure 2.7: **Brisbane, Melbourne and Perth Respondents' Position in their Organisation**

Respondents were asked to identify what field (e.g. water supply, sewage) and type (e.g. design, technical, planning) of work they undertake. Figure 2.8 presents the broad field of work undertaken by respondents in Brisbane, Melbourne and Perth. Overall, there was a good representation, in each city, from respondents who are involved in three traditional areas of urban water management: water supply, stormwater/waterways and sewage. Interestingly, 12 per cent of respondents across all three cities indicated they work in the broader area of 'total water cycle management' (Figure 2.8). There were a large proportion of respondents in Perth who suggested they were involved in land development (Figure 2.8); this reflects the higher proportion of land developers who responded to the survey than in other case study cities.

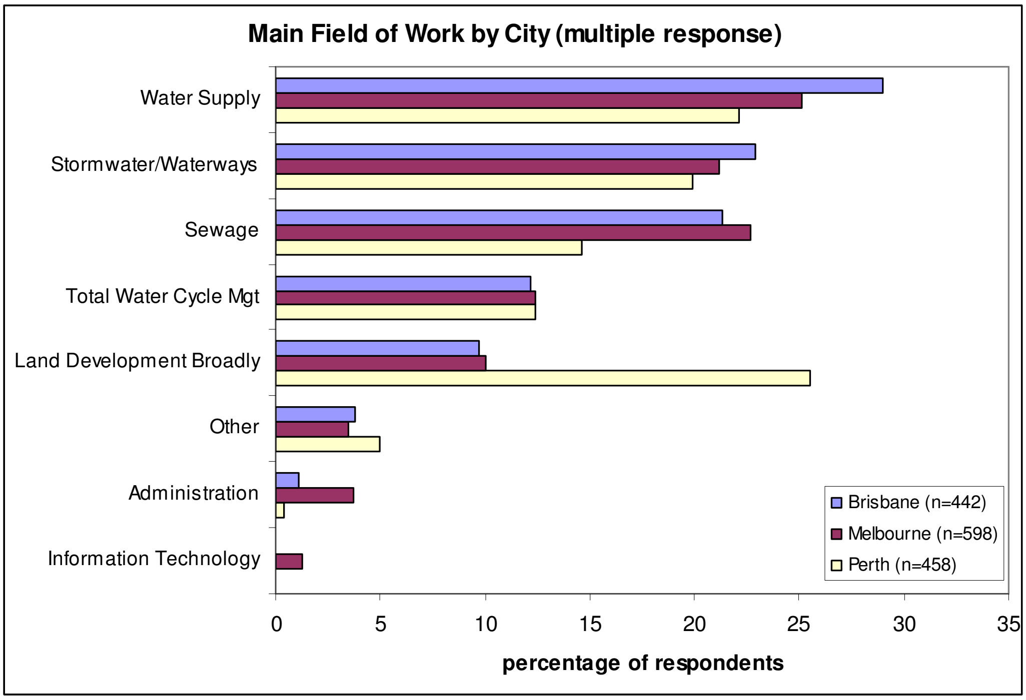


Figure 2.8: Brisbane, Melbourne and Perth Respondents' Main Field of Work

Within these broad fields of endeavour (Figure 2.8), respondents were also asked to identify whether they held, for example, a position in policy, research, education or technical operations. Figure 2.9 indicates the majority of respondents across each city were principally involved in the design, technical and operations division(s), closely followed by individuals with positions in strategy and/or policy.

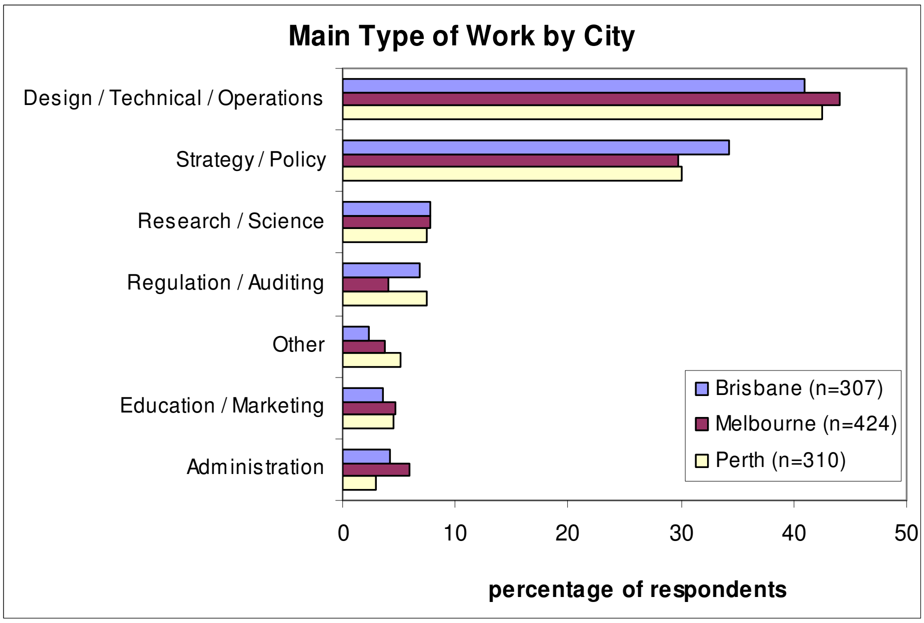


Figure 2.9: Brisbane, Melbourne and Perth Respondents' Main Type of Work

2.4 *Assessment of Survey Respondent Representativeness*

The questionnaire survey was targeted at professionals who broadly work in the urban water sector which include, among others, local government officers, consultants, engineers, planners, and policy/strategy officers. Therefore, it is difficult to accurately assess how representative our respondent numbers are based on the general urban water professional population. In an effort to determine how representative our data were, water retailers in each of the three case study cities were asked to provide an assessment of their total number of employees (excluding contractors). Table 2.4 provides an indication of how representative the respondent numbers were. However, it is important to note that the total number of employees provided from each organisation did not separate out administrative staff, therefore the sample size may in fact be greater. Another difficulty was encountered with determining the representation of Brisbane City Council respondents. Brisbane Water (a business unit of Brisbane City Council) employees were not separated out from Brisbane City Council; therefore, it is difficult to accurately determine the representativeness of the respondent totals.

Another validation process was undertaken, where the Program's steering committee members were asked to comment on how representative they believed the number of respondents from their organisation was in relation to total of individuals who work in urban water management services. All steering committee members agreed that the numbers adequately reflected a good representation from their respective organisations (i.e. South East Water, Water Corporation, Yarra Valley Water etc).

Table 2.4: An Assessment of the Representativeness of the Respondent Population

Title of Utility	Number of Employees (excluding contractors)	Number of Survey Respondents from Organisation	Date Recorded	Percentage of Retailer/Utility (%)
Water Corporation	2519	101	25/07/2007	4
Brisbane Water	825	115 (BCC)*	26/07/2007	14
Melbourne Water	642	29	25/07/2007	4.5
Yarra Valley Water	392	25	30/06/2006	6.4
South East Water	391	113	30/06/2006	29
City West Water**	246	-	30/06/2006	-
Melbourne Consolidated	1671	167	-	10

* Brisbane City Council was the only stakeholder group we provided, Brisbane Water was not an option but is incorporated within Brisbane City Council
** City West Water did not agree to participate in the online survey
Courtesy Mr R.Young (WSAA).

3.0 Association with Diverse Water Supply Sources and Uses

Supplementing traditional water supplies is a critical issue in Australia and diverse water source options need to be considered. According to the receptivity model, association is achieved when there is recognition and understanding of the 'problem' and its solutions (Table 1.2). For example, respondents would recognise and accept that diverse water sources are required to supplement conventional water supplies and also recognise their fit-for-purpose application. This Chapter presents the data collated on the perceptions of urban water professionals regarding the importance of developing and using diverse water source options. These results work towards establishing the level of association professionals in the urban water sector have towards advancing total water cycle management.

Respondents were asked to consider the perceived importance of diverse water sources to themselves ('you'), to 'their organisation', 'the community' and 'State politicians' according to the scale: very low, low, average, high, very high and 'I don't know'. Eight diverse water source options were identified: greywater, stormwater, sewage, rainwater, seawater, new dams, groundwater and water trading. The question also asked respondents to consider the concept of 'fit-for-purpose' water use, which was defined for respondents as:

> *the use of alternative sources of water for activities that best match the quality of water needed. For example, lower quality water should be used for activities that do not require high quality water (i.e. not using potable water for flushing toilets).*

Based on the diverse water supplies identified above, the range of fit-for-purpose uses tested in the survey included nothing, drinking, indoor and outdoor household use, public open space, environmental flows, industry, and all uses. The question posed to respondents asked what the appropriate uses for the diverse water sources might be; multiple responses were permitted.

The combined high and very high response categories regarding the importance of supplementing conventional water supplies with alternative water sources for Brisbane, Melbourne and Perth are presented below. The range of diverse water supply uses, as supported by professionals in the urban water industry is also presented below. It is important to note the total number of respondents who nominated 'all uses' for a specific water source was added to each of the other categories, except the category of 'nothing'. Raw data tables are located in Appendix B.

3.1 Key Findings

Investigating diverse water source options to augment conventional supplies was considered an important task by professionals operating in each case study city. More specifically, the development of rainwater, greywater, stormwater and sewage were rated as the most important options for ensuring improved water supply security. Importantly, the professional community also perceived that pursuing these diverse water sources was important to 'their organisation', 'the community' and 'State politicians'. This demonstrates a high level of association with the problem of water scarcity and recognition of potential solutions (securing water supply through diversity of options).

Comparatively lower levels of support were offered for the development of seawater, new dams and groundwater in Brisbane and Melbourne, whereas in Perth, seawater and groundwater were rated higher, perhaps reflecting the access to groundwater in Perth and the construction of a desalination plant. Of note, many respondents in each of the three cities indicated they personally, along with state politicians, support the option of using water trading to supplement current water supplies.

Although sewage was identified as an important diverse water source option in each city, respondents generally perceived 'the community' as being less receptive to sewage, and also less receptive to stormwater in Melbourne.

Overall, there was consistency across the three case study cities regarding the appropriate uses for the diverse water source options based on risk perceptions. For example, 'recycled' water such as greywater, stormwater and sewage were rated highly for use in outdoor areas (household and public spaces), industry and environmental flows, although sewage was considered less suitable for environmental flows than stormwater. Similarly, these diverse water source options were considered inappropriate for use involved close human contact (indoor household use and drinking). This reflects the fit-for-purpose agenda, where risk to public health is minimised through reducing human (bodily) contact with water sources. Although not statistically significant, there was little overall support from professionals with an engineering background for drinking alternative water sources. However, few diverse water sources were deemed appropriate for drinking.

3.2 Rainwater

Rainwater was consistently rated as a water source option of high importance across the four categories in each city (Figure 3.1). Professionals in Brisbane, Melbourne and Perth perceived 'the community' considers rainwater as an important option; however, in Melbourne, the highest importance rating came from the professional respondents ('you'). There was consensus among respondents when data were analysed for differences according to 'experience in urban water management' and 'stakeholder group'. While not significant, the Water Corporation of Perth was less likely to support rainwater as an alternative source as compared to other stakeholder groups. Furthermore, in Melbourne, respondents with a professional background in science/engineering were more likely to consider rainwater of low importance compared to respondents with planning/humanities and 'other' backgrounds.

Rainwater was considered appropriate for all uses across each of the cities, with Perth and Brisbane respondents the most responsive to using rainwater for human consumption (Figure 3.2). Very few respondents identified rainwater as having no use at all. Further analysis of respondents who considered rainwater appropriate for drinking indicated there were no significant differences among respondents based on their 'stakeholder group', 'experience in urban water management', or 'level in organisation'. It is noteworthy that very few respondents with an engineering/science professional background supported the use of rainwater for drinking in all three cities, but most significantly in Melbourne.

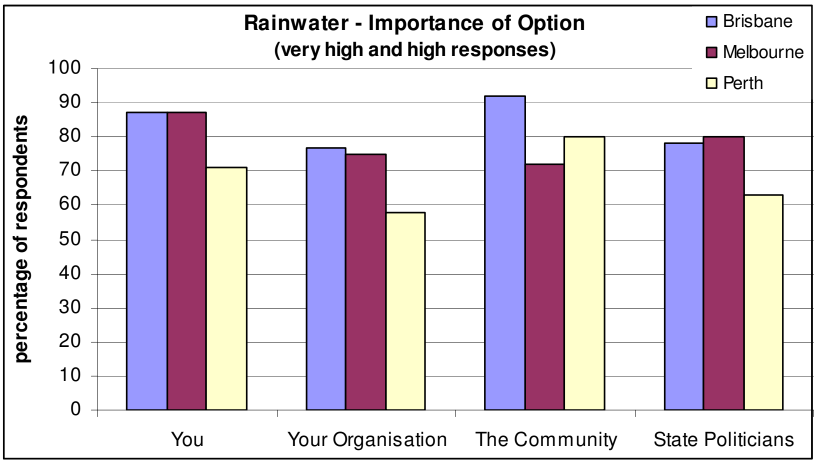


Figure 3.1: Perceived Importance for Supplementing Conventional Water Supply with Rainwater

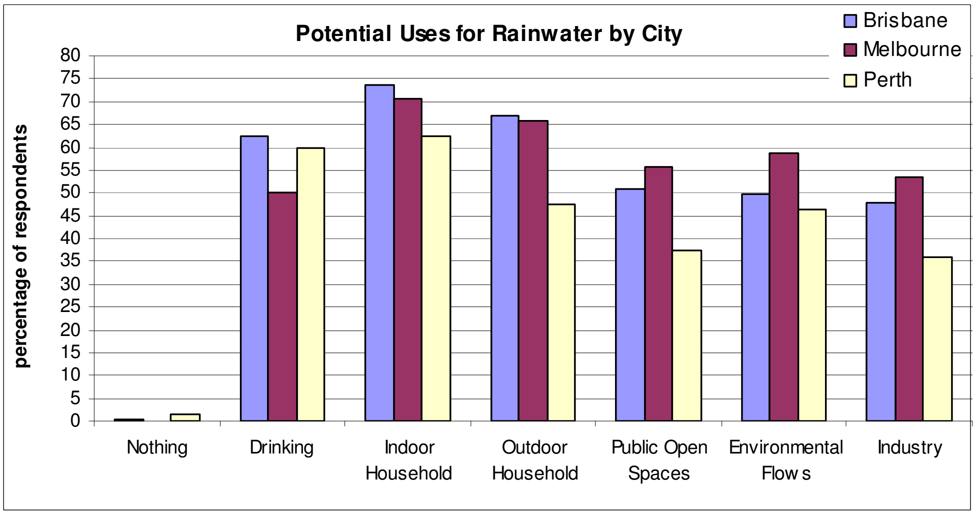


Figure 3.2: Potential Uses for Rainwater by City

3.3 Greywater

In each city, greywater was considered an important water source option, although 'your organisation' and 'state politicians' were perceived to be less supportive than individual respondents ('you') and 'the community' (Figure 3.3). Over 65 per cent and 45 per cent of respondents in each city viewed greywater as appropriate for use in outdoor household areas and public open spaces, respectively (Figure 3.4). Overall, very few respondents considered greywater appropriate for drinking. Of those respondents who advocated drinking greywater, there were no statistical differences based on the length of 'experience in urban water management', their 'position level' or the 'type of work' they perform.

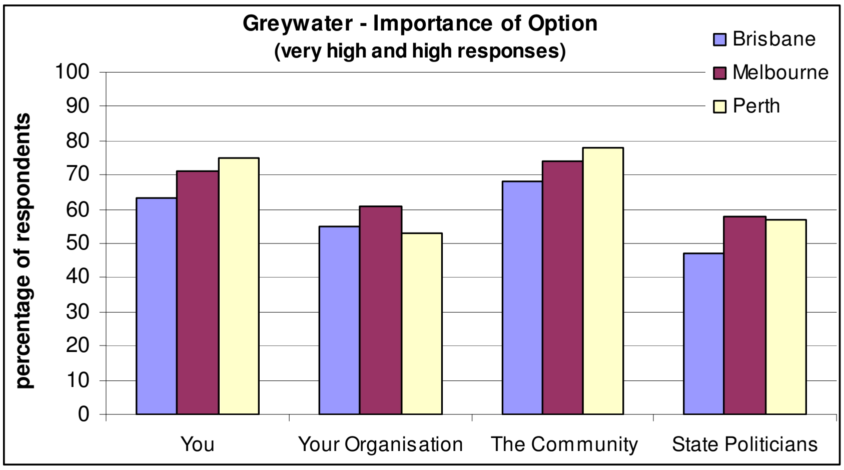


Figure 3.3: Perceived Preferences for Supplementing Conventional Water Supply with Greywater

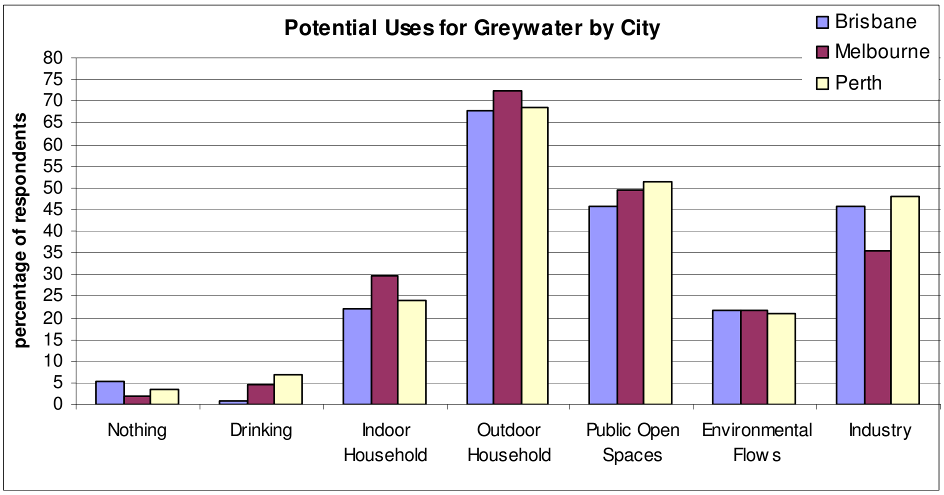


Figure 3.4: Potential Uses for Greywater by City

3.4 Stormwater

Stormwater received strong support in Brisbane, Perth and Melbourne across the four categories, although 'the community' in Melbourne were perceived to support stormwater considerably less than other categories (Figure 3.5). In Brisbane and Perth, respondents with planning/humanities background were significantly more likely to support the use of stormwater than respondents with a background in engineering/science. There was little variation among respondents according to the length of 'experience in urban water management' and their 'level within organisation'.

Also, across each of the three cities there were similar results regarding the appropriate uses for stormwater. There was strong support for using stormwater in outdoor areas (household and public open spaces), in industry and for environmental flows (Figure 3.6). Conversely, very few respondents perceived stormwater as appropriate for use inside the house, both for drinking and general indoor use, particularly in Perth. There was low support across each of the cities for 'all uses' (Appendix B). No significant differences were identified among respondents according to 'experience in urban water management', 'level in organisation', 'professional group' or 'type of work'.

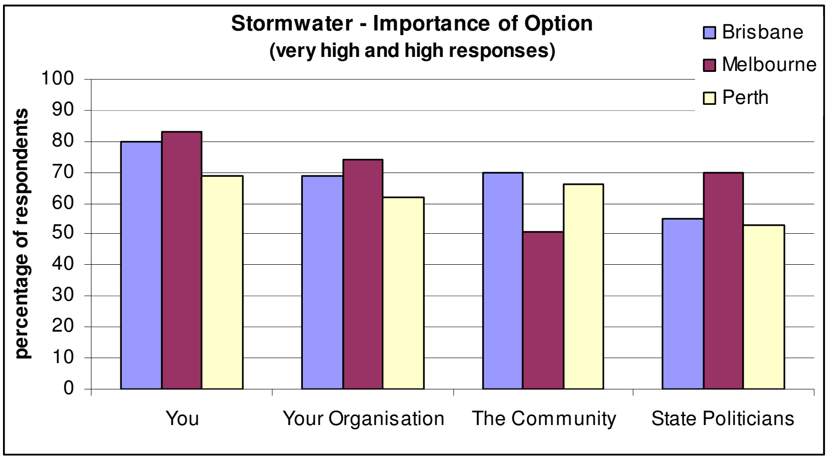


Figure 3.5: Perceived Importance for Supplementing Conventional Water Supply with Stormwater

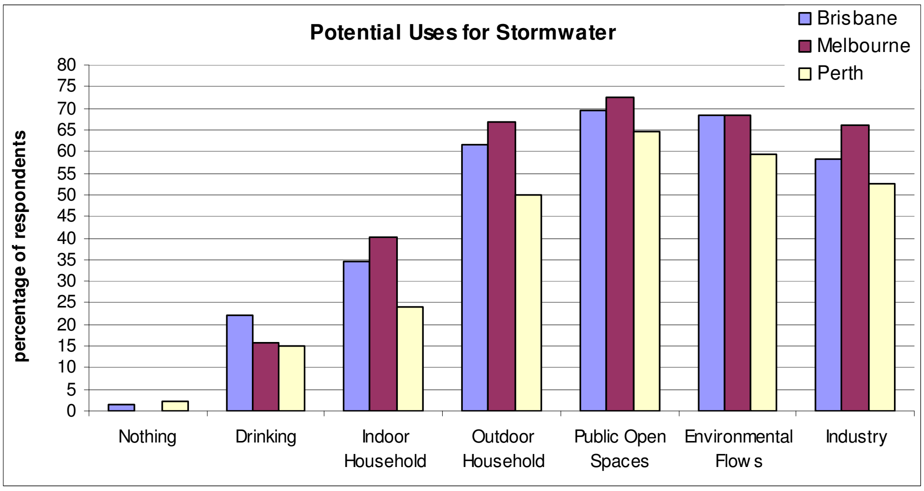


Figure 3.6: Potential Uses for Stormwater by City

3.5 Sewage

There was strong support for sewage by respondents, who also perceived 'their organisation' was supportive (Figure 3.7). Respondents suggested 'the community' were the least likely, out of the four categories, to consider sewage as an important diverse water source option (Figure 3.7). However, non-government respondents were more likely than state government respondents to consider 'the community' as willing to accept recycled sewage. There was also broad agreement among respondents according to the 'experience in urban water management', 'level in organisation' and 'stakeholder group'. Statistical analysis identified that professionals with backgrounds in planning and science had opposing views; planners were less likely to consider sewage as suitable for augmenting supply, whereas engineers were more likely to support the use of sewage across all cities.

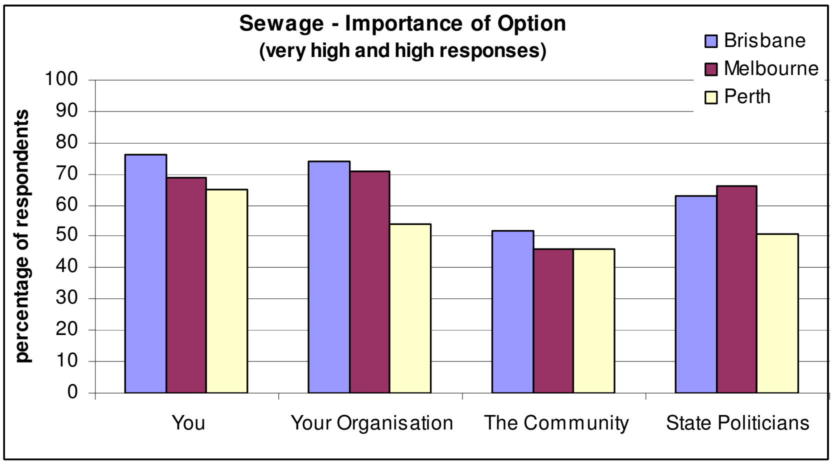


Figure 3.7: Perceived Importance for Supplementing Conventional Water Supply with Sewage

The use of recycled sewage in outdoor areas (household and public spaces) and for industry was strongly supported by respondents in each city (Figure 3.8). Few respondents considered recycled sewage appropriate for drinking; however, 10-15 per cent of respondents across all three cities saw sewage as appropriate for use in all categories (Appendix B). Overall, Brisbane respondents were more supportive of close human contact (consumption and indoor household use) than either Perth or Melbourne respondents.

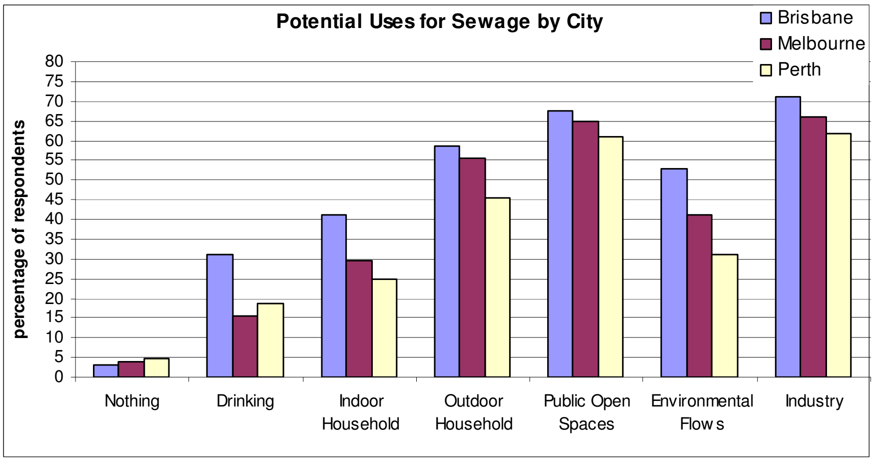


Figure 3.8: Potential Uses for Sewage by City

Among respondents who identified recycled sewage as appropriate for all uses, there were no significant differences according to length of 'experience in urban water management'; however, respondents from Brisbane in middle-level positions were significantly less likely than junior or senior respondents to consider sewage appropriate for drinking. Yet in Perth and Melbourne, there were lower levels of support for drinking recycled sewage. There was a clear trend in Brisbane, where the increasing levels of support for drinking sewage correlated with seniority in their organisation. Furthermore, when examining whether sewage should be used for drinking or to maintain environmental flows, there was a consensus among respondents as no significant differences were identified amongst respondents according to their 'experience in urban water management', 'professional group' or 'type of work'. Also, water utility/retailer/business respondents held similar views to the other 'stakeholder groups' on using sewage.

3.6 Seawater

In all three cities, amongst respondents, there was a common perception that 'state politicians' are more likely to consider seawater as an important future water source option over 'the community' or urban water organisations ('your organisation') (Figure 3.9). Individuals with experience of between 2-5 years in Brisbane and Melbourne were less likely to consider seawater as an important diverse water source. When comparing the frequency results against the demographic data there were no significant differences between respondents according to their 'position in their organisation' or 'professional group'. Although professionals in Melbourne considered seawater of low importance for all four categories, water business respondents were significantly more likely to consider seawater as a future water source option than other stakeholders. A similar trend was also exhibited in Perth. Furthermore, respondents in Brisbane and Melbourne, who have two to five years urban water management experience, were more likely to consider seawater as not suitable for supplementing conventional water supplies.

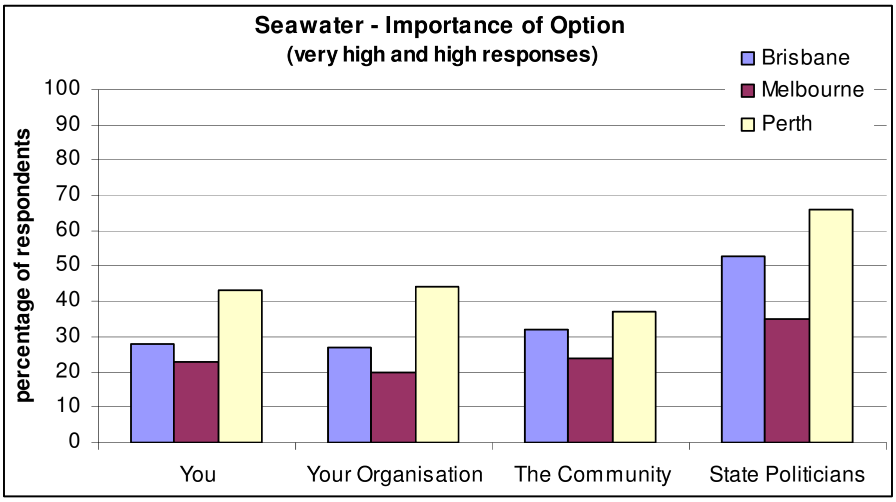


Figure 3.9: Perceived Importance for Supplementing Conventional Water Supply with Seawater

In Brisbane and Melbourne, over 25 per cent of respondents considered seawater was not appropriate for any use, whereas in Perth, the majority identified seawater appropriate for use in industry, human consumption and indoor household use (Figure 3.10). There was support across the three cities for seawater to be used for industrial purposes, but low support for using seawater for other uses. Drinking seawater was considered appropriate by over 45 per cent of Perth respondents and over 35 per cent of Brisbane respondents, with distinctly less support from Melbourne respondents. Indeed, the length of 'experience in urban water management' correlated with agreeing to use seawater for drinking in Melbourne and Perth. For example, 0-10 years experience in Melbourne and Perth, the less likely you are to agree, whereas the more experienced the respondent was (10 plus years) the more likely you were to agree to using seawater for drinking. Similarly, the more senior position respondents held in Melbourne the more likely respondents were to perceive seawater as useful for drinking purposes. In Perth, Water Corporation respondents were also more likely to suggest that seawater should be used for drinking in comparison to other 'stakeholder groups'. No significant differences were identified among respondents who support drinking seawater based on 'experience in urban water management', 'professional group' and main 'type of work'. Similarly, there were no significant differences among respondents who considered seawater should be used for nothing according to 'experience in urban water management', 'level in organisation' and 'professional group'.

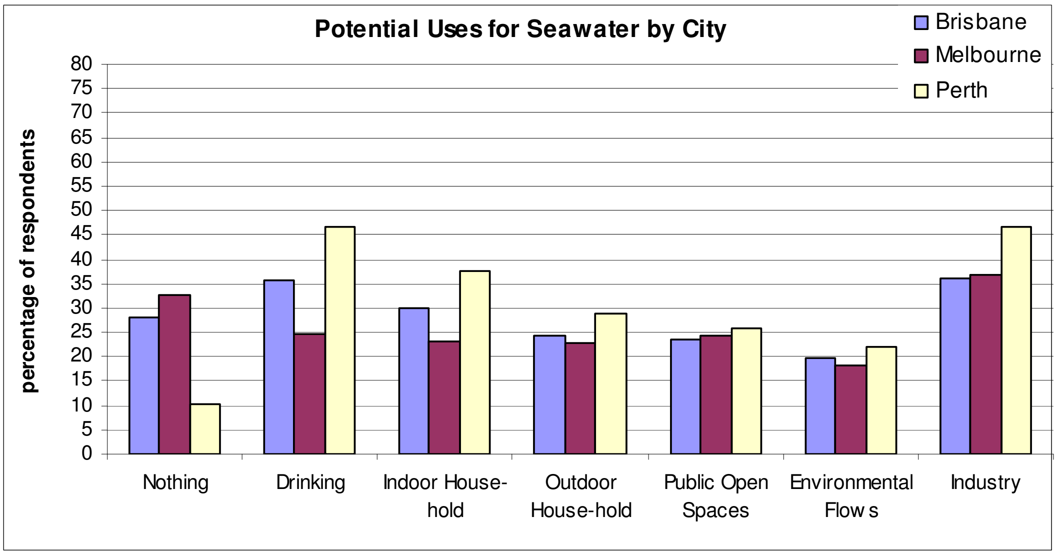


Figure 3.10: Potential Uses for Seawater by City

Using seawater for environmental flows had low support across all three cities. Of those respondents who considered seawater appropriate for environmental flows, Brisbane planners were more supportive and in Melbourne, the more junior position one held, the more significantly likely one was to support this option. Respondents with science and engineering backgrounds were not supportive of using seawater for environmental flows in all three cities.

3.7 Groundwater

Groundwater was not perceived as an important option to pursue for supplementing current water supplies in Brisbane or Melbourne. For example, less than 30 per cent of Melbourne respondents for each category considered groundwater an important diverse water source option (Figure 3.11) and in Brisbane, 'your organisation' is the only group perceived to consider groundwater as a potential future water source option (Figure 3.11). Perth respondents, however, indicated stronger support for this water source; this reflects where the majority of Perth's current water supplies are sourced from. Overall, responses were fairly consistent regarding perceptions on what groundwater should be used for across the cities and across the categories for use. The exception was in Perth, where respondents identified groundwater as being appropriate for drinking, more so than Melbourne or Brisbane respondents (Figure 3.12).

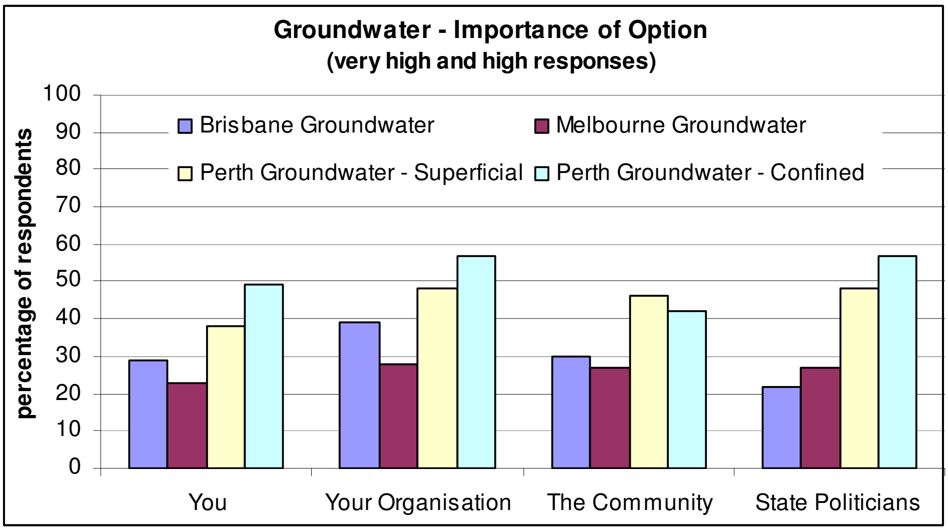


Figure 3.11: Perceived Importance for Supplementing Conventional Water Supply with Groundwater.

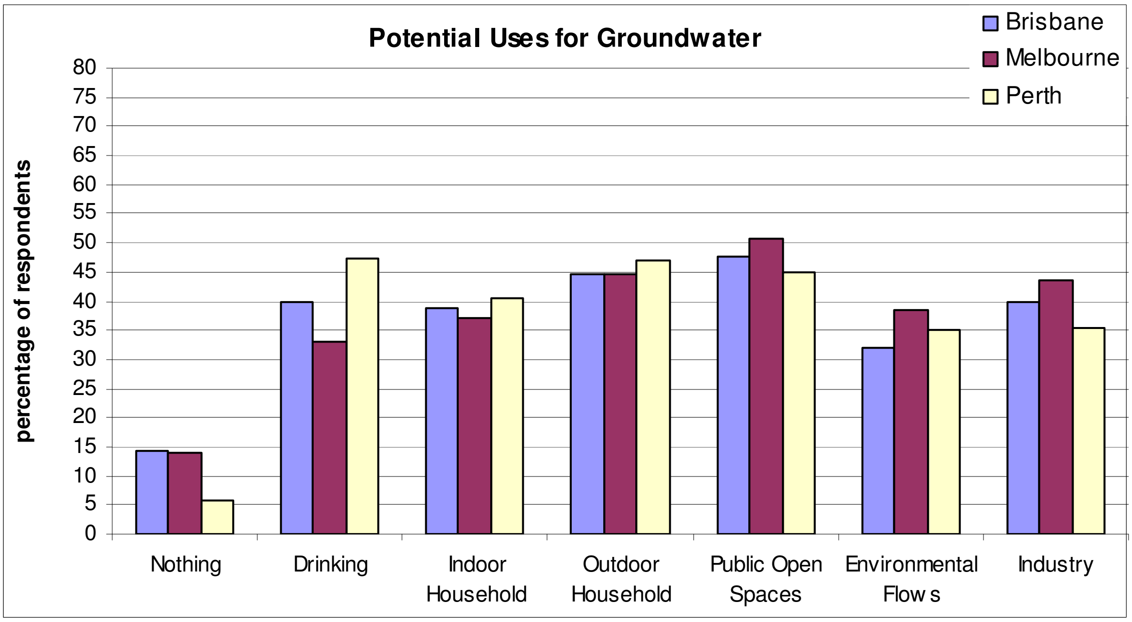


Figure 3.12: Potential Uses for Groundwater by City

3.8 New Dams and Water Trading

Across the three cities, new dams were consistently identified as an option of low importance for supplementing current water supplies. Indeed, in Melbourne, new dams only achieved a high to very high response from 15 per cent of respondents (Appendix B). However, the exception to this was in Brisbane (Figure 3.13), where 66 per cent of respondents perceived 'state politicians' and 40 per cent of water professionals consider new dams an important future water source option (although there was no difference between the 'professional groups'). Moreover, in Perth, over 70 per cent of respondents with training in engineering/science consider new dams integral to water supply, whereas planners were polarised. Upon further analysis, there were no significant differences among respondents within cities based on the respondents' 'level in organisation' (senior, junior) for new dams and while not a significant difference, non-government respondents were more likely to identify that 'the community' consider new dams an important future water source option. Interestingly, in Melbourne, South East Water respondents were more likely to agree new dams are an important future water source option.

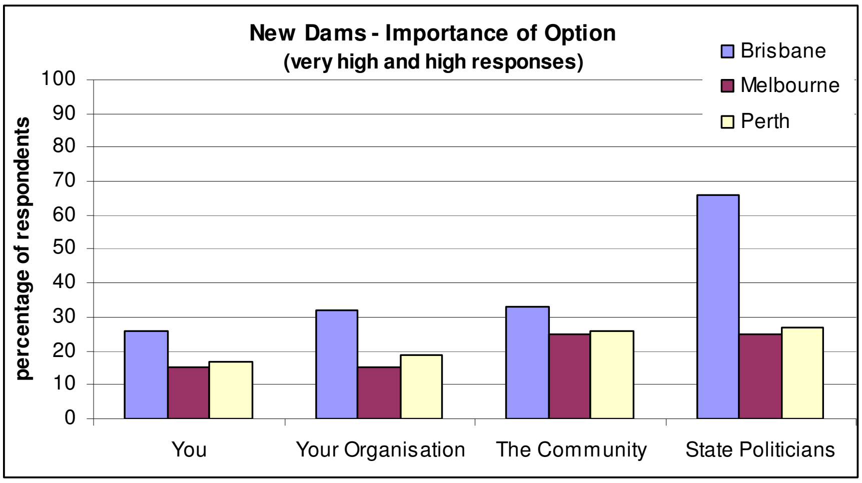


Figure 3.13: Perceived Importance for Supplementing Conventional Water Supply with New Dams

Finally, water trading was identified as being important to State Politicians (as perceived by over 50 per cent of respondents in each of the three case studies) closely followed by professionals (Figure 3.14). However, water trading was not identified as a strong 'community' preference (Figure 3.14).

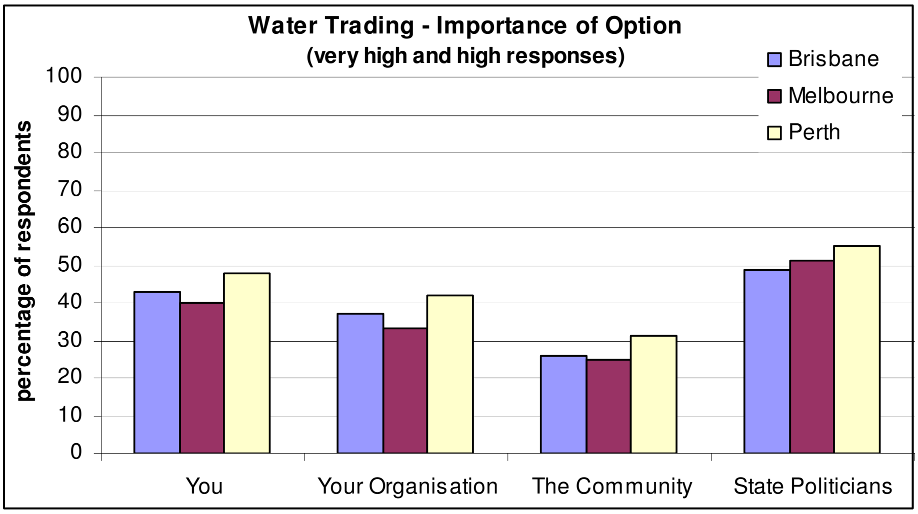


Figure 3.14: Perceived Importance for Supplementing Conventional Water Supply with Water Trading.

4.0 Factors Influencing the Uptake of Rainwater Tanks and On-site Greywater Systems

This Chapter presents the level of professional receptivity to developing and implementing decentralised, on-site technologies: rainwater tanks and on-site greywater systems. Using the receptivity model (Section 1.2; Figure 1.2), association and acquisition by urban water professionals are examined. Association factors tested the receptivity of urban water professionals to the socio-political context by asking respondents to rate whether 'community perceptions', 'environmental outcomes' and 'public health outcomes' enable or constrain the adoption of decentralised systems (see Section 2.1; Table 2.2). Similarly, another eight factors were also tested to help assess whether urban water professionals had the appropriate capacity, skills and management arrangements to support the implementation of rainwater tanks and on-site greywater systems (Acquisition) (see Section 2.1; Table 2.2). The acquisition factors examined were 'technical feasibility and performance', 'professional knowledge and expertise', 'government policy', 'management arrangements and responsibilities', 'regulation and approvals processes', 'property access rights', and the impact of 'capital' and 'maintenance' costs. The purpose of reviewing these factors is to assist in the identification of perceived drivers and barriers that influence the uptake of decentralised technologies for rainwater and greywater use.

Respondents rated the perceived influence (if any) of the eleven factors according to the scale: I don't know, strongly prevents, slightly prevents, neither prevents nor encourages, slightly encourages and strongly encourages. Raw data tables for the core findings are located in Appendix B.

4.1 Key Findings: Drivers and Barriers

Urban water professionals in Brisbane, Melbourne and Perth clearly support the development of on-site technologies in both Greenfield and Existing areas. Despite this strong support and strong 'awareness', respondents recognised there are numerous barriers preventing further adoption of decentralised systems.

Although urban water professionals in Brisbane, Melbourne and Perth were highly aware of the need for and support the development of greywater, respondents demonstrated low levels of receptivity to adopting the appropriate decentralised technology (on-site greywater systems). Nine out of the eleven association and acquisition factors were perceived to be barriers in the adoption of on-site greywater systems; the only driver was perceived to be 'environmental outcomes', while 'property rights access' was considered to have no influence on uptake (Table 4.1).

Professional receptivity to rainwater tank adoption was higher with respondents in Brisbane and Melbourne identifying the majority of acquisition factors neither enable nor constrain uptake. Indeed, government policy was recognised as a driver, perhaps reflecting the rebate schemes on offer to households in each case study city. 'Community perceptions' and 'environmental outcomes' were also identified as a driver. However, public health outcomes were still considered a barrier. Acquisition levels can still improve with attention required on improving regulatory processes, management arrangements and addressing the impact of costs (Table 4.1).

Table 4.1: Drivers and Barriers to the Implementation of On-site Technologies

Receptivity Matrix Attributes	BRISBANE On-site Raintank	BRISBANE On-site Greywater	MELBOURNE On-site Raintank	MELBOURNE On-site Greywater	PERTH On-site Raintank	PERTH On-site Greywater
ASSOCIATION FACTORS						
Community Perceptions	Driver	Slight Barrier	Driver	Slight Barrier	Driver	Barrier
Environmental Outcomes	Driver	Mixed	Driver	Driver	Driver	Slight Driver
Public Health Outcomes	Mixed	Barrier	Neutral	Barrier	Barrier	Barrier
ACQUISITION FACTORS						
Technical Feasibility & Performance	Slight Driver	Barrier	Neutral	Barrier	Slight Barrier	Barrier
Professional Knowledge & Expertise	Slight Driver	Barrier	Mixed	Barrier	Mixed	Barrier
Government Policy	Driver*	Slight Barrier*	Driver*	Slight Barrier	Mixed	Barrier
Management Arrangements & Responsibilities	Neutral	Barrier	Neutral	Barrier	Slight Barrier	Barrier
Regulation & Approvals Processes	Slight Barrier	Barrier	Slight Barrier	Barrier	Slight Barrier	Barrier
Property Access Rights	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Capital Costs	Neutral	Barrier	Slight Barrier	Barrier	Barrier	Barrier
Maintenance Costs	Neutral	Barrier	Neutral	Barrier	Barrier	Barrier

* Brisbane responses only refer to Local Government (Brisbane City Council)

Barrier	Slight Barrier	Mixed	Slight Driver	Driver	Neutral (N)
Majority > 25%	Majority >10%<24%	<10% difference, Driver & Barrier	Majority >10%<24%	Majority > 25%	Receptivity factor not important

4.2 Perceived Importance and Association Factors

There was a strong consensus within and among case study cities regarding the importance of pursuing the implementation of on-site technologies in greenfield and existing sites, although Perth respondents were less certain (Figure 4.1).

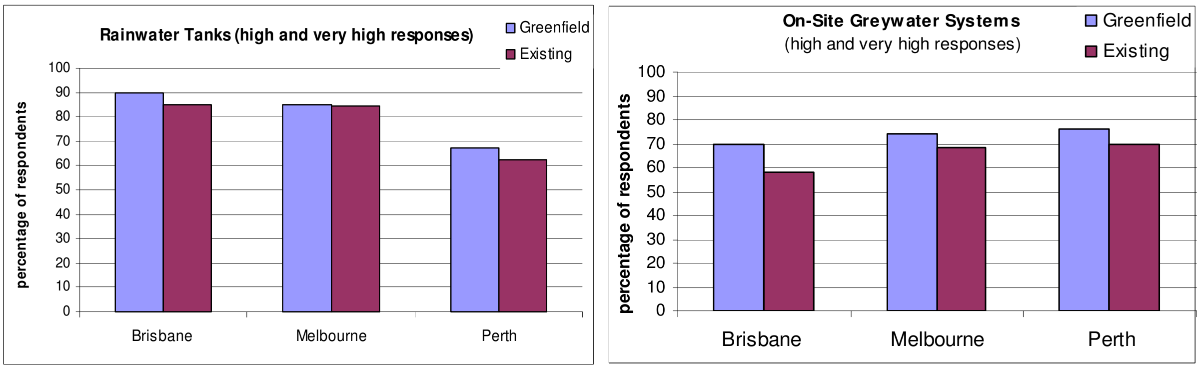


Figure 4.1: The Importance of Applying On-site Technologies for Future Water Sources to Greenfield and Existing Sites in Brisbane, Melbourne and Perth
These graphs depict the combined totals of respondents who identified these technologies were of high and very high importance.

Professionals considered 'community perceptions' were divided for on-site technologies. For example, while 'community perceptions' were identified as an encouraging factor in the adoption of rainwater tanks in all three cities (although Perth respondents were less certain) (Figure 4.2), more than 50 per cent of respondents in each city considered 'community perceptions' impeded the adoption of on-site greywater systems (Figure 4.2). This is despite respondents identifying that 'the community' supported the development of greywater as an important diverse water supply source (Section 3.3).

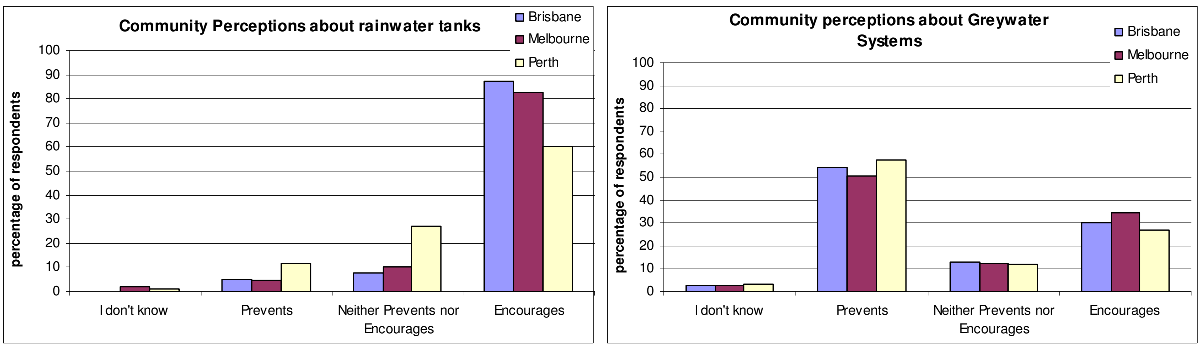


Figure 4.2: Community Perceptions Influence on the Adoption of On-site Technologies

The association factor 'environmental outcomes' was perceived as an outright driver for the adoption of both rainwater tanks and on-site greywater systems (Figure 4.3). Despite the professed environmental benefits, respondents in each case study perceived that the adoption of decentralised technologies, in particular on-site greywater systems, was hindered by potential 'public health outcomes' (Figure 4.4).

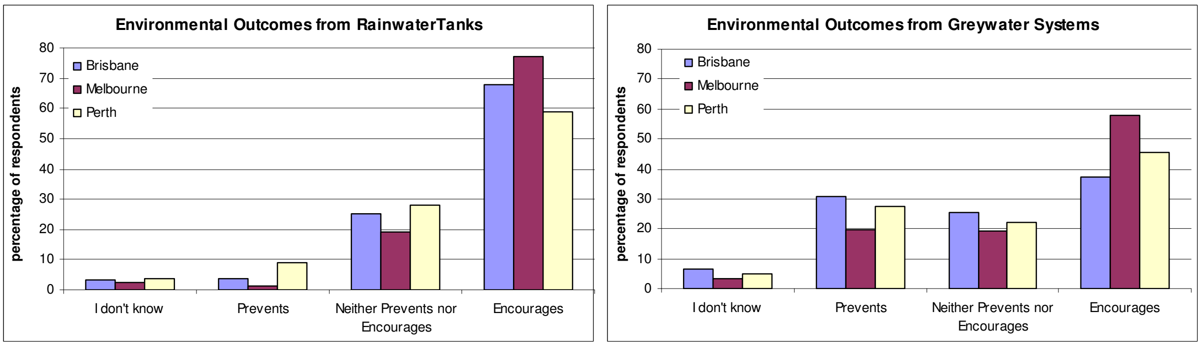


Figure 4.3: Environmental Outcomes Influence on the Adoption of On-site Technologies

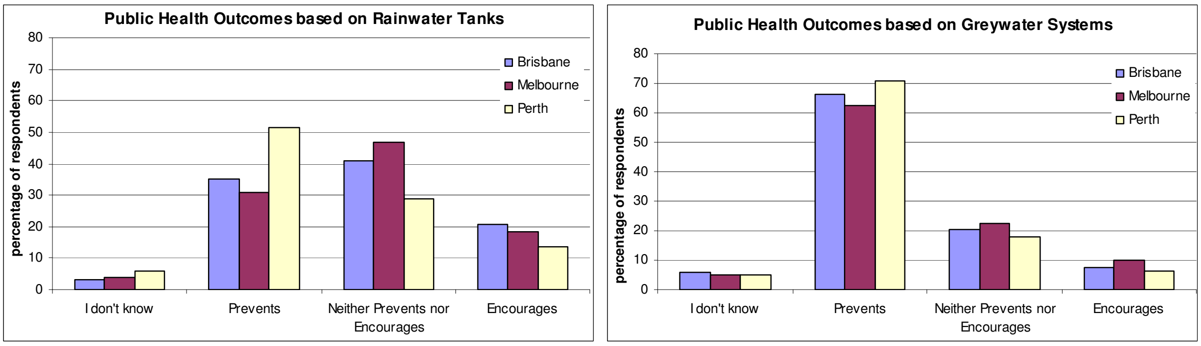


Figure 4.4: Public Health Outcomes Influence on the Adoption of On-site Technologies

4.3 Technical Feasibility and Professional Knowledge

More Brisbane respondents considered that 'technical feasibility and performance' encouraged the installation of rainwater tanks (40 per cent of respondents) in comparison to Perth and Melbourne respondents (20 and 22 per cent respectively). Yet, over 50 per cent of respondents in each city perceived that 'technical feasibility and performance' limited the uptake of on-site greywater systems (Figure 4.5).

Similarly, 'professional knowledge and expertise' was also perceived by urban water professionals to inhibit the adoption of on-site greywater systems in all three case studies. However, for rainwater tanks this was considered, in Brisbane and Melbourne, to be neither a positive or negative influence on adoption (Figure 4.5). On the other hand, urban water professionals in Perth indicated that 'professional knowledge and expertise' was a 'slight barrier' for rainwater tanks and an outright barrier for on-site greywater systems (Figure 4.5).

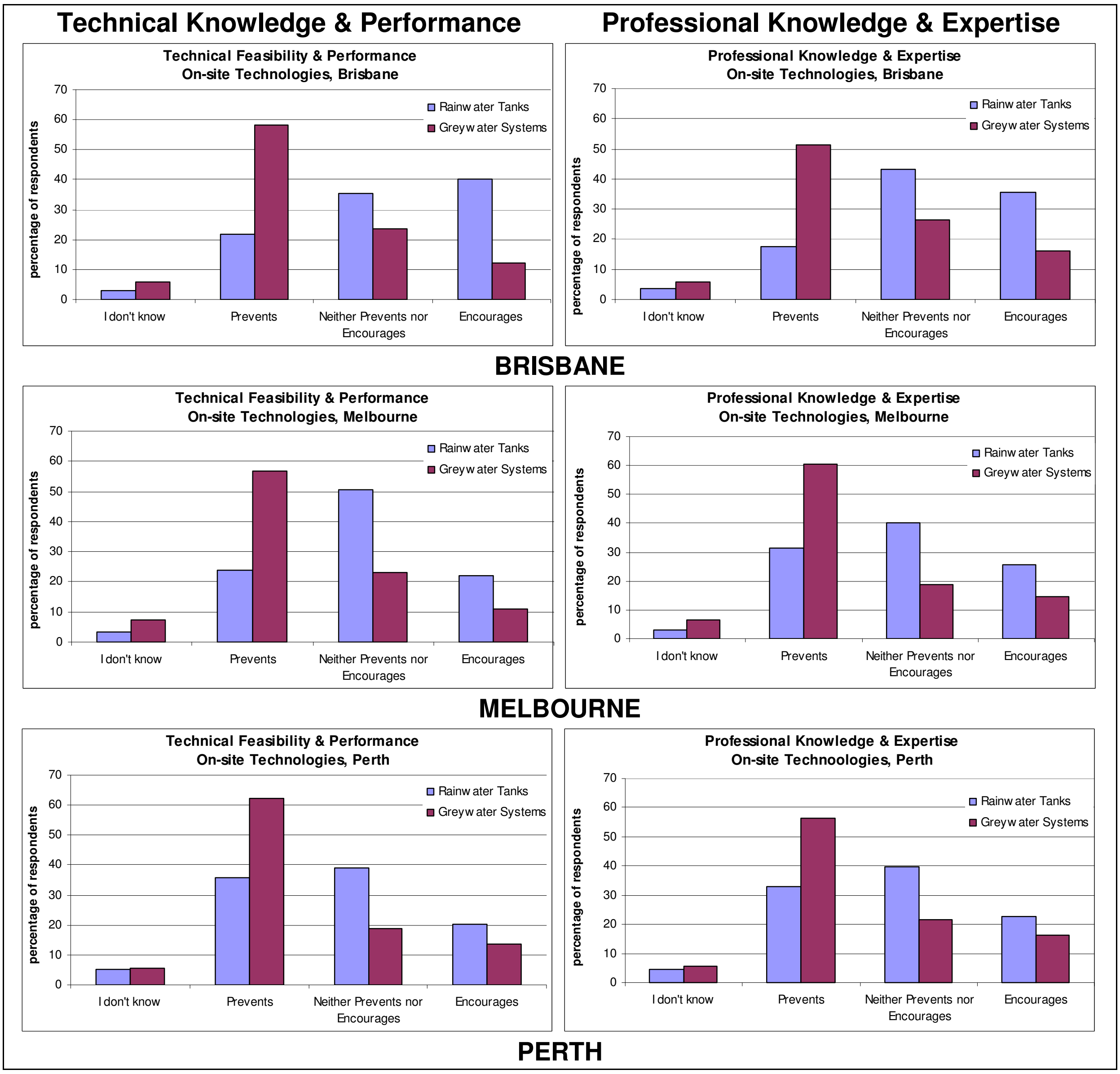


Figure 4.5: Perceived Influence of Technical Feasibility and Performance, along with Professional Knowledge and Expertise, on the Adoption of On-site Technologies

4.4 Management Arrangements and Government Policy

The question on ‘government policy’ was framed the same way for Melbourne and Perth respondents, but not for Brisbane respondents. While still focused on the same technologies, Brisbane respondents were asked to consider the specific influence of federal government, state government and Brisbane City Council’s policy on technology adoption. Melbourne and Perth respondents suggested that government policy does encourage the uptake of rainwater tanks while preventing the adoption of greywater systems (Figure 4.6). Brisbane respondents suggested that all levels of government policy have an influence on rainwater tank adoption, though this is strongest at the state and local levels. In Brisbane respondents indicated that federal government policy has no influence on on-site technology adoption, however a considerable number of respondents did not know what impact federal policy may have (Figure 4.7). For the implementation of on-site greywater systems, state and local government policy was considered, overall, to be a limiting factor (Figure 4.7).

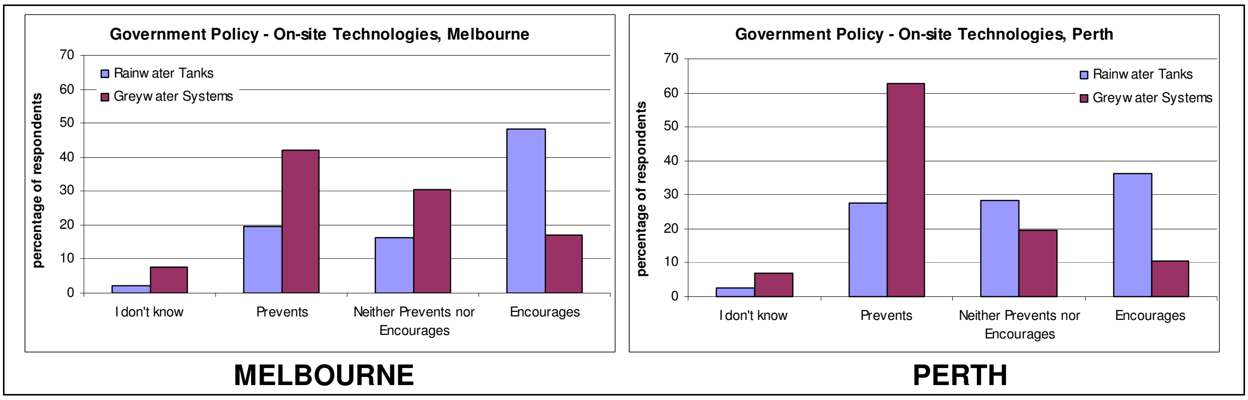


Figure 4.6: Perceived Influence of Government Policy on the Adoption of On-site Technologies in Melbourne and Perth

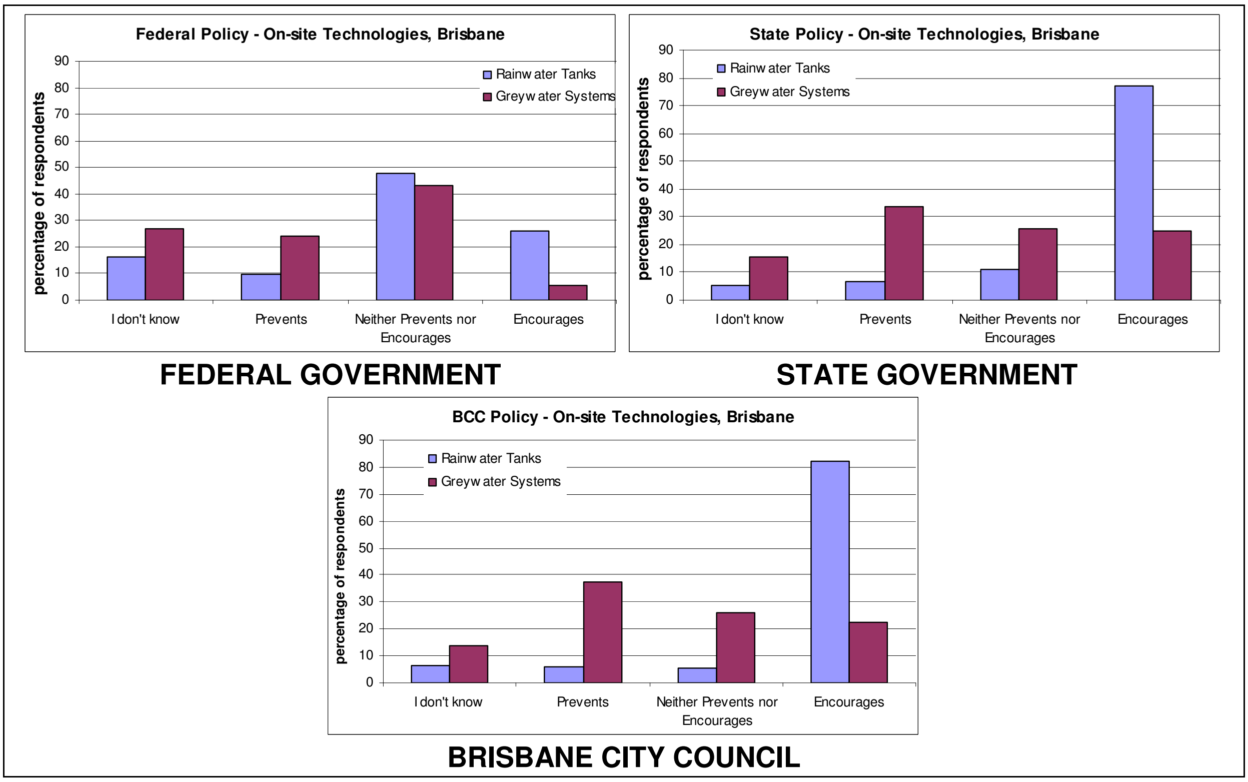


Figure 4.7: Perceived Level of Influence Federal, State, and Local Government Policy on the Adoption On-site Technology in Brisbane

The majority of respondents perceived 'management arrangements and responsibilities' in each of the three cities to have little impact on the adoption of rainwater tanks. Indeed, most professionals consider the factor to be neutral. However, 'management arrangements and responsibilities' were perceived in each state to constrain the adoption of on-site greywater systems (Figure 4.8).

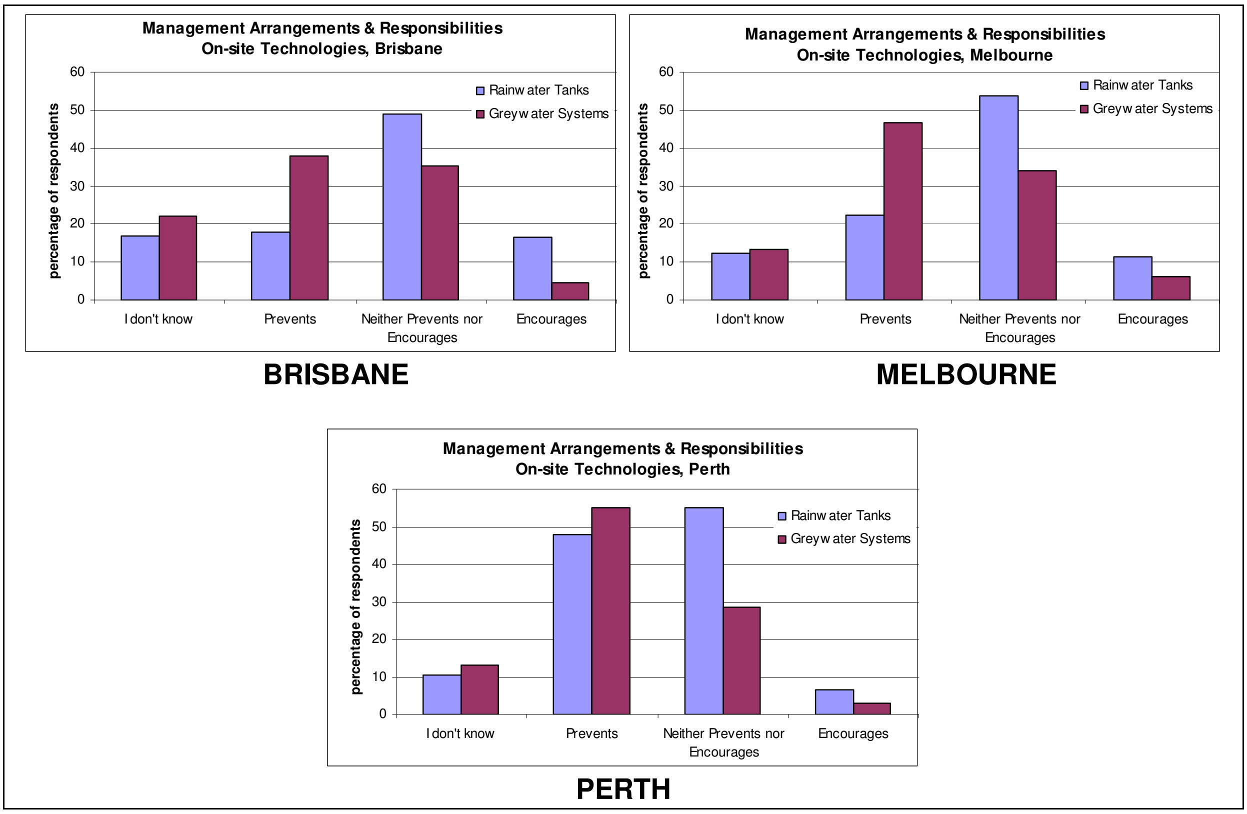


Figure 4.8: **Perceived Influence Management Arrangements and Responsibilities have on the Adoption of On-site Technologies**

4.5 Regulation/Approval Processes and Property Access Rights

In each of the three States, urban water professionals perceived the adoption of rainwater tanks would be slightly impeded by the 'regulation and approvals processes', whereas this factor was identified as an outright barrier to the implementation of on-site greywater systems (64 per cent in Brisbane; 61 per cent in Melbourne and 74 per cent in Perth) (Figure 4.9). Although the majority of respondents identified 'property access rights' as having no direct influence (either positive or negative) for adopting decentralised systems, there was a substantial proportion (approximately 20-25 per cent) of respondents in each state who were unsure ('I don't know') of the impact this factor had on technology implementation (Figure 4.9).

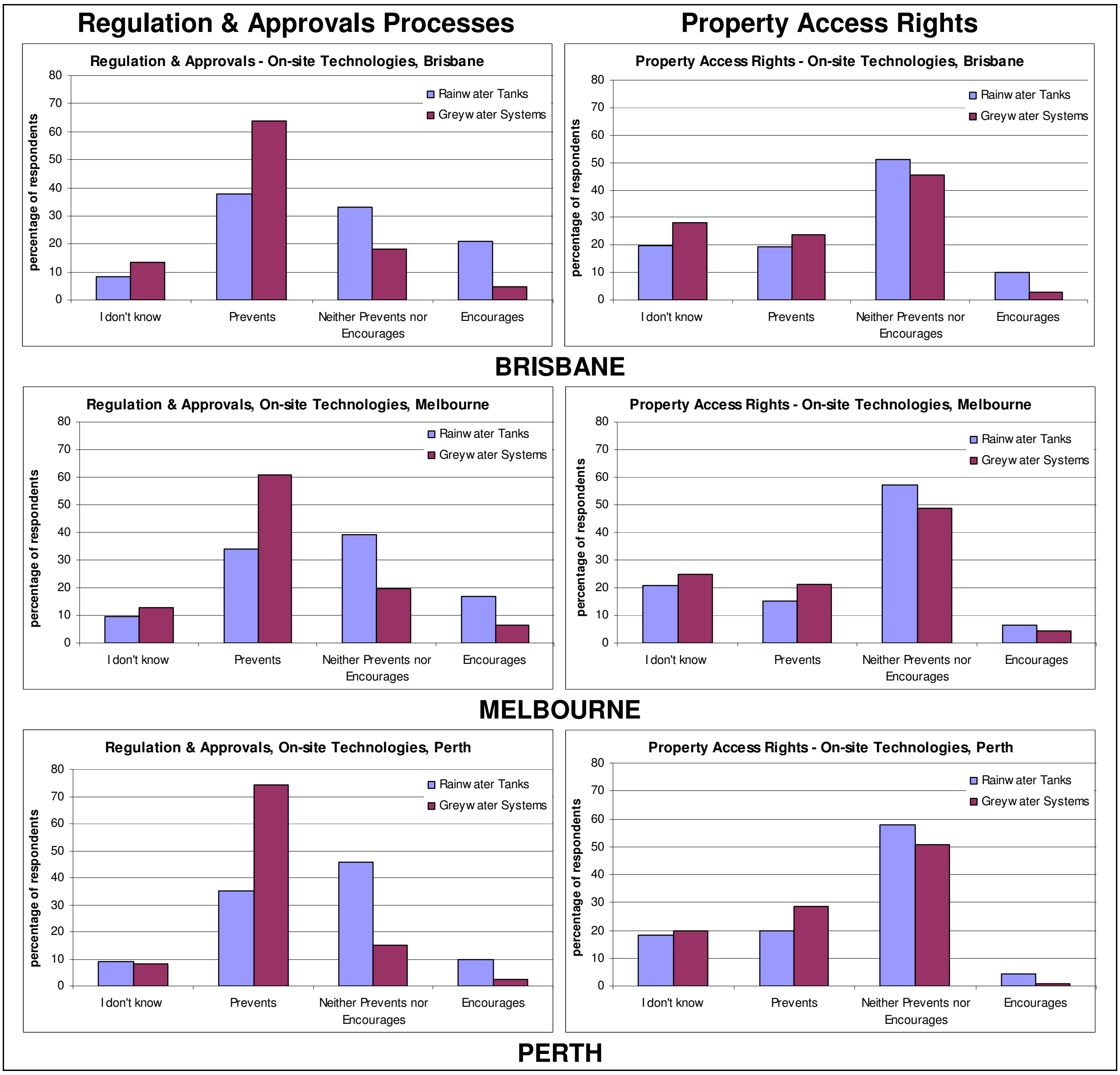


Figure 4.9: Perceived Influence of Regulation and Approvals Processes, along with Property Access Rights on the Adoption of On-site Technologies

4.6 Capital and Maintenance Costs

Urban water professionals in Perth perceived both capital and maintenance costs to inhibit the uptake of rainwater tanks and on-site greywater technologies (Figure 4.10). Melbourne respondents however, suggested that while costs were a limiting factor in the adoption of greywater systems they were less so in rainwater tank implementation. Similarly, Brisbane respondents perceived costs do not influence the adoption of rainwater tanks, but do present a barrier to the adoption of greywater systems (Figure 4.10).

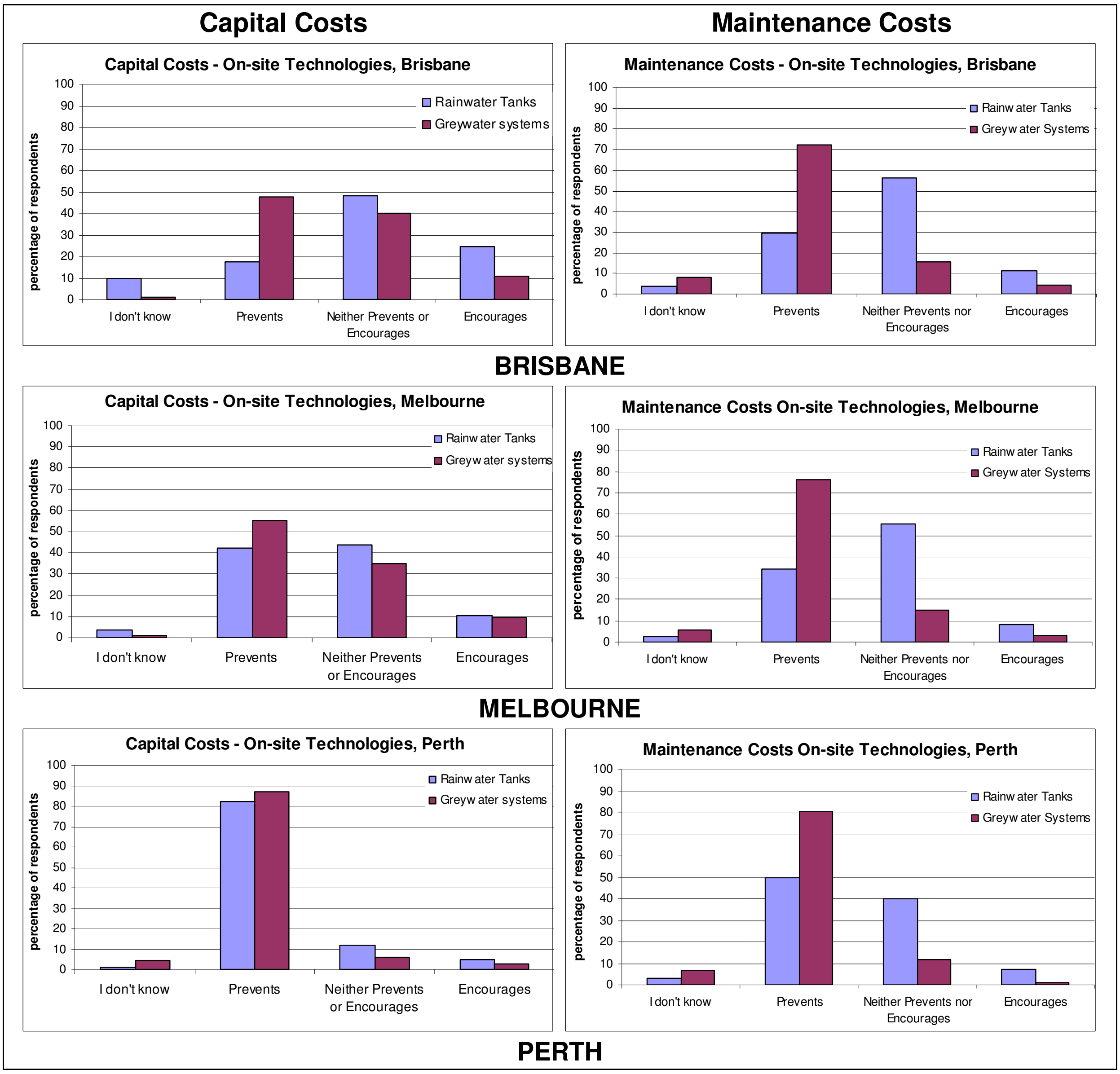


Figure 4.10: Perceived Influence of Capital and Maintenance Costs on the Adoption of On-site Technologies

5.0 Factors Influencing the Uptake of Third-pipe Technologies in Greenfield and Existing areas

Third-pipe systems can help introduce flexibility in water supply options by connecting homes and businesses to an alternative water source to supplement conventional potable supplies, typically recycled water (sewage and/or stormwater). Professional receptivity to implementing precinct-scale technologies was tested through a series of association and acquisition 'influencing' factors. Urban water professionals were asked to consider whether a range of factors influenced the implementation of third-pipe technologies in greenfield and existing areas. Greenfield sites were defined for respondents as 'new urban developments typically located on the periphery of existing metropolitan areas', while existing sites were defined as 'areas within established suburbs of a metropolitan region including housing extensions and building redevelopment'. This Chapter reveals the level of receptivity urban water professionals have to the implementation of third-pipe technologies in Brisbane, Melbourne and Perth.

Respondents were asked to rate the level of influence eleven factors have on adoption of third-pipe technologies based on a scale from I don't know, strongly prevents, slightly prevents, neither prevents nor encourages, slightly encourages to strongly encourages. Raw data tables located in Appendix B.

5.1 Key Findings

The findings revealed that urban water professionals in Brisbane, Melbourne and Perth consider that pursuing the implementation of third-pipe technologies in greenfield development areas was more important than implementation in existing areas. This is further reflected in the level of professional receptivity to third-pipe technologies, which varied amongst the case study cities. Overall, Brisbane and Melbourne urban water professionals were more receptive to third-pipe technologies than Perth professionals. For example, urban water professionals in Melbourne and Brisbane were more inclined to have responses that were equally distributed (i.e. slight barrier, neutral and slight driver).

Association levels were similar in Brisbane, Melbourne and Perth, where 'environmental outcomes' are considered an outright driver. In Melbourne 'community perceptions' were perceived to drive third-pipe development in greenfield areas but not in existing areas, whereas in Brisbane and Perth community perceptions were 'mixed' (equally distributed among barrier, driver and neutral) for greenfield areas and barriers for existing site adoption. Urban water professionals in each city also perceived the 'public health outcomes' to be a barrier.

Generally, the limited number of drivers at the acquisition level reflects a low level of receptivity amongst urban water professionals. Melbourne urban water professionals were the only respondents to identify any acquisition factors as drivers ('professional knowledge' and 'government policy') and even then only in greenfield areas. Indeed, 'management arrangements', 'property access rights' and the impact of 'costs' was considered by respondents in each city to inhibit the adoption of precinct-scale technologies for supplying alternative water sources (Table 5.1). However, Brisbane and Melbourne respondents have slightly higher levels of receptivity than Perth respondents based on the number of ‘mixed signals’ presented in the data, where approximately equal number of professionals perceived an influencing factor encouraged or prevented the adoption of third-pipe technologies (see Table 5.1).

Table 5.1: Drivers and Barriers to the Implementation of Third-pipe Technologies in Greenfield and Existing Areas

Receptivity Matrix Attributes	BRISBANE		MELBOURNE		PERTH	
	Third-pipe		Third-pipe		Third-pipe	
	Greenfield	Existing	Greenfield	Existing	Greenfield	Existing
ASSOCIATION FACTORS						
Community Perceptions	Mixed Driver/ Barrier	Slight Barrier	Driver	Mixed Driver/ Barrier	Mixed Driver/ Barrier	Barrier
Environmental Outcomes	Driver	Driver	Driver	Driver	Driver	Driver
Public Health Outcomes	Barrier	Barrier	Slight Barrier	Barrier	Barrier	Barrier
ACQUISITION FACTORS						
Technical Feasibility & Performance	Mixed Driver/ Barrier	Barrier	Mixed Driver / Barrier	Slight Barrier	Barrier	Barrier
Professional Knowledge & Expertise	Mixed Driver / Barrier	Slight Barrier	Slight Driver	Slight Barrier	Barrier	Barrier
Government Policy	Mixed Driver / Barrier	Slight Barrier	Slight Driver	Barrier	Barrier	Barrier
Mgt Arrangements & Responsibilities	Barrier	Barrier	Slight Barrier	Barrier	Barrier	Barrier
Regulation & Approvals Processes	Neutral	Barrier	Neutral	Barrier	Neutral	Barrier
Property Access Rights	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier
Capital Costs	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier
Maintenance Costs	Barrier	Barrier	Barrier	Barrier	Barrier	Barrier

* Brisbane responses only refer to local government, Brisbane City Council’s policies

Barrier Majority > 25%	**Slight Barrier** Majority >10%<24%	**Mixed** <10% difference, Driver & Barrier	**Slight Driver** Majority >10%<24%	**Driver** Majority > 25%	**Neutral** (N) Receptivity factor not important

5.2 Perceived Importance and Association Factors

Respondents were asked to identify the importance they placed on pursuing the development of third-pipe technologies for providing recycled water to greenfield and existing development areas. Third-pipe systems were clearly rated as more important for development in greenfield sites over existing areas (Figure 5.1). For example, over 24 per cent of Melbourne and Brisbane respondents considered building third-pipe systems for stormwater and sewage were of low importance in existing areas (Appendix B).

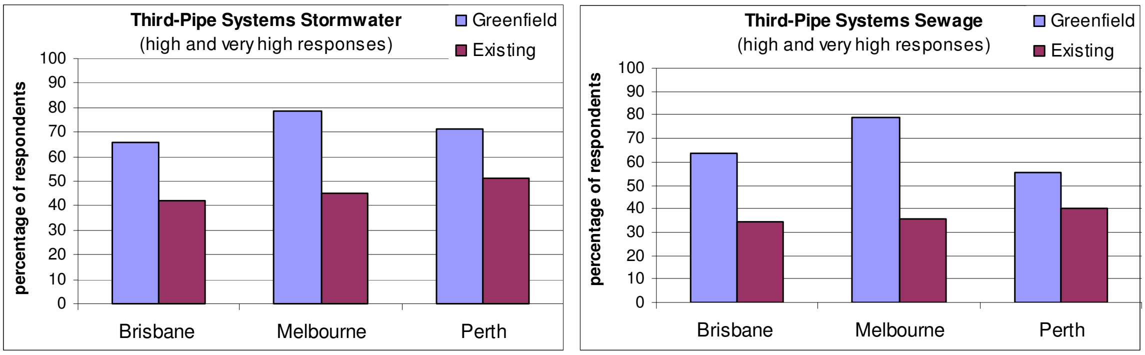


Figure 5.1: **The Importance of Implementing Third-pipe Technologies for Future Water Sources to Greenfield and Existing Areas in Brisbane, Melbourne and Perth**
These graphs depict the combined totals of respondents who identified these technologies were of high and very high importance.

There were no significant differences among viewpoints regarding the importance of pursuing third-pipe systems when comparing local government respondents against developers and consultants' opinions on sewage. However, in regard to third-pipe systems, Melbourne-based developers and consultants were more likely to suggest third-pipe systems were of higher importance in greenfield sites (60.6 per cent) than for existing areas. In general, local government respondents were more supportive and considered pursuing third-pipe systems in greenfield and existing areas as important. While a similar trend was exhibited in Perth, the respondents from local government were more conservative; indicating third-pipes in existing areas were of average importance.

'Community perceptions' were regarded by urban water professionals in Brisbane, Melbourne and Perth as encouraging the uptake of third-pipe systems in greenfield areas (Figure 5.2). However, in existing site re/development, 'community perceptions' were regarded as a limiting factor in Brisbane and Perth and to a lesser degree in Melbourne (Figure 5.2). Similarly, environmental outcomes were perceived to encourage the adoption of third-pipe systems in both greenfield and existing areas (Figure 5.3). However, almost 12 per cent of respondents in Brisbane and Perth did not know what impact environmental outcomes would have on implementing third-pipe technologies.

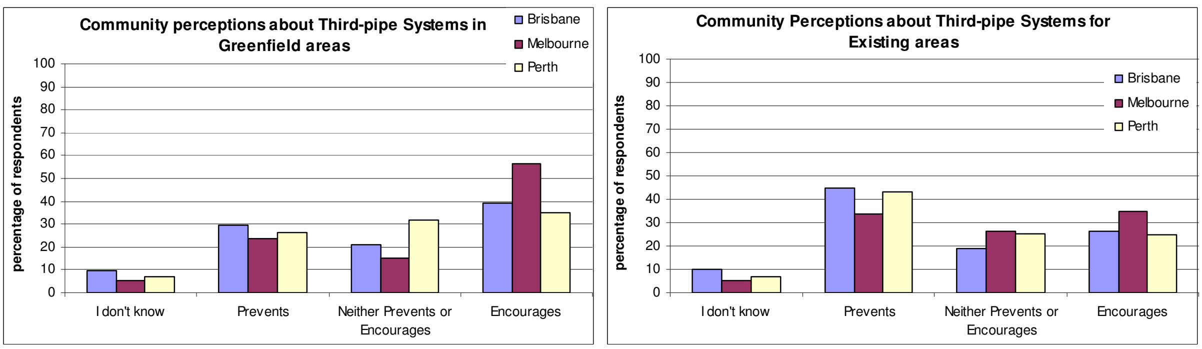


Figure 5.2: **Community Perceptions Influence on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas**

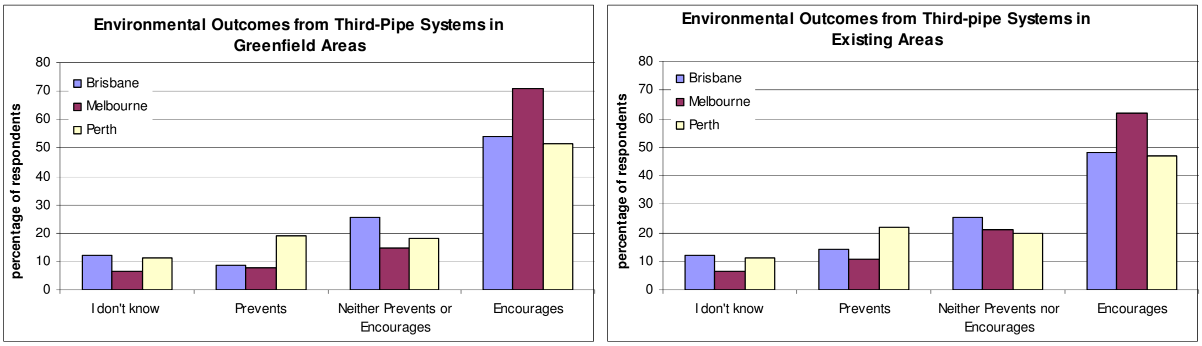


Figure 5.3: Environmental Outcomes Influence on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas

A pattern similar to on-site technologies emerges, where third-pipe systems in both greenfield and existing areas in Brisbane, Melbourne and Perth were considered to be limited by 'public health outcomes' (Figure 5.4). For example, over 40 per cent of respondents in Brisbane and Melbourne, and over 50 per cent of respondents in Perth perceived there to be potential public health risks in adopting third-pipe technologies.

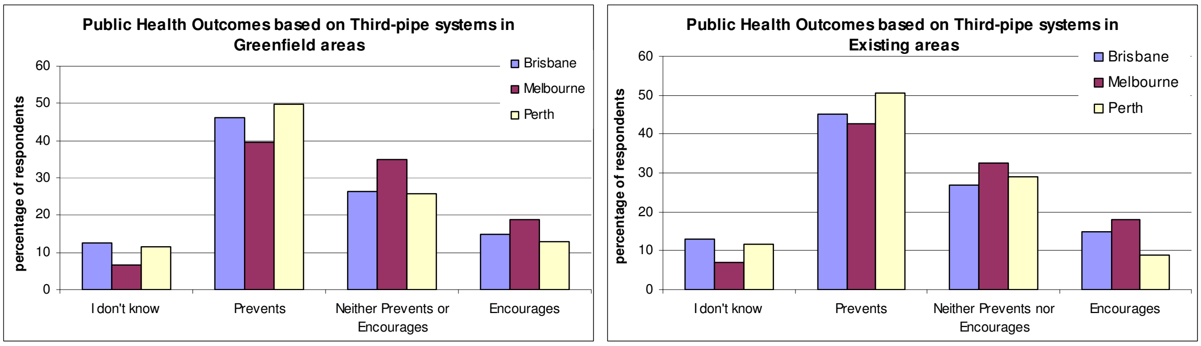


Figure 5.4: Public Health Outcomes Influence on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas

5.3 Technical Feasibility and Professional Knowledge

Perth urban water professionals considered 'technical feasibility and performance' to be a limiting factor in greenfield and existing areas. While in Melbourne, 34 per cent of respondents considered 'technical feasibility and performance' neither prevented nor encouraged third-pipes in greenfield sites; indeed a similar percentage of respondents claimed this factor both prevented and encouraged adoption (28 percent negative; 30 per cent positive respectively). Brisbane responses were similarly distributed; although, overall the majority considered 'technical feasibility and performance' limited third-pipe system implementation in greenfield sites. On the contrary, over 50 per cent of respondents in Brisbane, Melbourne and Perth considered that the factor 'technical feasibility and performance' was an outright barrier for third-pipe systems adoption in existing areas (Figure 5.5).

Brisbane urban water professionals perceived that industry-based 'professional knowledge and expertise' equally encouraged and prevented the adoption of third-pipe systems in both greenfield and existing development sites (Figure 5.5). Conversely, Perth professionals perceived this factor to be an outright barrier for both development areas (greenfield and existing). Melbourne urban water professionals highlighted that 'professional knowledge and expertise' encouraged third-pipe system adoption in greenfield sites, but prevented implementation in existing areas (Figure 5.5).

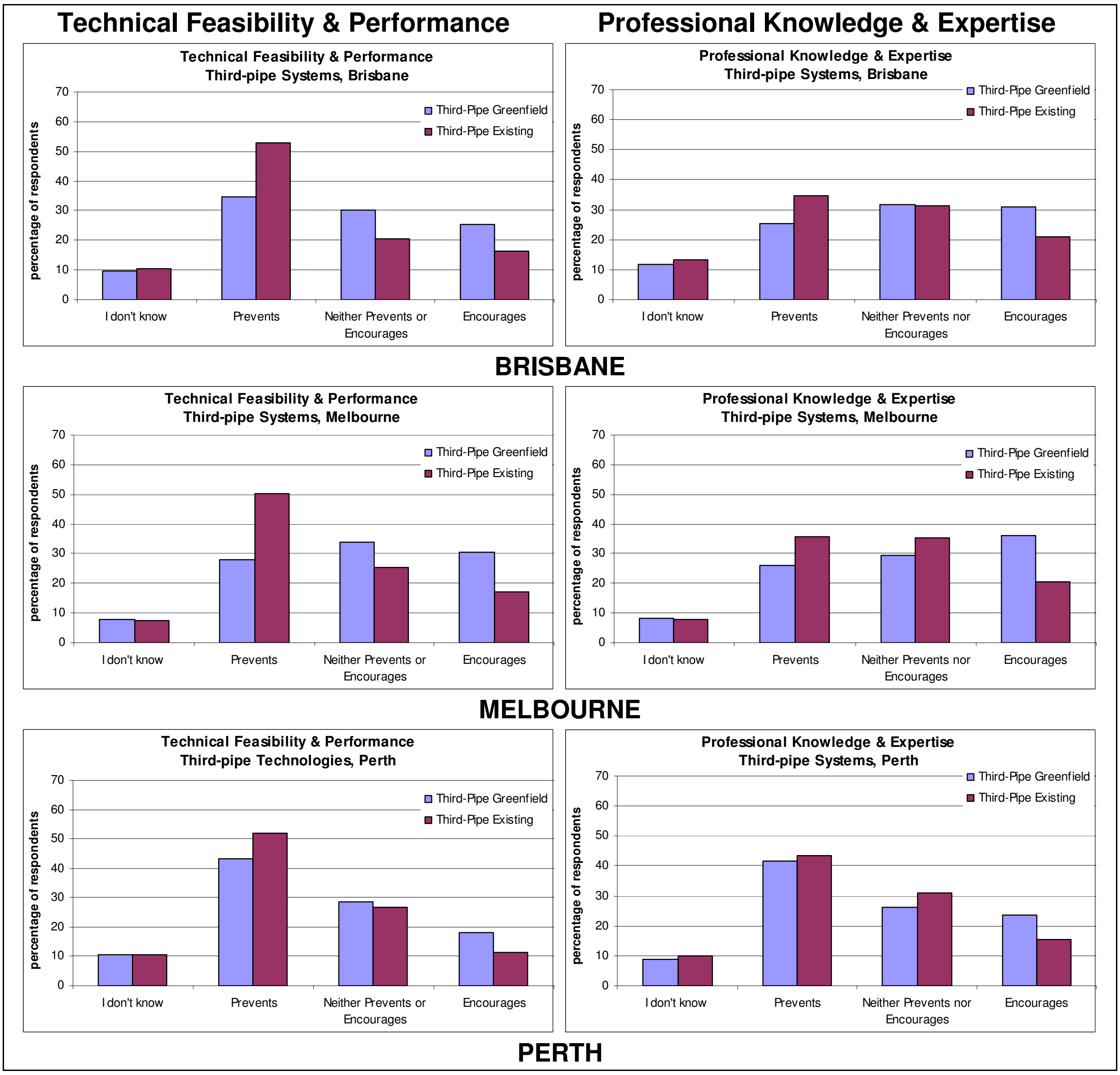


Figure 5.5: Perceived Influence of Technical Feasibility and Performance, along with Professional Knowledge and Expertise on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas

5.4 Government Policy and Management Arrangements

A substantial proportion of urban water professionals in each case study city did not know how 'management arrangements and responsibilities' influenced the adoption of third-pipe systems in greenfield and existing sites (between 24 to 26 per cent of respondents in Brisbane and 13 to 16 per cent in Perth and Melbourne). Furthermore, many respondents did not consider 'management arrangements' as an influencing factor on third-pipe adoption (Figure 5.6). Generally, when directly comparing responses within cities, more respondents identified 'management arrangements and responsibilities' prevent the adoption of third-pipe systems in both greenfield and existing areas (particularly in Perth) (Figure 5.6).

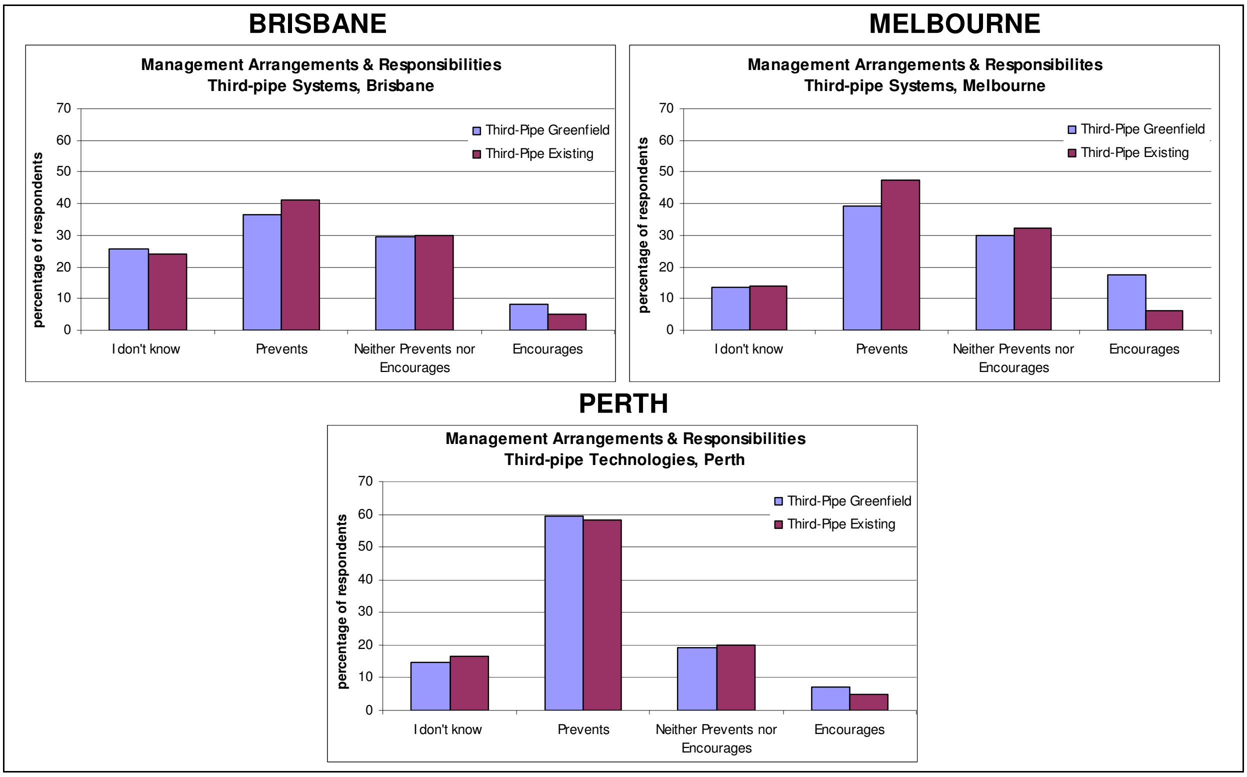


Figure 5.6: Perceived Influence of Management Arrangements and Responsibilities on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas

Government policy was considered a limiting factor by over 50 per cent of Perth respondents for the adoption of third-pipe systems in greenfield and existing areas. Conversely, 47 per cent of Melbourne respondents considered 'government policy' encourages uptake, but only in greenfield areas, whereas 43 per cent of professionals perceived implementation in existing areas was limited by policy (Figure 5.7).

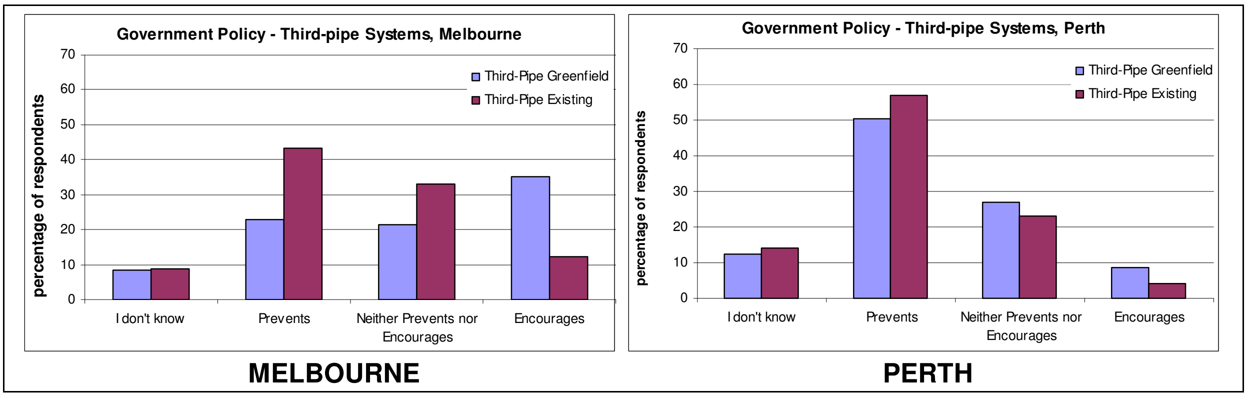


Figure 5.7: Perceived Influence of Government Policy on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas of Melbourne and Perth

An equal number of Brisbane respondents suggested that they either 'did not know' how federal government policy impacted adoption, while others perceived federal policy as 'neutral' (no direct influence) for both greenfield and existing sites (Figure 5.8). Similar results were also identified at the state policy level (Figure 5.8). No clear trend was exhibited amongst respondents regarding the influence of Brisbane City Council's policy, although policy was considered to be slightly preventative for adoption in existing areas (Figure 5.8).

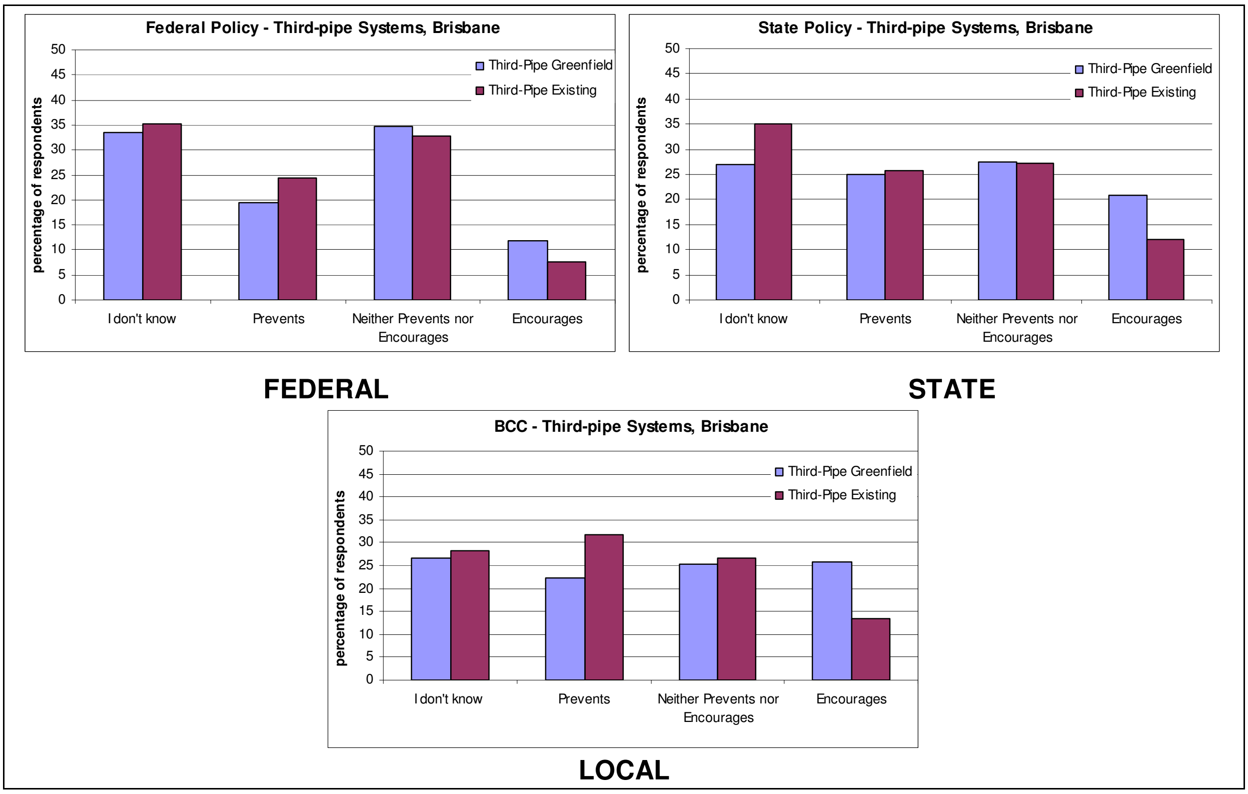


Figure 5.8: Perceived Influence of Federal, State and Local Government Policy on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas of Brisbane

5.5 Regulation/Approval Processes and Property Access Rights

Implementation of third-pipe systems in greenfield development areas in Brisbane, Melbourne and Perth was perceived to be neither encouraged nor prevented by the 'regulation and approvals processes'. On the other hand, in each city, the majority of respondents identified 'regulation and approvals processes' inhibited the uptake of third-pipe technologies in existing areas (Figure 5.9). Despite this trend, a substantial proportion of urban water professionals did not know how 'regulations and approvals' may impact third-pipe implementation.

Data were analysed to determine any differences amongst organisations with a 'stake' in water management and organisations with a 'focus' in water management (see Section 2.2). The only significant difference was in Melbourne, where organisations with a 'stake' were more negative about 'regulation and approvals processes' for greenfield sites than respondents with a 'focus' in water management. Furthermore, approximately 50 per cent of respondents from an organisation with a 'focus' on water management, indicated they perceived 'regulation and approval processes' as a limiting factor to third-pipe systems in existing areas.

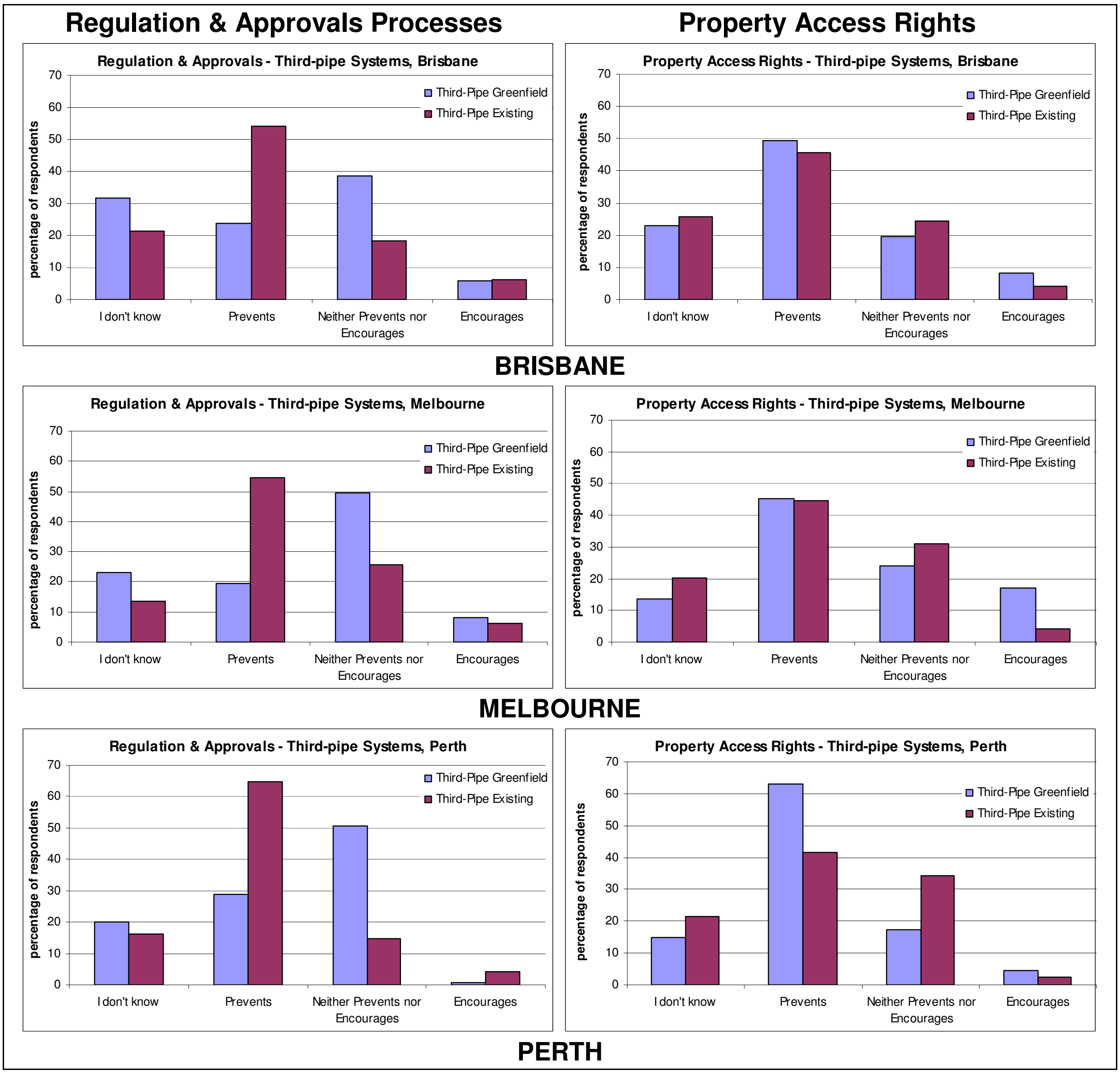


Figure 5.9: Perceived Influence of Regulation and Approvals Processes, along with Property Access Rights on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas

In contrast to on-site technology adoption (Section 4.5), 'property access rights' were perceived to constrain the adoption of third-pipe systems in both greenfield and existing areas (Figure 5.9). However, across all three cities, this does vary. For example, in Melbourne, respondents considered 'property access rights' constrained adoption in both greenfield and existing sites, while in Perth and Brisbane, respondents identified greenfield sites were impacted upon more by 'property access rights' than existing areas (Figure 5.9).

5.6 Capital and Maintenance Costs

The influence of capital and maintenance costs was perceived to prevent technology adoption in greenfield and existing areas, in each case study city (Figure 5.10). In Brisbane, almost 30 per cent of urban water professionals did not know how costs might impact third-pipe implementation in existing areas (Figure 5.10). Upon further analysis, it was revealed those individuals with limited experience in the industry (0-1 years) and who hold junior positions are less likely to consider capital costs as a preventative factor. We found the more experienced and more senior a respondent, the more likely the individual considered capital costs as a preventative factor. However, respondents in executive positions were less inclined to identify capital costs as preventative.

Stakeholder groups provided similar responses regarding the impact of costs on technology adoption, although, in Perth, the Water Corporation were more inclined to identify maintenance costs as a preventative factor than other water businesses in Melbourne or Brisbane. Interestingly, there was a significant difference between respondents with varying professional backgrounds. A respondent with a planning/humanities/urban design background was least likely to consider capital or maintenance costs as a limiting factor, whereas a respondent with an engineering/science background/training was most likely to consider costs as prohibitive.

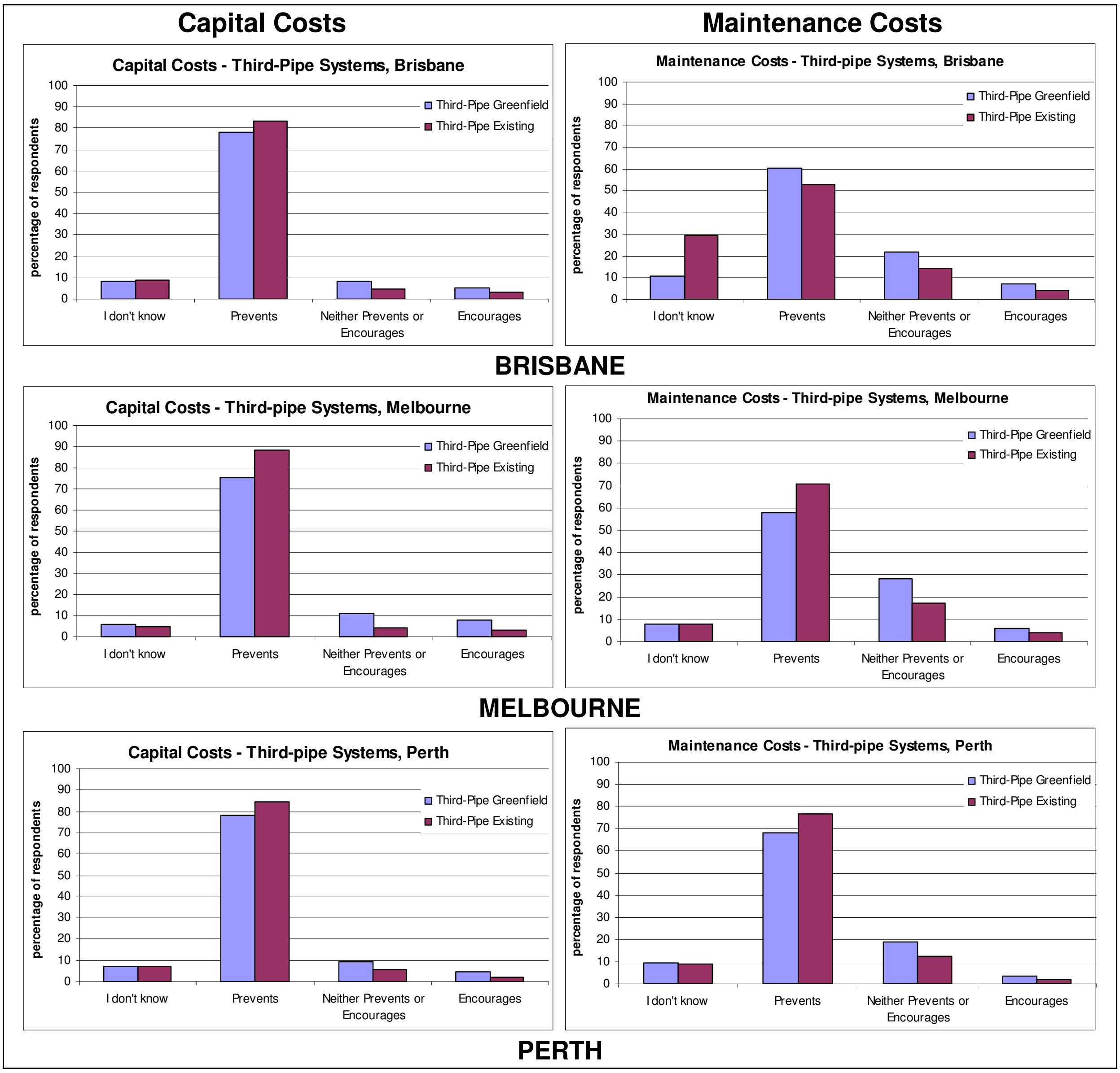


Figure 5.10: Perceived Influence of Capital and Maintenance Costs on the Adoption of Third-pipe Technologies in Greenfield and Existing Areas

6.0 Factors Influencing the Uptake of Indirect and Direct Potable Reuse Schemes

Schemes for providing alternative water sources at a regional scale include indirect and direct potable reuse. Indirect potable reuse requires the addition of treated wastewater to conventional water storage systems to supplement supplies, whereas direct potable reuse involves treating wastewater to a potable standard and supplying this directly, without addition to an existing water storage body. Urban water professionals were asked to rate eleven potentially influencing factors to test their level of receptivity to developing these technologies as regional-scale, centralised systems.

Respondents were asked to rate the influence of these factors based on the following scale: I don't know, strongly prevents, slightly prevents, neither prevents or encourages, slightly encourages and strongly encourages. First, the key findings are summarised, highlighting the overall level of professional receptivity to indirect and direct potable reuse and then the detailed findings in relation to each influencing factor are presented.

6.1 Key Findings: Drivers and Barriers

Although urban water professionals in Brisbane, Melbourne and Perth recognise the importance of pursuing both indirect and direct potable reuse schemes, there remain significant barriers to their implementation. Similar to the levels of professional receptivity for third-pipe systems, urban water professionals in Brisbane, Melbourne and Perth demonstrated low levels of receptivity to both indirect and direct potable reuse schemes.

Urban water professionals in Brisbane Melbourne and Perth associate with the 'environmental outcomes' that can result from pursuing centralised options, but also perceive that 'community perceptions' and 'public health outcomes' inhibit their application. At an acquisition level, Brisbane and Melbourne respondents are further ahead than Perth respondents, particularly regarding the factors of 'technical feasibility and performance' and 'professional knowledge and expertise' (Table 6.1). Indeed, professionals in Brisbane considered these two factors were drivers for indirect potable reuse development and in Melbourne there were 'mixed signals' with responses equally distributed between slight barrier, neutral and slight driver.

Outright barriers to advancing the adoption of centralised technologies such as indirect and direct potable reuse schemes included 'management arrangements and responsibilities', 'regulation and approvals processes', 'capital' and 'maintenance' costs (Table 6.1). Interestingly, a large proportion of urban water professionals also suggested they did not know what influence certain factors could have on the adoption of reuse technologies.

Table 6.1: Barriers and Drivers to the Implementation of Indirect/Direct Potable Reuse Schemes

Receptivity Matrix Attributes	BRISBANE		MELBOURNE		PERTH	
	Potable Reuse		Potable Reuse		Potable Reuse	
	Indirect	Direct	Indirect	Direct	Indirect	Direct
ASSOCIATION FACTORS						
Community Perceptions	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**
Environmental Outcomes	**Driver**	**Driver**	**Driver**	**Driver**	**Mixed Driver / Barrier**	**Mixed Driver / Barrier**
Public Health Outcomes	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**
ACQUISITION FACTORS						
Technical Feasibility & Performance	**Slight Driver**	**Slight Barrier**	**Mixed Driver / Barrier**	**Mixed Driver / Barrier**	**Slight Barrier**	**Slight Barrier**
Professional Knowledge & Expertise	**Driver**	**Mixed Driver / Barrier**	**Mixed Driver / Barrier**	**Mixed Driver / Barrier**	**Slight Barrier**	**Slight Barrier**
Government Policy	**Mixed Driver / Barrier ***	**Barrier***	**Barrier**	**Neutral**	**Barrier**	**Neutral**
Mgt Arrangements & Responsibilities	**Slight Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**
Regulation & Approvals Processes	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**
Property Access Rights	**Neutral**	**Neutral**	**Neutral**	**Neutral**	**Neutral**	**Neutral**
Capital Costs	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**
Maintenance Costs	**Slight Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**	**Barrier**
* responses only refer to Brisbane City Council's policies (local government)						

Barrier Majority > 25%	**Slight Barrier** Majority >10%<24%	**Mixed** <10% difference, Driver & Barrier	**Slight Driver** Majority >10%<24%	**Driver** Majority > 25%	**Neutral** (N) Receptivity factor not important

6.2 Perceived Importance and Outcome Factors

Respondents were asked to identify the importance they placed on pursuing indirect and direct potable reuse schemes for supplementing conventional water supplies in Greenfield and Existing areas. Indirect potable reuse was considered a more important technology option than direct potable reuse for both Greenfield and Existing sites in Brisbane, Melbourne and Perth (Figure 6.1).

'Community perceptions' were considered an outright barrier to the adoption of indirect and direct potable reuse schemes in Brisbane, Melbourne and Perth (Figure 6.2). Conversely, the achievement of 'environmental outcomes' by adopting indirect and direct potable reuse schemes was perceived as an encouraging factor in adopting the centralised option in Brisbane and Melbourne and a 'mixed signal' in Perth (Figure 6.3).

Urban water professional respondents clearly perceive that 'public health outcomes' remain an obstacle in the adoption of both indirect and direct potable reuse schemes (Figure 6.4).

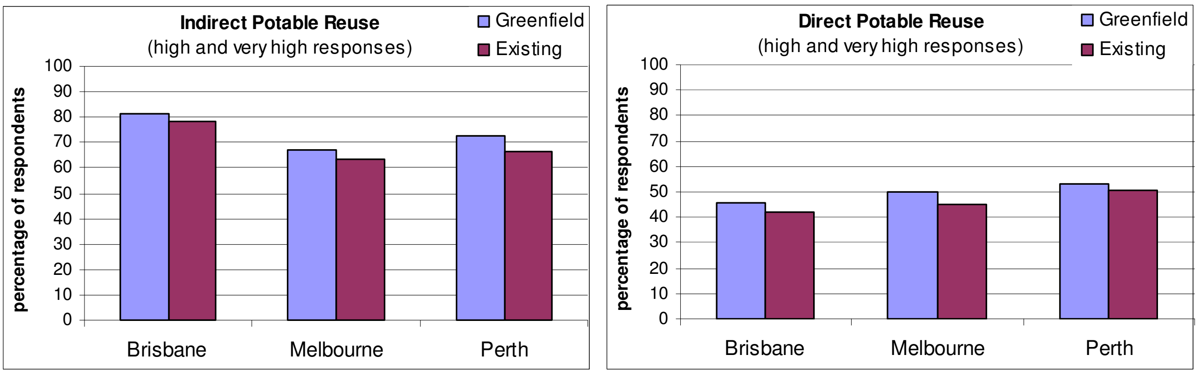


Figure 6.1: The Importance of Implementing Indirect and Direct Potable Reuse Schemes for Future Water Sources to Greenfield and Existing Areas of Brisbane, Melbourne and Perth

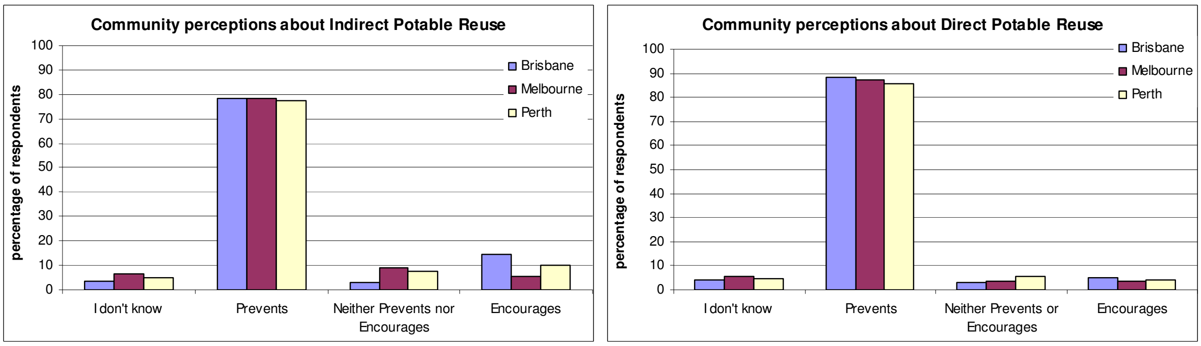


Figure 6.2: Community Perceptions Influence on the Adoption of Indirect and Direct Potable Reuse Schemes

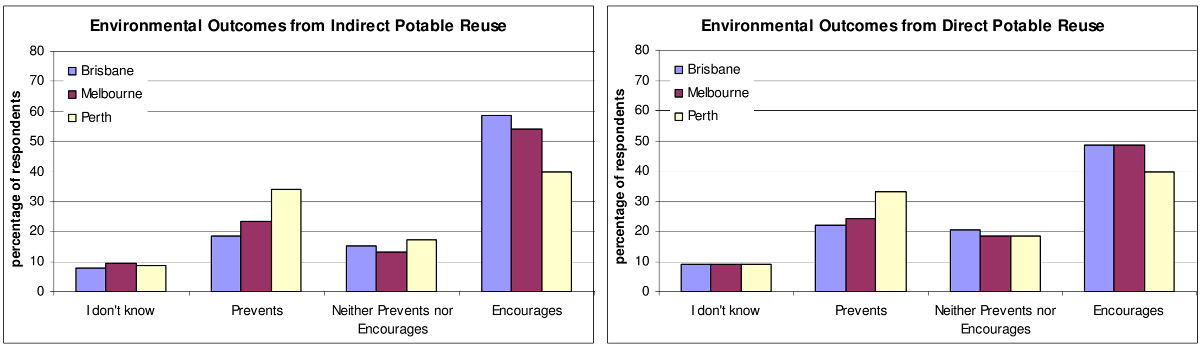


Figure 6.3: Environmental Outcomes Influence on the Adoption of Indirect and Direct Potable Reuse Schemes

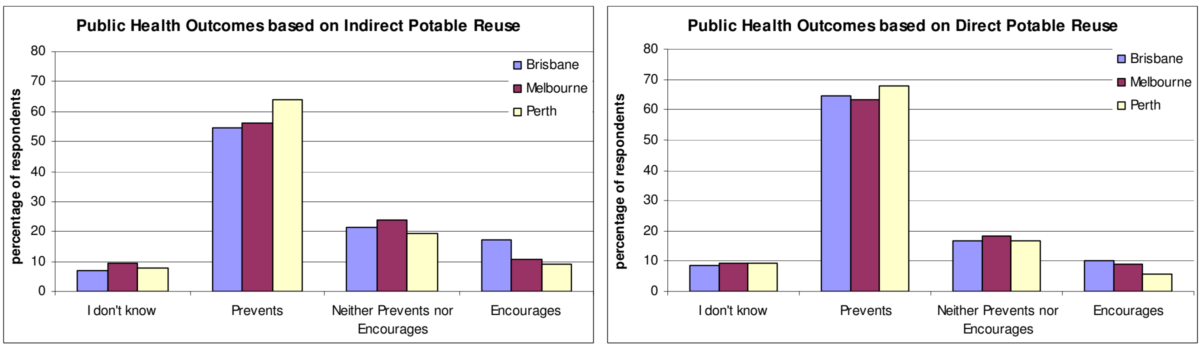


Figure 6.4: Public Health Outcomes Influence on the Adoption of Indirect and Direct Potable Reuse Schemes

6.3 *Technical Feasibility and Professional Knowledge*

Brisbane respondents clearly perceived that current ‘technical feasibility and expertise’ exists for indirect potable reuse but not for direct potable reuse schemes (Figure 6.5), whereas in Melbourne, the views provided a ‘mixed signal’, evenly distributed between barrier and driver. Similar results were also identified in Melbourne and Brisbane regarding the perceived influence of the industry’s level of ‘professional knowledge and expertise’ on adopting indirect and direct potable schemes. Conversely, professional respondents from Perth considered these two factors, along with the majority of acquisition factors, as a barrier to implementing these two centralised reuse operations (Figure 6.5).

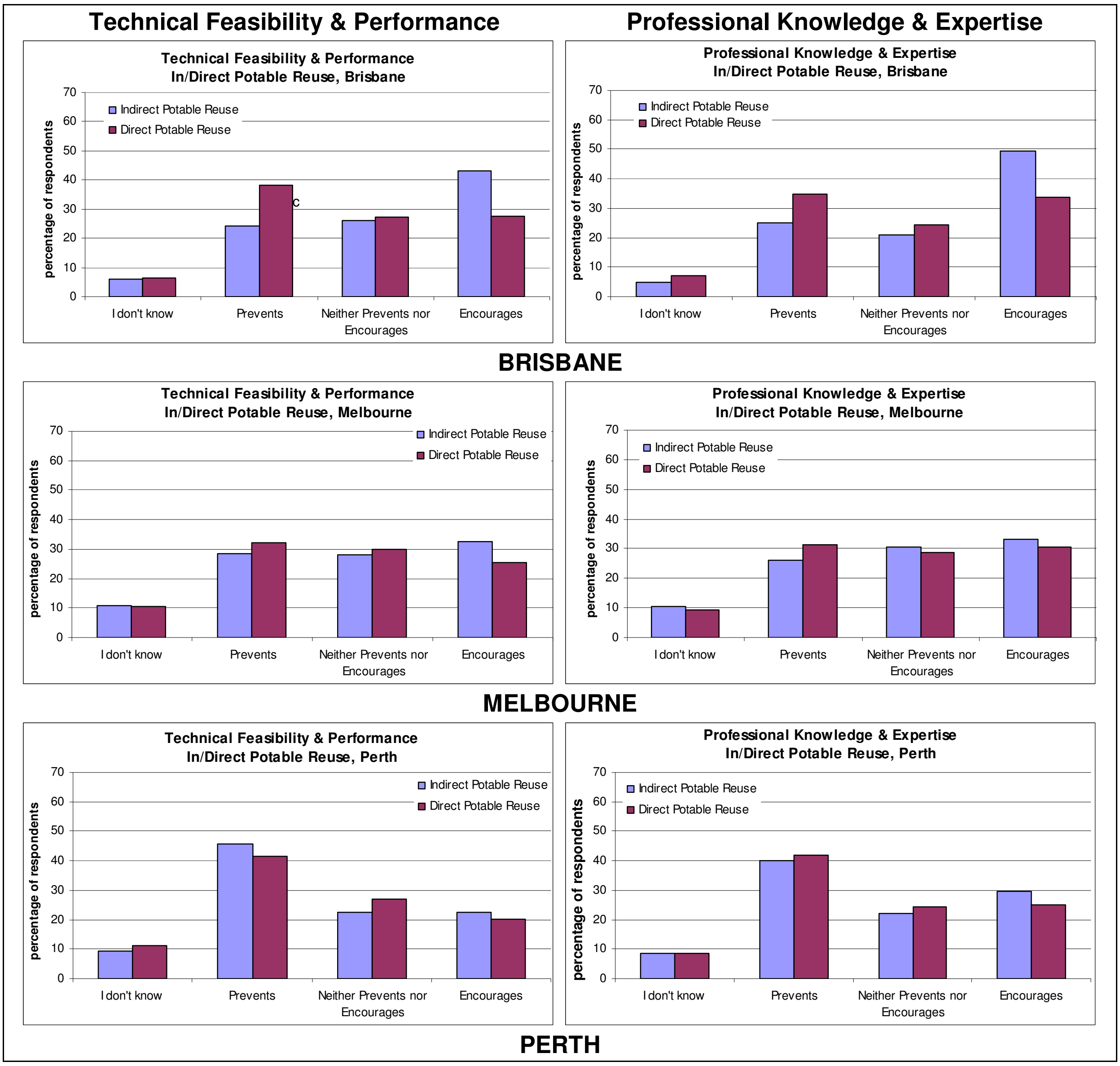


Figure 6.5: Perceived Influence of Technical Feasibility and Performance along with Professional Knowledge and Expertise on the Adoption of Indirect and Direct Potable Reuse Schemes

6.4 Government Policy and Management Arrangements

'Management arrangements and responsibilities' were perceived by urban water professionals in Brisbane, Melbourne and Perth to inhibit the development of both indirect and direct potable reuse schemes. However, in Brisbane, respondents were equally divided between a negative impact and no impact for indirect potable reuse (Figure 6.6). Once again, there were a large proportion of respondents who did not know how this factor could impact on technology adoption, for example, in Brisbane, 18 per cent and 20 per cent of respondents for indirect and direct potable reuse respectively. Melbourne and Perth urban water professionals were clearer in their responses, with the majority indicating that 'management arrangements and responsibilities' in each State inhibited the implementation of indirect and direct potable reuse; over 55 per cent of respondents in Perth and over 42 per cent in Melbourne (Figure 6.6).

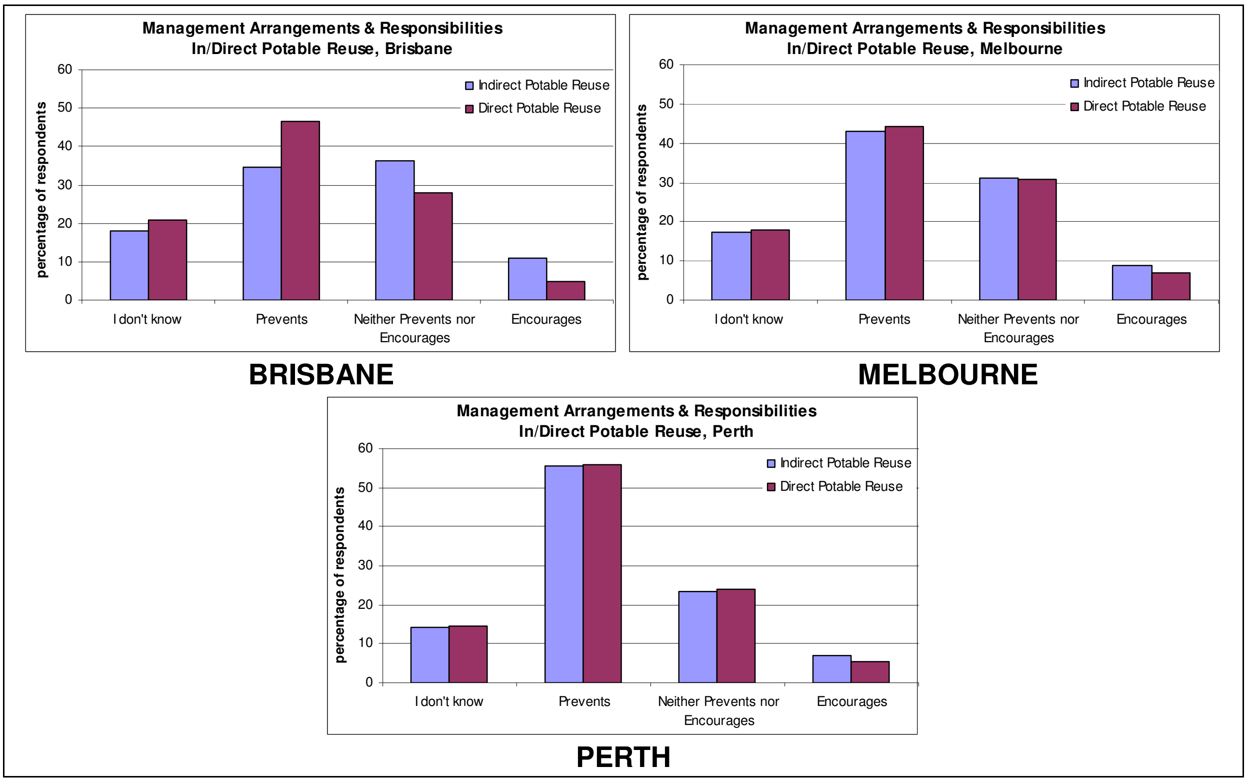


Figure 6.6: Perceived Influence of Management Arrangements and Responsibilities on the Adoption of Indirect and Direct Potable Reuse Schemes

'Government policy' was also considered a limiting factor for indirect potable reuse implementation in Melbourne and Perth (Figure 6.7). In contrast, the majority of Melbourne and Perth respondents believed direct potable reuse implementation was neither encouraged nor limited by 'government policy', although a large proportion of respondents indicated they 'didn't know' (Figure 6.7). Similarly, in Brisbane, a substantial proportion of respondents (between 15 and 25 per cent), across the three levels (federal, state and local) did not know how 'government policy' might influence the adoption of either direct or indirect potable reuse (Figure 6.8). Overall, Brisbane respondents indicated that indirect and direct potable reuse adoption was constrained by federal and state policy. Although Brisbane City Council's policy (local government) was considered an encouraging factor (29.4 per cent of respondents) for indirect potable reuse implementation, the overall response suggests an even distribution (mixed signal). Conversely, local policy was considered to limit the introduction of direct potable reuse (Figure 6.8).

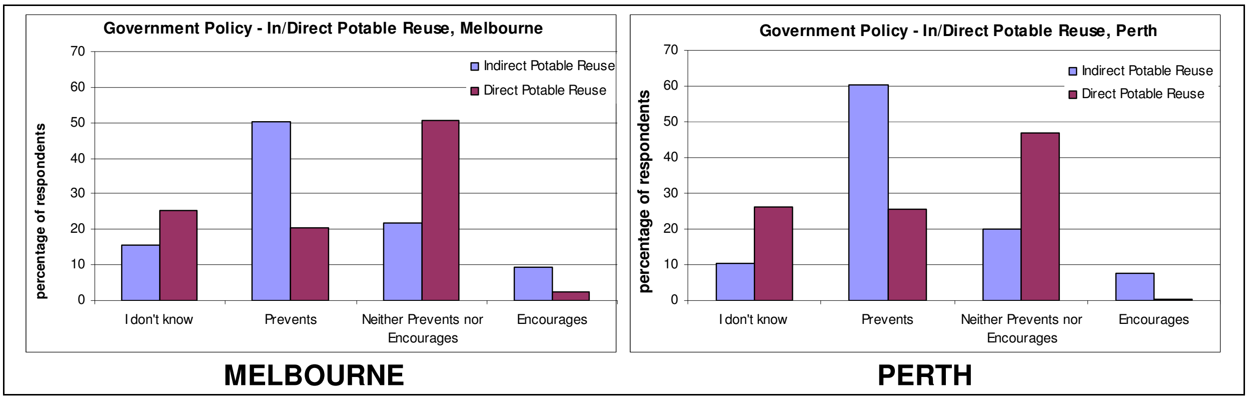


Figure 6.7: Perceived Influence of Government Policy on the Adoption of Indirect and Direct Potable Reuse Schemes in Melbourne and Perth

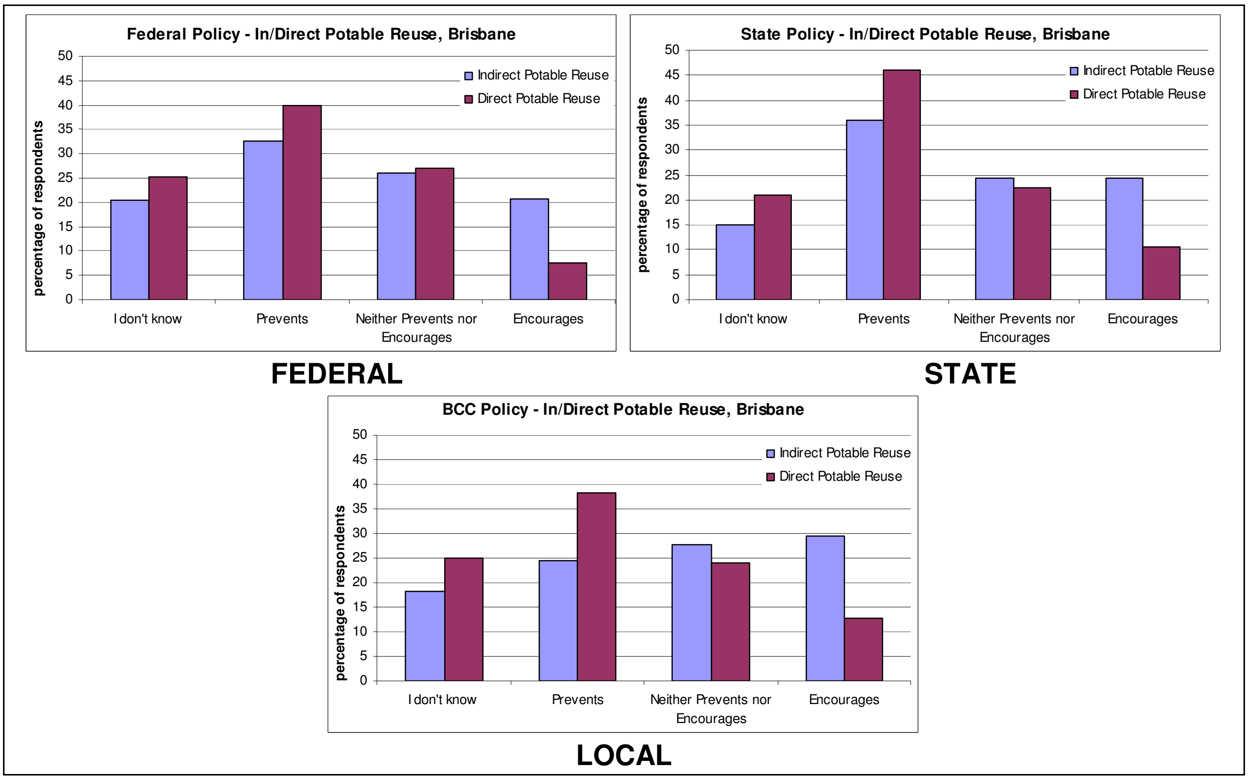


Figure 6.8: Perceived Influence of Federal, State and Local Policy on the Adoption of Indirect and Direct Potable Reuse Schemes in Brisbane.

6.5 Regulation/Approval Processes and Property Access Rights

Brisbane, Melbourne and Perth urban water professionals suggested that ‘property access rights’ did not influence the potential development/implementation of either indirect or direct potable reuse schemes (Figure 6.9). Conversely, ‘regulation and approvals processes’ was considered an outright barrier for both indirect and direct potable reuse, with over 50 per cent of respondents in Brisbane and Melbourne and over 68 per cent of respondents in Perth perceiving this to inhibit technology adoption.

Figure 6.9: Perceived Influence of Regulation and Approvals Processes along with Property Access Rights on the Adoption of Indirect and Direct Potable Reuse Schemes

6.6 Capital and Maintenance Costs

As Figure 6.10 demonstrates, capital and maintenance costs were considered limiting factors in the implementation of indirect and direct potable reuse schemes. However, a considerable number of respondents in each city perceived that maintenance costs (and to a lesser extent capital costs) neither encouraged nor prevented the adoption of these centralised systems.

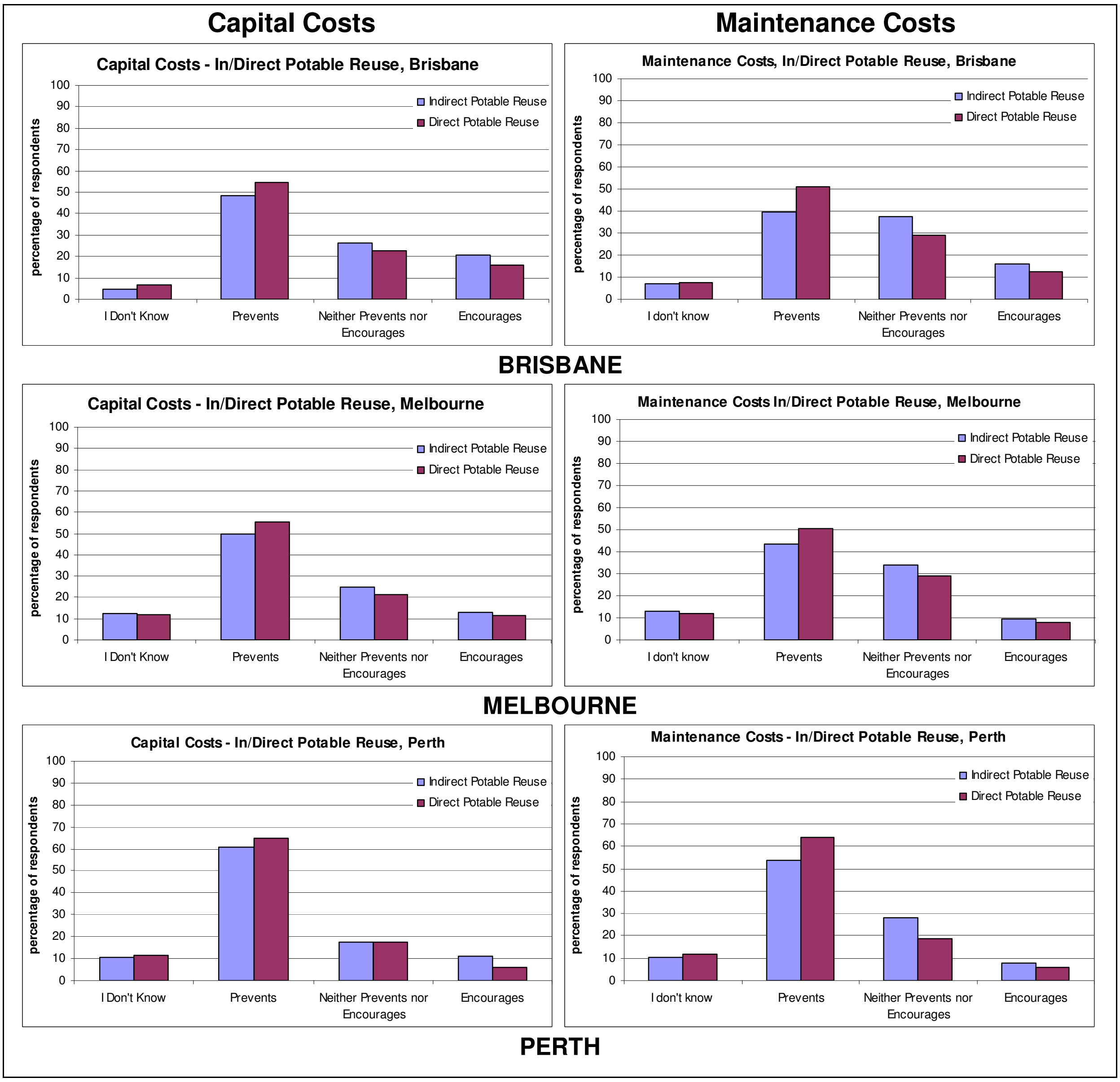


Figure 6.10: Perceived Influence of Capital and Maintenance Costs on the Adoption of Indirect and Direct Potable Reuse Schemes

7.0 Perceptions of Institutional Arrangements and Stakeholder Commitment to Total Water Cycle Management

To continue to assess the level of receptivity of urban water professionals to advancing SUWM practices, this section examines the influence of current institutional arrangements and the perceived level of commitment by a range of organisations, in promoting total water cycle management (TWCM). These attributes are important in helping to understand the level of receptivity, and indicate the level to which urban water professionals feel supported in their pursuit of advancing more SUWM practices.

It is important to note that since the time of the survey (October-November 2006), the institutional arrangements in Brisbane, Melbourne and Perth may have changed following sectoral reforms. The context at the time of the survey is outlined in Section 1.3 and further contextual information can be accessed through case study context reports located on the Program's website (www.urbanwatergovernance.com).

Following a summary of the key findings, this section presents the outcomes of how respondents rated the effectiveness of their current institutional arrangements in working towards TWCM. Urban water professionals were asked to rate the effectiveness based on the scale I don't know, very poor, poor, neutral, good and very good. Next, the perceptions of professionals regarding the level of commitment by various organisations to advancing TWCM are presented. Respondents were able to rate the level of commitment along the following continuum: I don't know, no commitment, some individuals committed, increasing organisational/sector awareness, major organisational departments and internal champions committed, organisation/sector fully committed and, not applicable. Raw data tables are located in Appendix B.

7.1 Key Findings

Overall, urban water professionals suggested their institutional arrangements were not optimal, rating them as ineffective for advancing a TWCM approach; hence resulting in lower receptivity levels. However, the perceptions of organisational commitment suggests that the organisations with a major responsibility for urban water management, in particular the water retailers (e.g. Melbourne Water, Brisbane City Council and Water Corporation) are more committed to advancing TWCM than organisations with a 'part' role (e.g. economic and health regulators).

Although land developers, consultants and local governments were perceived by urban water professionals to have low levels of commitment to advancing TWCM, there was recognition that these organisations had a 'growing level of awareness' and 'some individuals committed'.

7.2 Effectiveness of Institutional Arrangements

Respondents were asked to rate how effective they perceived the current[8] institutional arrangements were in facilitating TWCM. To prevent any misunderstanding across the different cities, total water cycle management was defined for survey respondents as follows:

- Total Water Cycle Management: recognises that our water services – including water supply, sewerage and stormwater management – are interrelated and linked to the well-being of our catchments and receiving waterway environments (including surface and subsurface). In involves making the most appropriate use of water from all stages of the water cycle that best delivers social, ecological and economic sustainability.

Table 7.1 and Figure 7.1 present the collated data on the perceived institutional in/adequacy for Brisbane, Melbourne and Perth. While a number of respondents remained neutral or indicated that they 'didn't know', the overall majority of respondents suggested current institutional arrangements were ineffective, rating them as poor to very poor (Table 7.1).

Table 7.1: Perceived Effectiveness of Institutional Arrangements for Advancing Total Water Cycle Management in three Australian cities.

CASE STUDY CITY	VERY POOR %	POOR %	NEUTRAL %	GOOD %	VERY GOOD %	I DON'T KNOW %
BRISBANE	12.8	42.4	17.3	18.1	2.5	7.0
MELBOURNE	8.1	38.9	21.3	18.7	3.7	9.2
PERTH	17.2	47.5	18.9	12.6	2.1	1.7

Perth respondents considered their institutional arrangements to be the least adequate with 65 per cent of responses in the combined poor to very poor categories, while 55 per cent of Brisbane and 47 per cent of Melbourne respondents also suggested institutional arrangements were poor to very poor for advancing TWCM.

[8] at time of survey

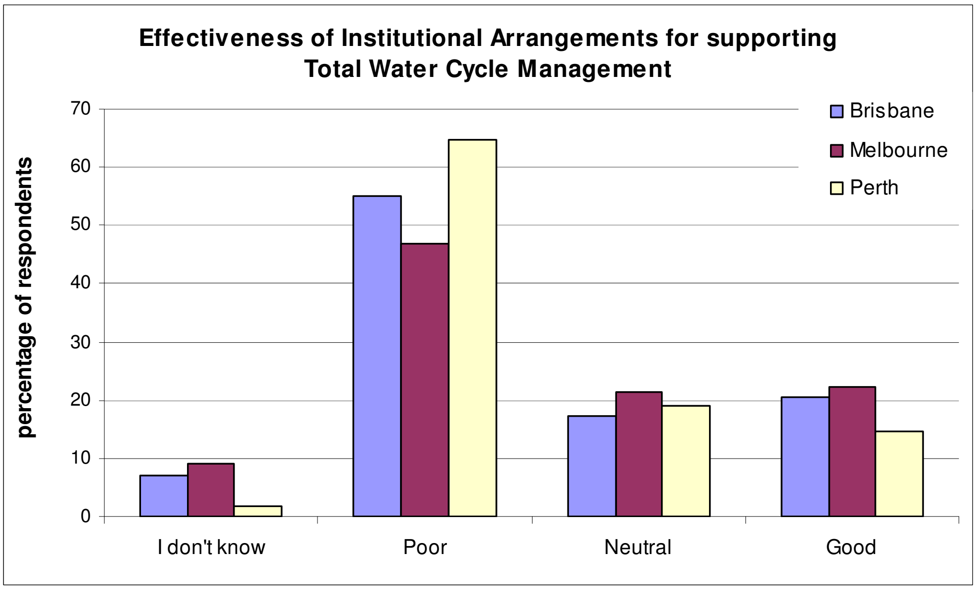


Figure 7.1: Perceived Effectiveness of Institutional Arrangements in Brisbane, Melbourne and Perth for Advancing the Concept of Total Water Cycle Management

7.3 Brisbane Stakeholders

The most 'fully committed' organisation in Brisbane was perceived to be the Moreton Bay Waterways and Catchments Partnership, followed by the Queensland Water Commission, South East Queensland Water and Brisbane City Council (Figure 7.2). However, taking into consideration the next level of commitment ('major organisational departments and internal champions committed'), then overall, Brisbane City Council was perceived as the most committed to TWCM with 53 per cent of respondents (Figure 7.2). Closely following behind the Brisbane City Council and Moreton Bay Waterways and Catchment Partnership's level of commitment were the Queensland Water Commission, Environmental Protection Agency and South East Queensland Water.

High levels of uncertainty regarding the commitment from organisations such as the Queensland Competition Authority and Queensland Health to achieving TWCM were also demonstrated in Figure 7.2. Land Developers and the Department of Main Roads also scored negatively. Figure 7.2, however, also demonstrates that, although there is a perception of no commitment in the organisations to the right of the graph, there is a growing level of awareness, with the recognition from respondents that 'some individuals' are indeed committed, for example Land Developers and Consultants (Figure 7.2).

7.4 Melbourne Stakeholders

Urban water professionals seemed less certain about the perceived level of commitment to TWCM from a range of organisations, demonstrated by the high number of 'I don't know' responses (Figure 7.3). Despite this, Melbourne Water and Sustainability Victoria were considered to be the most 'fully committed' organisations. When combining the 'fully committed' category with 'major organisational departments and internal champions committed', Melbourne Water has a 60 per cent response rate. Indeed, not one respondent suggested they were 'not committed' (Figure 7.3). Given only 29 out of the

424 respondents from Melbourne represented Melbourne Water, it is clear respondents from many other organisations perceive Melbourne Water as an important organisation in achieving TWCM.

Similar to the results for Brisbane, Figure 7.3 highlights a high level of uncertainty regarding the level of commitment from organisations without a ‘core’ role in urban water management in Melbourne. The Department of Human Services and the Essential Services Commission, alongside land developers and local government all scored over five per cent ‘not committed’ (the lowest) rating. However, and again similar to the Brisbane case study, land developers, consultants, and local governments are recognised for the ‘growing sector awareness’ and commitment of ‘some individuals’ (Figure 7.3).

7.5 Perth Stakeholders

Perth respondents clearly identified the major water utility, the Water Corporation, as the most ‘fully committed’ organisation, with 22 per cent of respondents agreeing. This was followed by the State agencies, Department of Environment and Conservation, Department of Water, the Environmental Protection Authority and the Swan River Trust. Similar to Melbourne and Brisbane, the economic and health regulators received comparatively high levels of ‘not committed’ responses and high levels of uncertainty (I don’t know) (Figure 7.4). Furthermore, as demonstrated in the other two case studies, local governments and land developers were rated with ‘some individuals committed’ and a ‘growing sector awareness’ (Figure 7.4).

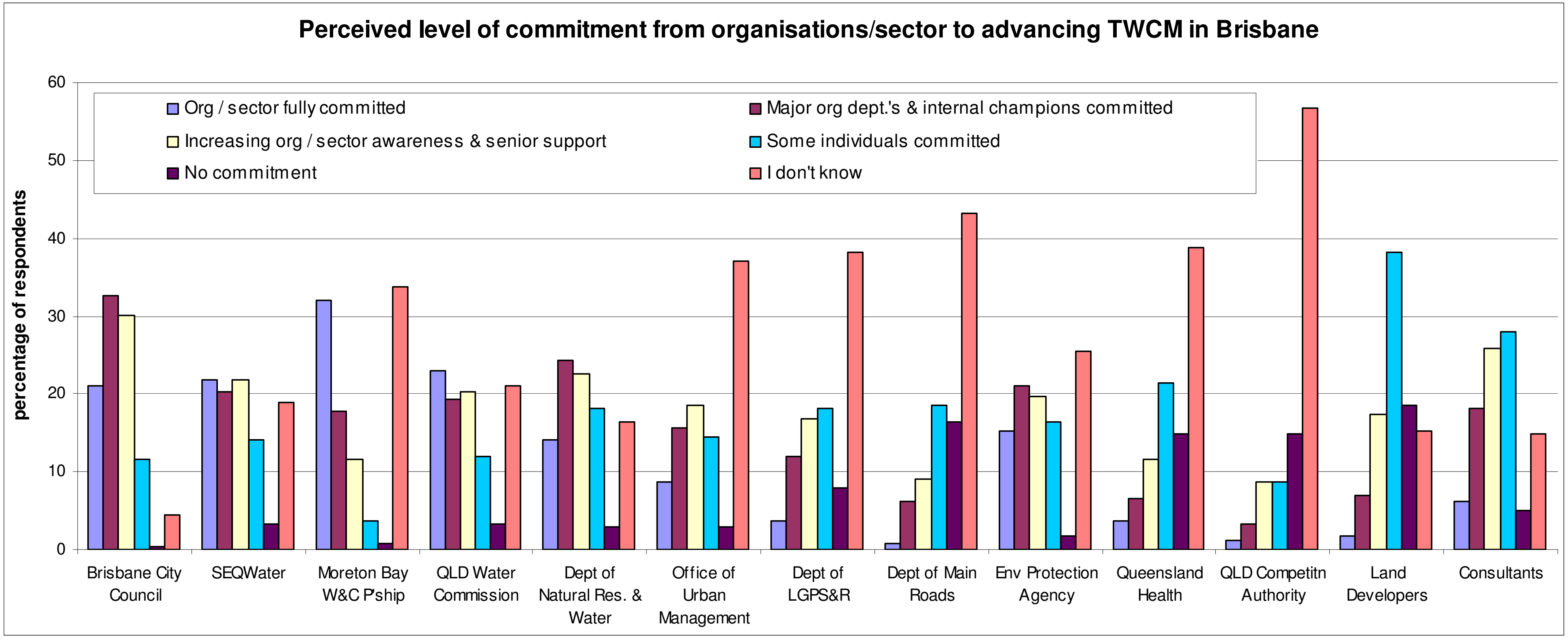


Figure 7.2: Perceived Level of Commitment from Organisations in Brisbane to Advancing Total Water Cycle Management

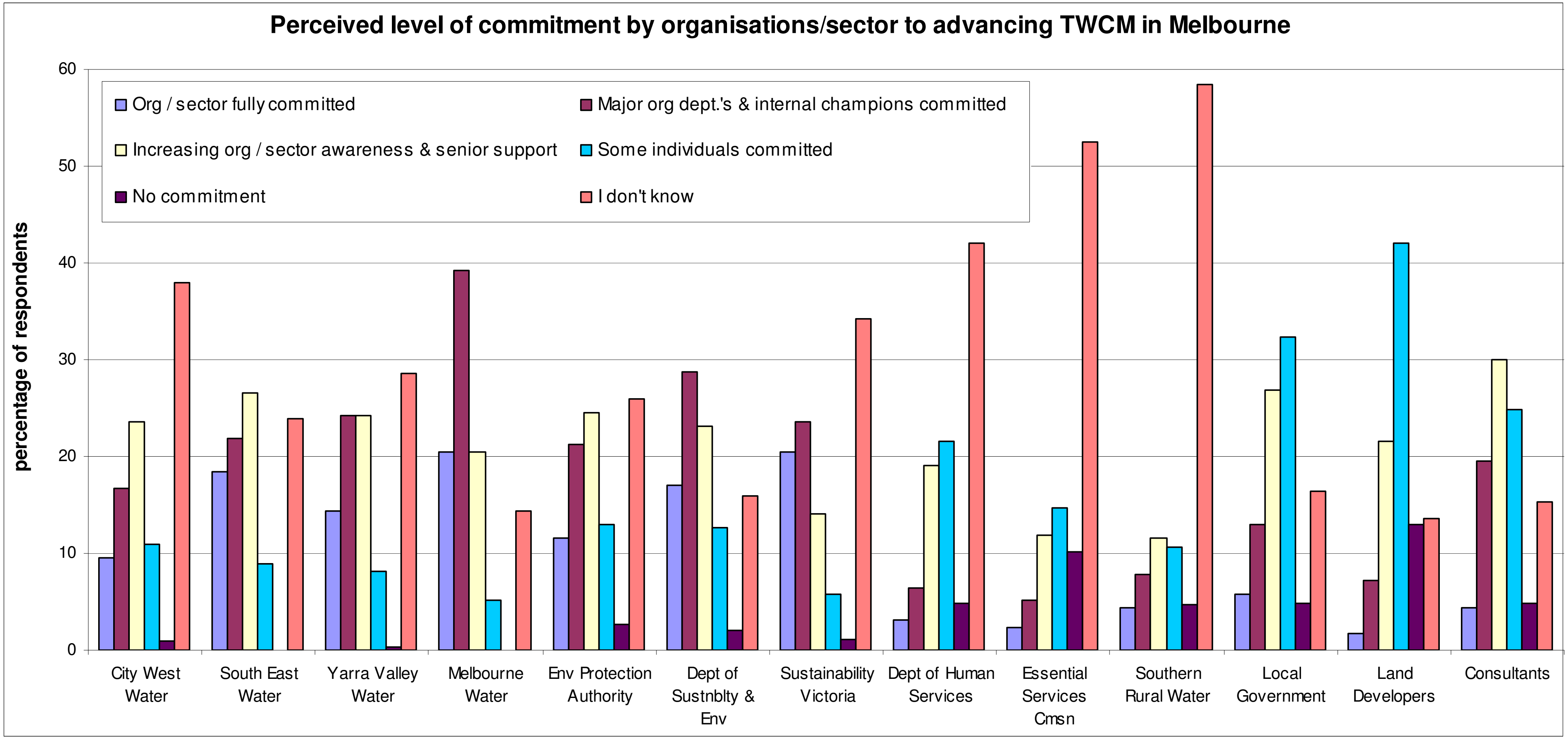


Figure 7.3: Perceived Level of Commitment from Organisations in Melbourne to Advancing Total Water Cycle Management.

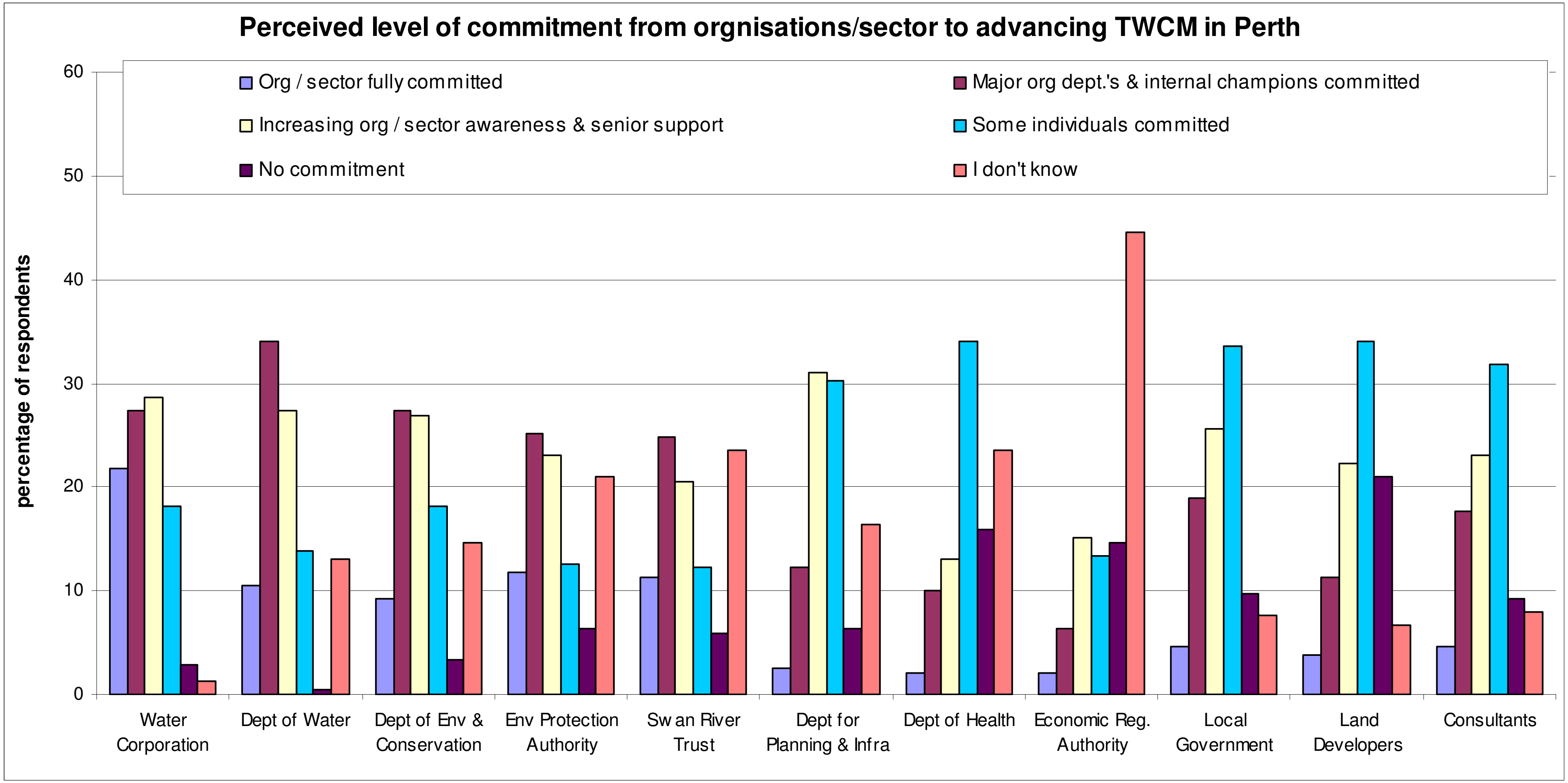


Figure 7.4: Perceived Level of Commitment from Organisations in Perth to Advancing Total Water Cycle Management.

7.5 *Contrasting Local Government with the Private Sector*

The way local government respondents and land developers/consultants perceived the commitment of local governments to TWCM was analysed and statistically significant differences were identified (Table 7.2). In Perth, local government respondents were more negative about their sector's level of commitment than developers/consultants were. For example, 18 per cent of local government respondents indicated their sector (local government as a whole) was 'not committed', whereas the majority of developers/consultants (35 per cent) considered local governments to have 'major organisational departments and internal champions committed' (Table 7.2). Conversely, Brisbane City Council respondents (local government) were more supportive of their sector's commitment, with 36 per cent of urban water professionals identifying their sector as 'fully committed'. On the other hand, the majority of developers/consultants considered Brisbane City Council (local government) to have only 'increasing organisational awareness and senior support' (44 per cent). Similar to Perth responses, Melbourne local government respondents were more negative about their sector's commitment; 38 per cent of local government respondents indicated their sector has 'some individuals committed', while 48 per cent of developers/consultants perceived local government commitment to be equally shared between 'some individuals committed' and 'growing sector awareness'. However, there were a similar number of respondents who suggested 'I didn't know' the level of commitment of local government to TWCM.

Table 7.2: Comparing the Different Perceptions of Commitment by Local Governments to Total Water Cycle Management by Land Developers/Consultants and Local Government Respondents in Brisbane, Melbourne and Perth.

PERCEIVED LEVEL OF COMMITMENT	BRISBANE		MELBOURNE		PERTH	
	Developers & Consultants %	BCC %	Developers & Consultants %	LGovt %	Developers & Consultants %	LGovt %
No commitment	0	0	8.7	1.9	0	18.2
Some individual commitment	11.8	9.7	23.9	37.7	21.8	51.5
Increasing org/sector awareness	44.1	23.7	23.9	28.3	32.7	18.2
Major org departments & internal champs committed	32.4	30.1	10.9	18.9	34.5	12.1
Organisation / sector fully committed	5.9	35.5	8.7	1.9	10.9	0.0
'Don't know'	2.9	1.1	23.9	9.4	0.0	0.0
Not Applicable	2.9	0	0.0	1.9	0.0	0

Source (Survey Raw Data, Appendix B).

8.0 Projected Implementation Timeframes

To further develop our understanding of professional receptivity to adopting and using diverse water supply sources, respondents were asked to predict what they perceived as realistic implementation timeframes for eight diverse water supply sources. Urban water professionals were asked how long before greywater, stormwater, sewage, saltwater, new dams, rainwater and water trading would become integral to conventional supplies. The projected timeframes ranged from already mainstream, next five years, 6 to 15 years, 16 to 30 years, over 30 years, with alternative options 'I don't know' and 'not applicable'. Figures 8.1, 8.2 and 8.3 (below) present the results of the analysis for each city. Raw data tables are located in Appendix B.

8.1 Key Findings

Over 40 per cent of urban water professionals in Brisbane, Melbourne and Perth considered rainwater was an 'already integral' future water supply option. Each case study city predicts the next five years will be busy with the development of diverse water source options. In Brisbane, Melbourne and Perth, professional respondents' project there will be an industry focus on greywater, rainwater, sewage, stormwater and water trading. Furthermore, Perth respondents also predicted further development over the next five years to their 'already integral' seawater option. Similarly, over 30 per cent of Brisbane respondents also nominated seawater would be developed over the next five years. Whereas in late November 2006 in Melbourne, over a quarter of all respondents did not see seawater being developed until the next 6-15 years timeframe and at least 15 per cent of respondents indicated it could take up to 30 years.

Stormwater and sewage will continue to be developed in all three cities over the next 6 to 15 years, while groundwater and seawater are predicted to be developed further in Brisbane, whereas Melbourne focused more on long term development of seawater.

8.2 Brisbane

Over 40 per cent of Brisbane respondents identified that rainwater was already an integral component of their water supply options. However, almost 50 per cent of respondents suggested that rainwater tanks will continue to develop as an alternative water source for the next five years (Figure 8.1). Respondents also identified that all other diverse water source options will be developed over the next five years (Figure 8.1). Yet for seawater, sewage, stormwater, water trading, groundwater and new dams, there will be ongoing development for up to 15 years. Some respondents considered seawater and groundwater will also continue to be developed over the next 30 years (Figure 8.1).

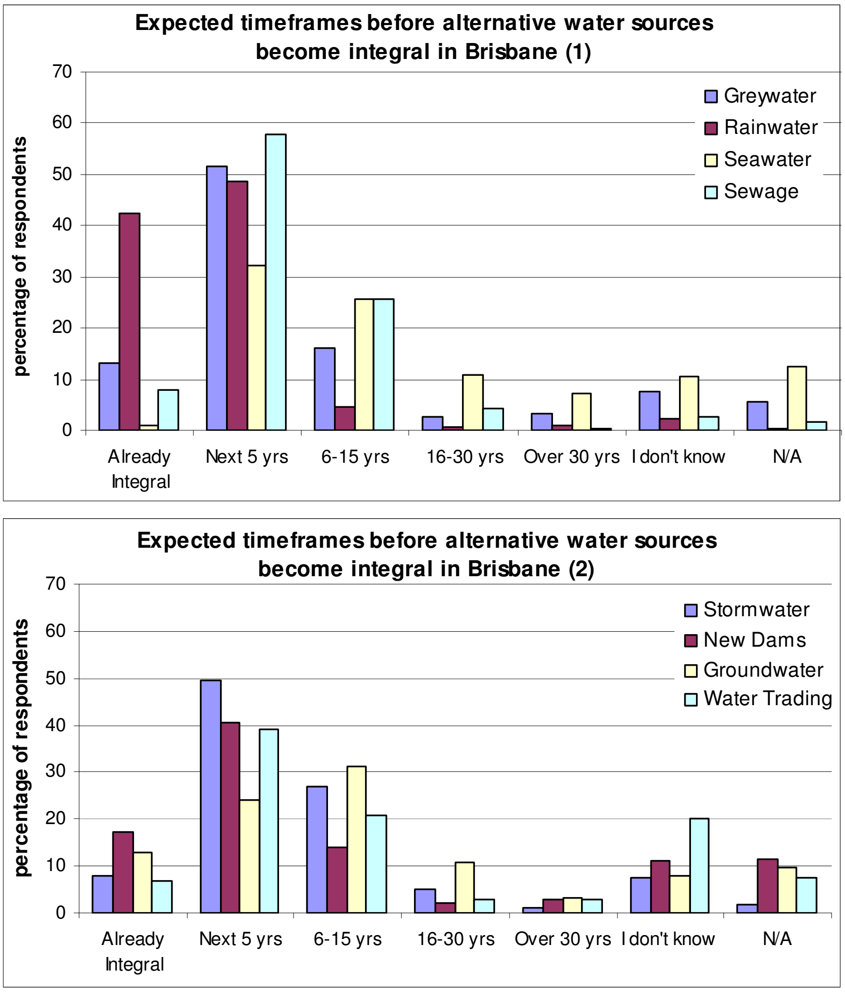


Figure 8.1: **Expected Timeframes before Diverse Water Supply Options become Integral in Brisbane.**

8.2 Melbourne

In Melbourne, over 40 per cent of respondents also considered rainwater as 'already integral' to conventional water supplies. To a lesser extent (approximately 15 per cent of respondents), greywater and stormwater were also considered integral, however, much development is expected in the next five to fifteen years. For example, Melbourne respondents identified that greywater, rainwater, sewage, stormwater, water trading and, to a lesser extent, new dams would be developed further over the next five years, with ongoing development for up to fifteen years (Figure 8.2). Seawater was identified as an option to develop in the longer term, with the majority of respondents identifying desalination would come online somewhere between 6 and 30 years (Figure 8.2). Similarly, groundwater was a development option that may take 30 years (Figure 8.2). However, the largest proportion of respondents (over 25 per cent) did not consider groundwater an appropriate option for Melbourne. Approximately 15 per cent of respondents indicated that they did not know when seawater, new dams, groundwater or water trading would be aligned in Melbourne.

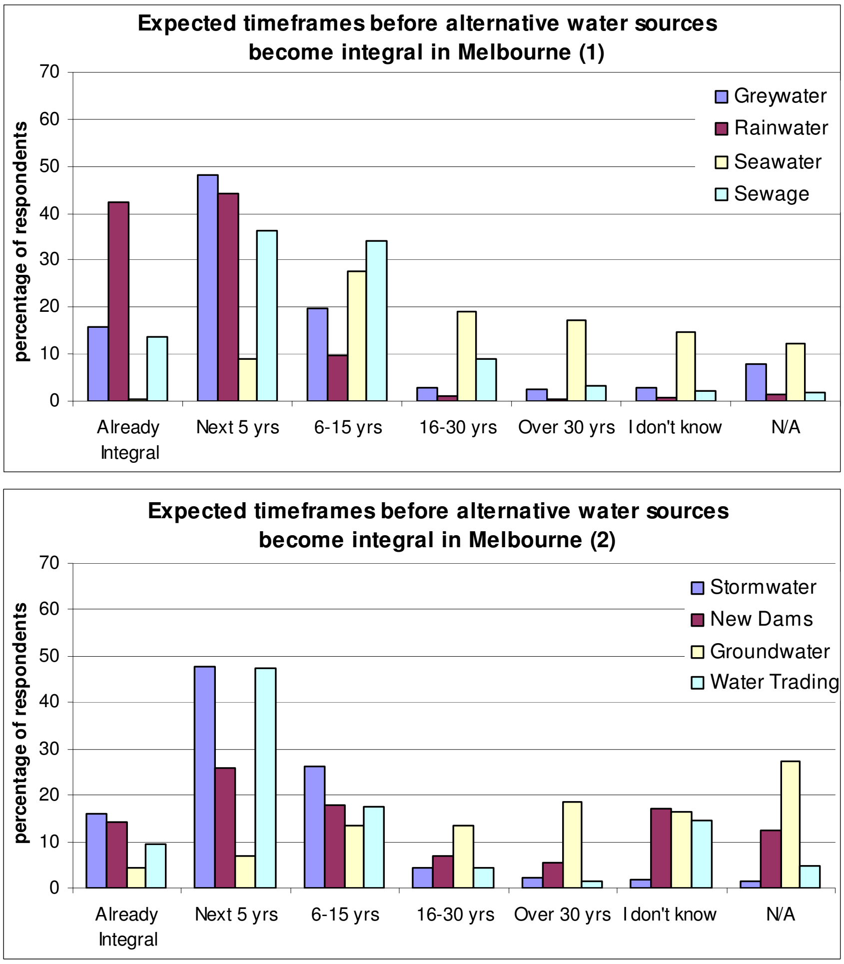
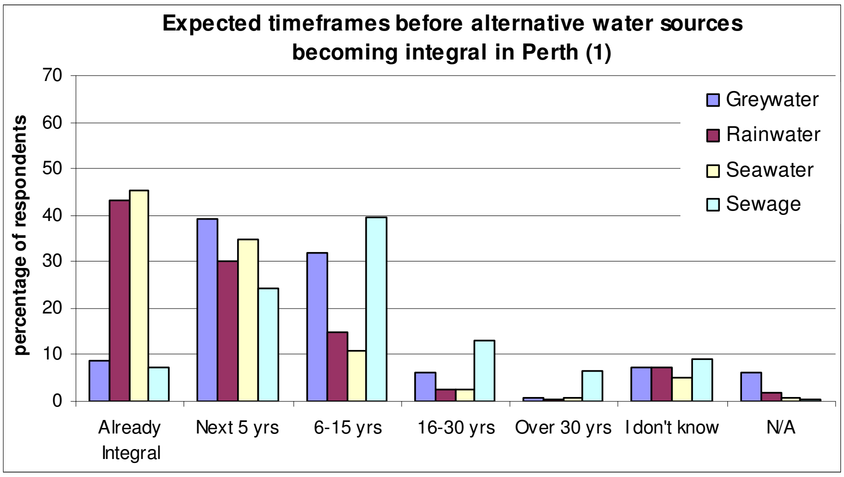


Figure 8.2: Expected Timeframes before Diverse Water Supply Options become Integral in Melbourne

8.3 Perth

Over 40 per cent of respondents in Perth considered rainwater and seawater as already integral with conventional water supplies and approximately 60 per cent indicated that new dams and groundwater (confined and superficial) were already integral to mainstream water supplies (Figure 8.3). However, other respondents also indicated that there would be substantial growth in these and other areas over the next 5 to 15 years (Figure 8.3), particularly for greywater, stormwater, sewage and water trading. Interestingly, Perth respondents were clearer about future timeframe objectives than Melbourne or Brisbane responses, with fewer respondents indicating that they didn't know projected timeframes, and greater confidence that alternative water sources may be aligned with mainstream supplies within the next 15 years.



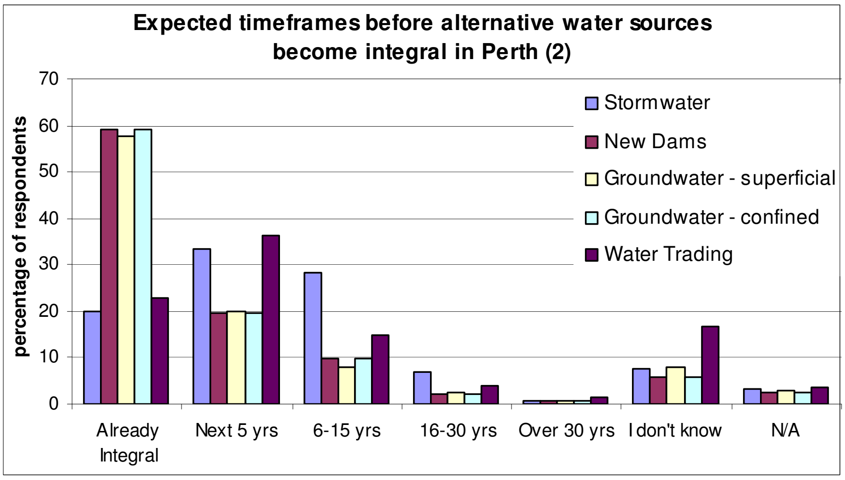


Figure 8.3: Expected Timeframes before Diverse Water Supply Options become Integral in Perth

Further interrogation of the data was undertaken by grouping responses according to those who envisaged the water source timeframe as either an 'optimist' (already integral or will be in 5 to 15 years) or a 'pessimist' (will be longer than 15 years). The recoded data were analysed against a range of variables (see Appendix C) and there were few significant differences identified. Based on the 'type of work' undertaken by respondents the only significant difference was identified in Brisbane, where respondents who work in total water cycle management and water supply were more optimistic regarding the timeframe for adoption of seawater, whereas and respondents who work in land development and stormwater envisaged longer timeframes. Likewise, a trend emerged for other diverse water source options where respondents who work in the stormwater and land development industries were generally more negative regarding timeframes, particularly for new dams, groundwater and seawater.

The only significant difference identified based around the level a respondent held in their organisation indicated that 'senior' Melbourne staff were more pessimistic about developing greywater options, while 'middle' level staff were more optimistic. Conversely, in Perth, 'junior' staff were more pessimistic about the introduction of water trading, while 'senior' and 'executive' staff were more optimistic. The less experienced a respondents was (i.e. 0-1 years), the more likely were to be pessimistic about timeframes over respondents with a greater length of experience (i.e. 6 plus years). Respondents with a 'professional background and/or training' in engineering and science were more 'optimistic' in

Brisbane regarding timeframes for stormwater and rainwater development than ‘others’ but there were no significant differences among ‘professional backgrounds’ for greywater, new dams, water trading, seawater, sewage or groundwater in any of the case study cities.

9.0 Concluding Remarks

This data report has provided a statistical snapshot of the perceived social and institutional drivers and barriers to implementing sustainable urban water management in Australian cities. This is the first stage in a broader program of research aimed at investigating and identifying the institutional factors most important for enabling a Water Sensitive City. While the analysis in this report is mostly descriptive, future reports will provide more detailed analysis. Professionals operating in the urban water sector were targeted to provide empirical evidence regarding the drivers and barriers that encourage or impede the development and implementation of diverse water sources and technologies. Framed using the concept of receptivity, this report documents how urban water professionals are aware of, and associate with the need to augment conventional potable water supplies with diverse water sources in a fit-for-purpose (water use) context. However, there remains a tension regarding the perceived environmental outcomes as compared with the perceived public health implications in using certain diverse water source options (e.g. greywater and sewage). The data suggests that the urban water industry is struggling to develop the requisite capacity and skills (acquisition) to develop and successfully implement diverse water source technologies, particularly in Perth. Furthermore, the current institutional frameworks in each case study city were identified as a constraining factor, suggesting further institutional reforms may be required. Overall, there is a broad consensus among the range of stakeholder groups who responded to the survey about the limitations of the industry. As such, targeted institutional capacity building interventions, improved community engagement and participation programs, new institutional reform strategies and a visioning process are suggested as possible policy mechanisms to help direct the urban water sector work towards achieving sustainable urban water management in Australia.

9.1. Where Next for the National Urban Water Governance Program?

Throughout 2006 and 2007, various types of data were collected and systematically analysed within and across case study cities. Data sources included online questionnaire survey data (as reported here), oral histories of the sector, interviews and focus groups with contemporary urban water professionals and associated stakeholders, industry, and scientific literature reviews. During 2008, further data will be collected on the potential of demonstration projects to encourage institutional learning in each of the three case study cities.

In late 2008, the final comparative report of the institutional analysis across the three case study cities (Brisbane, Melbourne and Perth) will be made available. However, the Program will also produce a series of interim reports, the first of which includes the survey data reports, along with the context reports.

It is important to note that all products produced by the National Urban Water Governance Program are freely available on the program's website (www.urbanwatergovernance.com).

Finally, it is hoped that this research program will help guide future sectoral reform and help promote strategically targeted institutional capacity building interventions to help transition towards a Water

Sensitive City by incorporating sustainable urban water management principles and practices. Now is the right time to begin the dialogue around what our future Water Sensitive Cities may look like around the country, not only aesthetically, but also, institutionally.

10.0 References

Birrell, B., Rapson, V. and Smith, T. F., (2005) *Impact of Demographic Change and Urban Consolidation on Domestic Water Use.* Water Services Association of Australia, Melbourne, Australia, pp: 24

Brown, R., (2005) Impediments to Integrated Urban Stormwater Management: The Need for Institutional Reform. *Environmental Management* 36(3): 455-468.

Brown, R. R., Sharp, L. and Ashley, R.M., (2006a) Implementation impediments to institutionalising the practice of sustainable urban water management. *Water, Science and Technology* 54(6-7): 415-422.

Brown, R., Mouritz, M. and Taylor, A., (2006b) Institutional Capacity. In: Wong T.H.F., *Australian Runoff Quality*, Chapter 5 Engineers Australia, Canberra: 1-20.

Brown, R., and Farrelly, M., (2007a) Barriers to Advancing Sustainable Urban Water Management: a typology. *Rainwater and Urban Design 2007: Conference Proceedings of the 5th International Water Sensitive Urban Design Conference and the 13th International Rainwater Catchment Systems Conference*. 21-23 August 2007, Sydney Australia.

Brown, R., and Farrelly, M., (2007b) *Advancing Urban Stormwater Quality Management in Australia: a survey of stakeholder perceptions of institutional drivers and barriers*, Report No. 07/05, National Urban Water Governance Program, Monash University, Melbourne.

Brown, R. and Keath, N., (2007) Turning the super-tanker: Policy tools for avoiding crisis-based decisions and encouraging the transition to Sustainable Urban Water Management. *Rainwater and Urban Design 2007: Conference Proceedings of the 5th International Water Sensitive Urban Design Conference and the 13th International Rainwater Catchment Systems Conference*. 21-23 August 2007, Sydney, Australia. CD-ROM

Council of Australian Governments (CoAG), (2004) *Intergovernmental Agreement on a National Water Initiative.* Commonwealth of Australia and the Governments of New South Wales, Victoria, Queensland, South Australia, the Australian Capital Territory and the Northern Territory, signed 25 June 2004.

Cortner, H. J., (1998) Institutions matter: the need to address the institutional challenges of ecosystem management. *Landscape and Urban Planning* 40(1-3): 159-166.

Department of Sustainability and Environment (DSE), (2006) *Urban Development Program Annual Report 2006*. Department of Sustainability and Environment – Planning. The Government of Victoria. Accessed June 2007, online: http://www.dse.vic.gov.au.

Engineers Australia, (2005) *Australian Infrastructure Report Card,* August 2005, Engineers Australia, Canberra.

Hatton MacDonald, D. and Dyack, B., (2004) *Exploring the Institutional Impediments to Conservation and Water Reuse - National Issues.* Report for the Australian Water Conservation and Reuse Research Program, Policy and Economic Research Unit, CSIRO Land and Water,

Howe, C. W., Jones, R. N., Maheepala, S. and Rhodes, B., (2005) *Implications of Potential Climate Change for Melbourne's Water Resources.* A collaborative project between Melbourne Water and CSIRO Urban Water and Climate Impact Groups, Australia.

Jeffrey, P. And Seaton, R. A. F., (2003/2004) A Conceptual Model of 'Receptivity' Applied to the Design and Deployment of Water Policy Mechanisms. *Environmental Sciences* 1(3): 277-300.

Lee, D. H., (1999) Institutional and technical barriers to risk-based water resources management: A case study. *Journal of Water Resources Planning and Management* 125(4): 186-193

Lundqvist, J., Narain, S. and Turton, A., (2001) Social, institutional and regulatory issues. In: *Frontiers in Urban Water Management: Deadlock or Hope?* IWA Publishing, London: 344-398

McKay, J., (2005) Water Institutional Reforms in Australia. *Water Policy* 7: 35-52.

Maksimović, C. and Tejada-Guibert, J. A., (2001) *Frontiers in Urban Water Management: Deadlock or Hope?* IWA Publishing, London.

Marks, J., (2004) Negotiating Change in Urban Water Management: Attending to Community Trust in the Process. *International Water Sensitive Urban Design Conference – Cities as Catchments*, 21-25th November 2004, Adelaide.

Mitchell, V. G., (2004) *Integrated Urban Water Management: A review of current Australian practice.* Report of the Australian water Conservation and Reuse Research Program, a joint initiative of CSIRO and Australian water Association.

Mouritz, M., J., (1996) *Sustainable Urban Water Systems: Policy and Professional Praxis*. Unpublished PhD thesis, Institute for Science and Technology Policy, School of Social Science, Murdoch University, Perth.

Mourtiz, M. J., (2000) Where to Now? Keynote Paper. *The First National Water Sensitive Urban Design Conference*, 30th – 31st August 2000, Melbourne Australia.

Nancarrow, B. E., Kaercher, J. D., & Po, M., (2002) *Community attitudes to water restrictions policies and alternative water: A longitudinal analysis 1988-2002*, Perth: CSIRO Land and Water.

Prime Minister's Science Engineering and Innovation Council, (2007) *Water for Our Cities: building resilience in a climate of uncertainty.* A report of the PMSEIC working group for the Australian Government, Canberra.

Rauch, W., Seggelke, K., Brown R. and Krebs, P., (2005) Integrated approaches in urban storm drainage: Where do we stand? *Environmental Management* 35(4): 396-409.

Saleth, R. M. and Dinar, A., (2005) Water institutional reforms: theory and practice. *Water Policy* 7: 1-19.

The Barton Group, (2005) *Australian Water Industry Roadmap: A Strategic Blueprint for Sustainable Water Industry Development*, Report of The Barton Group, Coalition of Australian Environment Industry Leaders, May 2005, available at www.bartongroup.org.au (accessed 10/11/05).

Vlachos, E. and Braga, B. P. F., (2001) The challenge of urban water management. In: C. Maksimović and J. A. Tejada-Guibert, *Frontiers in Urban Water Management: Deadlock or Hope?* IWA Publishing, London: 1-36.

Wong, T. H. F., (2006) Water Sensitive Urban Design – the story so far. *Australian Journal of Water Resources*, 10(3): 213-221.

Yin, R., (2003) *Case Study Research: Design and Methods.* Sage Publications, Thousand Oaks: 179

National Urban Water Governance Program
Monash University, School of Geography and Environmental Science

Building 11, Clayton Campus,
Wellington Road, Clayton

Postal – Monash University,
Vic 3800, Australia

Phone + 61 3 9905 9992
Fax + 61 3 9905 2948

nuwgp@arts.monash.edu.au
www.urbanwatergovernance.com