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Exploring the regulatory framework and governance of decentralised water management systems: a strata and community title perspective

Jan Warnken, Nicole Johnston, Chris Guilding

Waterlines Report Series No 19, September 2009

Waterlines

A SERIES OF WORKS COMMISSIONED BY THE NATIONAL WATER COMMISSION ON KEY WATER ISSUES

Waterlines

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Authors: J Warnken, N Johnston and C Guilding

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Abbreviations and acronyms

BASIX	Building Sustainability Index (NSW)
B/C	In the first instance – a ‘body corporate’, equivalent to an ‘owners association’ or ‘owners corporation’ in other jurisdictions (all terms apply for this acronym unless explicitly linked to legislation in Queensland)
BCA	Building Code of Australia
Cwth	Commonwealth of Australia
DWMS	Decentralised water management system
Equivalent person	The average daily water use of an individual (about 200 to 250 litres per day)
EPA	Environmental Protection Agency (Queensland) or Environment Protection Authority (Vic)
GEM	Guidelines for Environmental Management
kL	kilolitres (1000 litres)
LGA	Local government authority
NATA	National Analytical and Testing Authority
NCTI	National Community Title Institute
NSW	New South Wales
PCA	Plumbing Code of Australia
Qld	Queensland
S&CT	Strata and Community Title
Vic	Victoria

Acts, regulations and plans cited

Acts

Body Corporate and Community Management Act 1997 (Qld)

Building Act 1975 (Qld)

Building Act 1993 (Vic)

Community Land Development Act 1989 (NSW)

Community Land Management Act 1989 (NSW)

Environmental Planning and Assessment Act 1979 (NSW)

Environmental Protection Act 1994 (Qld)

Environment Protection Act 1970 (Vic)

Essential Services Commission Act 2001 (Vic)

Health Act 1958 (Vic)

Hunter Water Act 1991 (NSW)

Integrated Planning Act 1997 (Qld)

Interpretation Act 1987 (NSW)

Local Government Act 1993 (NSW)

Local Government Act 1993 (Qld)

Local Government Act 1989 (Vic)

Owners Corporation Act 2006 (Vic)

Planning and Environment Act 1987 (Vic)

Plumbing and Drainage Act 2002 (Qld)

Protection of the Environment Operations Act 1997 (NSW)

Public Health Act 1991 (NSW)

Public Health Act 2005 (Qld)

Strata Schemes (Freehold Development) Act 1973 (NSW)

Strata Schemes Management Act 1996 (NSW)

Sydney Water Act 1994 (NSW)

Trade Practices Act 1974 (Cwth)

Water Act 2000 (Qld)

Water Act 1989 (Vic)

Water Industry Act 1994 (Vic)

Water Industry Competition Act 2006 (NSW)

Water Management Act 2000 (NSW)

Water Supply (Safety and Reliability) Act 2008 (Qld)

Water Resource (Gold Coast) Plan 2006 (Qld)

Water Resource (Morton) Plan 2007 (Qld)

Regulations

Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld)

Building Regulations 2006 (Qld)

Building Regulation 2006 (Vic)

Environmental Planning and Assessment Regulation 2000 (NSW)

Hunter Water (General) Regulation 2005 (NSW)

Environmental Protection Regulation 1998 (Qld)

Environment Protection (Scheduled Premises and Exemptions) Regulations 2007 (Vic)

Erneuerbare-Energien-Gesetz (EEG) 2000 (Germany)

Local Government General Regulation 2005 (NSW)

Owners Corporation Regulation 2007 (Vic)

Plumbing and Drainage Standard Regulation 2003 (Qld)

Plumbing Regulation 1998 (Vic)

Public Health Regulation 2005 (Qld)

Queensland Development Code 2008

Sydney Water Regulation 2006 (NSW)

Water Industry Competition (General) Regulation 2008 (NSW)

Executive summary

The broad aim of this report is to explore the regulatory framework and governance issues associated with decentralised water management systems (DWMSs) within a strata and community title (S&CT) context. Water shortages during the recent drought have renewed concerns about the sustainability of urban water management.

Concerns about the capacity of centralised water supply systems to deliver reliable and secure water supplies have triggered interest in the potential of localised DWMSs as an alternative approach to water management. S&CT developments appear to represent strong potential vehicles for promoting DWMSs because there is an extant legislative framework that supports the governance and management of such developments in all Australian states and territories. This legislative framework enables DWMSs to be implemented by allowing owners to communally own water and wastewater supply infrastructure, collect levies and fees to cover the operational costs relating to the infrastructure, constitute by-laws to regulate behaviour that may impact on the viability of the water system, and provide water and wastewater services. The integration of S&CT schemes with DWMSs could provide sufficient water to service the occupants of the scheme and provide irrigation for the grounds of a development. It could also allow for on-selling any excess water to third parties to help pay for a system‘s operational costs.

The statutory provisions for implementing DWMSs in S&CT complexes in the states of New South Wales, Queensland and Victoria are analysed in this report. A regulatory review identifies the types of water management measures that are required under each state‘s building codes and standards, the prerequisites for registering (or licensing) as a water service provider, the general development restraints (such as headwork charges and compulsory connection to water service networks), the planning conditions and approvals required for implementing DWMSs, and S&CT laws relating to the implementation and operation of DWMSs. The material reviewed is based on regulations in force as at August 2008.

In order to gain insight into the perspectives and opinions of stakeholders with S&CT-based DWMS experiences, a series of in-depth interviews was conducted over several months. Stakeholder groups represented by the interviewees included developers, S&CT managers and water industry experts. Also, delegates attending the National Community Titles Institute 2008 conference completed a survey of their experiences with managing S&CT schemes in general and DWMSs in particular. Generally, stakeholders believed that DWMSs have a future in the marketplace. Their primary concerns related to the management of these systems by bodies corporate or owners corporations and the imposition of headworks charges and water service fees. Mechanisms to set infrastructure contributions (or headworks charges) for developments with DWMSs and to determine water service charges for lot owners or occupiers were also identified as insufficiently flexible. The concern is that current arrangements do not enable the identification of different resource consumption demands placed on water infrastructure services across units within a strata title scheme.

Key conclusions and findings

S&CT subdivisions appear to carry considerable potential as a facilitator of DWMSs, although some issues need to be addressed before S&CT-based DWMSs are promoted more widely. The following recommendations have been advanced in the report in an attempt to alleviate impediments to S&CT based DWMSs.

- The type of DWMS depends on the site and size of a scheme. Developments in remote areas represent prime candidates for S&CT-based DWMS developments. To manage costs effectively, the body corporate of an S&CT subdivision should retain ownership of all infrastructure and employ a resident or facility manager to monitor and maintain the system. The remoteness of these sites could make it cost prohibitive to contract with third-party providers for routine maintenance.
- Re-developments of 'brownfield' (inner city) sites in areas with high rainfall (most coastal cities east or south of the Great Dividing Range) are strong candidates for incorporating a DWMS into an S&CT land subdivision. Here, the primary aim is to increase residential densities without the need for major upgrades to existing water service infrastructure—this can be done by installing communal rainwater tanks and greywater or blackwater treatment and recycling systems. In this environment, wastewater treatment plants can be connected to sewer mains to guarantee the safe discharge of untreated water. It appears that larger wastewater treatment systems for schemes with 50 to 250+ lots should be owned and operated by water technology companies and not bodies corporate. The space constraints of most brownfield sites might make it difficult to re-use large volumes of recycled water, which would then encourage the sale of excess water to surrounding properties. Water technology companies would be in a better position to maintain the necessary protocols and management regimes required for registration as a service provider; they would also have the benefit of no restraint over their ability to on-sell recycled water. The body corporate should, however, retain ownership of those parts of the common property where the DWMS infrastructure is located.
- Whether a DWMS is justifiable for a 'greenfield' site is less straightforward. Decisions will need to be made more on a case-by-case cost-benefit analysis of energy consumption, environmental and social costs for water services, and the quality and reliability of water service provision.
- For all DWMSs, lots should be individually water metered to provide water-saving incentives for unit occupants. It appears futile to pursue ambitious water-saving targets without measuring the water consumption of individual lots. Queensland has recognised this factor through an amendment to the Queensland Plumbing and Wastewater Code that now requires the installation of sub-meters in all new multi-unit developments and some non-residential premises. At the time of writing this report, no other state or territory had followed this lead.
- Regulation is required to enable small water service providers to operate small DWMS facilities on multiple sites.
- Minimum levels of public liability insurance need to be increased for schemes with a DWMS, in order to safeguard the body corporate against potentially large claims. Mandatory audits of the financial arrangements for replacing major equipment items (sinking/maintenance funds) should be considered. Reports should be forwarded to consumer protection authorities and made available to potential unit buyers. An emergency fund should be established for unforseen expenditure arising in the event of a malfunctioning system posing a health risk.
- Amendments to regulations allowing for the development of wastewater recycling in declared service areas would need to be made.

- A consistent approach for certification and licensing requirements for small-to-medium effluent recycling schemes across the states and territories is desirable.
- Approprate headworks charges are required for connecting a proposed DWMS development to centralised water service networks.
- Network maintenance and repair costs of centralised water services should be funded from consumption-based levies on occupants.
- Specialist strata managers should be consulted at the outset of any development that incorporates a DWMS.
- Greater technical monitoring and information exchange between S&CT schemes with DWMSs is desirable.
- Only appropriately qualified strata managers should be permitted to manage schemes with DWMSs.
- Training programs for key stakeholder groups is highly desirable.
- It is essential that developers implementing S&CT based DWMSs recognise the need to consult across a range of stakeholder groups (including S&CT managers) in the planning phase of a new development. They should also consider the impacts and long-term repercussions for bodies corporate that own and manage DWMSs.

Aims, objectives and scope

The initial aim and scope of this project was to investigate the potential of land subdivision under S&CT, and its inherent statutory objective to combine the interests of all lot owners in a scheme, in facilitating the implementation of DWMSs for large urban development in the peri-urban space (greenfield developments) in Australia. It soon became apparent that S&CT subdivisions were of equal significance for developing DWMSs in inner urban areas (mostly brownfield sites), and in remote areas for ecovillages or ecotourism resorts. Accordingly, the initial scope was broadened to include all development scenarios for S&CT land subdivisions, while narrowing its focus to the three states with the longest history and highest number of S&CT schemes: New South Wales, Queensland and Victoria.

This report contains:

- an overview of the potential, challenges, development concepts and terminology for DWMSs and S&CT land subdivisions (Chapters 1 and 2)
- a review of the current regulatory frameworks governing the implementation of S&CT schemes and DWMSs (Chapter 3)
- a compilation of current stakeholder concerns and potential issues with water management initiatives undertaken by bodies corporate (Chapter 4)
- a comparison of the components and characteristics of DWMSs for existing S&CT developments (Chapter 5)
- a compilation of the study‘s findings followed by recommendations of measures considered necessary to increase the implementation of DWMSs through S&CT land subdivisions (Chapters 6 and 7).

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1.Introduction

1.1 The urban water crisis

Reports released by the Intergovernmental Panel on Climate Change (IPCC 2007) and CSIRO (2007) predict continuing climate changes that are likely to increase the risks of further water shortages in Australia's major urban centres. Data provided for some of the major catchments feeding into urban dams and reservoirs already indicate a protracted decline in streamflows (CSIRO 2007, s. 2.2.5). This appears to be the result of decreasing precipitation and increasing evaporation associated with an increase in surface temperatures. The pressure on natural surface water supplies is also being exacerbated by an increasing demand for living in major capital cities and urban centres (ABS 2006).

There is now a real possibility that urban development could outgrow readily available natural water sources (mostly runoff water stored in large dams supplying the major urban and regional centres). The maintenance of sufficient reservoir water is a prerequisite for all centralised—essentially unaltered nineteenth century Chadwickian—water supply and sewage service concepts (Harremoes 1997, Cooper 2001, Wolfe 1999, Dingle 2008). To avert an imminent water crisis, state and local governments, in partnership with corporatised water authorities and water retailers, have embarked on improving the efficiency of existing centralised water and sewerage service infrastructure (Department of Natural Resources and Mines 2004; NSW Department of Infrastructure, Planning and Natural Resources 2004; Government of Victoria 2004). On the supply side, this has included repairing leaking pipes and constructing major interconnector pipe networks (frequently referred to as water grids). These measures are being supplemented by the construction of desalination plants and water purification plants to introduce large-scale recycling of treated wastewater—the intent is to reduce the dependence on rainwater runoff for urban water supply. At the same time, governments and their water authorities have introduced a wide range of water conservation programs and initiatives, ranging from water use restrictions, greater consumption-based pricing, water use education programs, and provision of rebate schemes for installation of in-house water saving devices and rainwater tanks,[1] as cost-effective ways to reduce excessive water use in (mostly residential) settings. Despite these measures, concerns remain that unabated population growth and increasing rainfall variability in the course of climate change will continue to threaten urban water supplies and sewage services, or it will signify expensive and energy intensive water supply management as these services continue to depend on an essentially nineteenth century, centralised system.[2]

1.2 Decentralised water management

A fundamentally different approach to mitigating urban water shortages would be to promote 'decentralised' or integrated urban water management solutions for medium and large residential or mixed-use developments. Such decentralised systems can combine the

[1] As a 'sweetener' to increase public support for water savings and restrictions.

[2] For much of the twentieth century, the establishment of large, centralised systems were considered the best option for establishing safe and reliable water services for densely populated and industrialised centres. Introducing water from alternative sources through water recycling and desalination generally requires large volumes of water to be transported from the point of collection to a central treatment facility, and then back to the point of re-use. This not only necessitates major investment in water transport infrastructure (pipe networks and pump stations), it also signifies ongoing energy costs to move wastewater and purified water through the system. In many cases, extensive purification technology or major upgrades to existing sewage treatment works will further increase energy costs where micro/ultra filtration and reverse osmosis is required. Ultimately, this energy consumption will also increase the carbon or greenhouse gas footprint per litre of potable water consumed, thereby exacerbating the greenhouse problem that is partly to be blamed for current urban water shortages.

advantages of onsite as well as centralised systems,[3] and they provide greater reliability of supply in times of drought and water restictions. Decentralised water management systems (DWMSs) allow for the planning and design of site-specific, local solutions to access a range (and combination) of alternative water sources, including the collection or harvesting of rainwater and stormwater, and reuse of greywater or recycling of wastewater. The potential of such localised solutions has been demonstrated with considerable success in Tokyo and other large Japanese cities (Ogoshi et al. 2001, Yamagata et al. 2003). Decentralised solutions can further assist in managing polluted water (runoff) from roads, hard stands, car parks, and other surfaces, and they also avoid some of the energy costs and infrastructure investment required for centralised systems.[4] Further, relative to smaller individual household systems, decentralised systems can yield economies of scale, signifying reduced operational and maintenance costs, as well as better environmental performance and lower energy demands.[5]

Other advantages that can arise from DWMSs include:

- reductions in discharge of nutrient and pollutant rich waters from older municipal wastewater treatment plants (those providing only primary or partially secondary treatment) and stormwater drains into the environment
- opportunities for developing and introducing new and alternative technologies (for example, specially designed advanced wastewater treatment plants, or new wastewater treatment systems designed to collect urine and faecal matter as separate waste streams to produce high quality fertilisers)
- opportunities for integration of local energy harvesting and water management systems
- possibilities for better control at the beginning of the pipe—through targeted education of the users (residents) to provide a better understanding of their actions or inactions with regard to the inputs and costs of their particular systems.

This approach to water management would become an integral part of a cascade approach to urban water management in cities as a whole. That is, it would be part of a system where 'surplus' water from developments higher up in a catchment could be used by developments lower down the catchment. This can reduce drainage and pumping costs, and it can optimise water demand management and recycling between different types of urban uses, such as residential, retail or light industry (Troy 1996).

Falling outside the realm of technical issues, a particular challenge for decentralised water service infrastructure is in identifying an appropriate management model. Decentralised water service development would create a close association between end users and their water service provider. Once constructed, water treatment systems and pipe networks are difficult and very expensive to change. This highlights the importance of 'getting it right first time' and the need for a long-term service arrangement that enables the party that has funded a privately-owned water service system to recoup the considerable costs associated with its development. With respect to the feasibility of DWMSs, it is noteworthy that governments in developed countries are generally expected to guarantee a safe, reliable and reasonably

[3] Onsite water management systems = systems installed on individual lots to serve one or two households within that lot (typically septic tanks), see also section 2.1 of this report.

[4] The overall energy efficiency of water sources utilised in a DWMS has yet to be determined. The evidence from individual components (e.g. rainwater tanks, membrane bioreactors) suggests a higher energy demand per volume of water for a 'decentralised' system relative to town water supplied by gravity fed central networks (e.g. Mikkelsen et al. 1999). Other studies report lower energy costs (Cheng 2002). On the other hand, Radcliffe (2003) flags major opportunities for energy savings for recycled water resulting from short transport distances. Energy demand (Pearce 2008); and overall system costs (Friedler and Hadari 2006), however, are likely to decrease with an increase in size of the water service system.

[5] Most water treatment systems (from almost any source: storm, grey and blackwater) tend to be more economical to build and operate at an intermediate (> 50–500 households) rather than an onsite scale. This generally requires a COMMUNAL system which should be designed in light of the optimal balance between a larger, and therefore more economical treatment system with more extensive pipe networks, without compromising the potential for greater water and energy efficiency relative to centralised systems.

priced water supply, irrespective of whether the supply is provided by private entities, government-owned water corporations or government organisations.

1.3 Governance of decentralised systems under strata or community title

Two significant issues associated with managing decentralised water supply services for individual lots within larger developments concern the: (1) ownership and responsibility arrangements for the infrastructure associated with providing the service, and (2) governance arrangements for the infrastructure (the powers and obligations of the service provider and its clients). 'Ownership' in relation to water service infrastructure includes the land required for housing water treatment and storage facilities, the equipment for the treatment system itself, and the pipe network required for water collection and distribution. In theory, there appears to be a choice of three main models, whereby the infrastructure and associated land is:

- owned by a local water authority—often owned by a local government authority (LGA) or the state government
- owned by a private company specialising in providing water services
- common property—either vested in a body corporate on behalf of the owners (NSW) or owned by the lot owners as tenants in common in shares proportionate to their lot entitlements (Queensland, Victoria).

In terms of governance and responsibility, the first ownership scenario represents a simple extension of arrangements applying under existing centralised schemes. A local government-owned water authority or water board would:

- hold all relevant licences and permits
- be ultimately responsible for monitoring and maintaining the equipment
- be liable for damages incurred due to the malfunctioning of any equipment.

In turn, lot owners would be deemed to have entered into an agreement, in conjunction with their council rate obligations, to pay levies and fees for water services to the water authority that is registered and authorised as a service provider under relevant legislation.

A strategic philosophy that has been predominant in many water supply authorities has seen asset consolidation, which has resulted in the reduction of the number of small and medium sized assets, in favour of large centralised facilities (in particular, water and sewage treatment plants). While this approach can be beneficial in terms of reducing treatment costs, it may be sub-optimal in terms of reducing the cost of transportation and costs of maintaining transportation infrastructure, as considerable investment has to be directed to pipelines and pumping station construction and maintenance. This asset consolidation predilection suggests that water authorities could resist the implementation of decentralised schemes.

The second alternative to water infrastructure and property ownership involves a private entity owning or controlling (as a principal owner or lessee) all or most parts of the infrastructure and landrelated to water service provision. The same entity would need to hold relevant licences and permits and be authorised as a service provider similar to a local water authority. The entity could contract a second, privately owned, water technology service company to lease and operate parts of this infrastructure where detailed expert knowledge is required for maintenance and repair.

The need to become authorised as a water service provider[6] can be avoided altogether under the third form of ownership noted above: a land subdivision scheme with a common property and lot entitlements for each lot owner.[7] In this case, the water service infrastructure is communally owned by all the lot owners and all interactions between individual owners and their representative body, the body corporate or owners association, is governed by existing legislation for managing such multi-title schemes. As indicated above, some minor differences exist in the wording that defines ownership over common property in the three states investigated. In general, however, the body corporate is seen as the principal owner of land and all movable assets associated with the common property. Accordingly, this report refers to the ‗bodycorporate' as the owner of common property and all its moveable assets.

Since bodies corporate are empowered under legislation to collect levies and fees, it follows that these powers could be extended to include the collection of levies associated with water service provision, without the need for any further granting of power (and associated obligations[8]). A body corporate would also need to hold all relevant water treatment and water extraction licences and permits. A body corporate could also engage a water service company to operate, monitor and maintain the water service equipment, without the need for registration of this company as a service provider.

The common property of a communal land subdivision is commonly designed to form a continuous section of land for open space purposes, visual amenities, and recreational activities. Part of the common property can be screened off and used for housing water treatment facilities. Other parts can be landscaped around lakes, which can add to the overall value of the complex and also function as a reservoir for storing excess water. In many parts of Australia, the ornamental vegetation commonly used on such land requires ongoing irrigation. Water required for cleaning driveways, car parking spaces and other communal areas adds to the water demand of such complexes. These demands can be met from rainwater, stormwater, greywater or recycled water (or any combination) distributed through a large, and therefore more economical irrigation system.

Finally, bodies corporate can be constituted with rules, also referred to as by-laws, with the capacity to influence the behaviour of lot owners. For example, such rules can require lot owners to use phosphate-free or phosphate-reduced laundry detergents, soaps and other cleaning products to reduce phosphate loads in their sewage streams and, accordingly, their treated effluent. By-laws can also be used for setting water restrictions and even designing project-specific economic incentives (through a combination of water services charges and body corporate fees). Such ‗atsource' measures can be much more effective than technically complex and generally more expensive end-of-the-pipe solutions. As disclosure obligations under a sales contract require the inclusion of the body corporate by-laws,[9] future lot buyers would be made aware of the rules relating to water management. Such knowledge can facilitate a selection and filtering process that increases the likelihood of attracting lot owners who are positively disposed to localised water management.

1.4 Applications for decentralised systems: greenfield *versus* brownfield sites

The demands placed on a DWMS and the extent of its overall contribution and significance to a development project are greatly affected by its location relative to an urban footprint. Access

[6] By agreement or through registration with a relevant authority (e.g. *Water Supply (Safety and Reliability) Act 2008* (Qld) Ch 2)

[7] For example: *Water Supply (Safety and Reliability) Act 2008* (Qld), Schedule 3 (Dictionary): the definitions of *water services* and *sewerage services* explicitly exclude bodies corporate from provisions under Ch 2, Part 4, of the Act.

[8] For example: under the *Water Supply (Safety and Reliability) Act 2008* (Qld), Ch 2, Part 4.

[9] For proposed lots in Queensland, and all lots in NSW and Victoria.

to centralised water service infrastructure is commonly available when developing an inner-city ‗brownfield' (infill) site; however, existing town water and sewer capacities commonly need upgrades to carry additional loads associated with the higher densities resulting from such developments.

Developing a project on a ‗greenfield' site outside the limits of urban water services, especially sewerage, either requires major upgrades or extensions of existing pipe networks, or implementation of some alternative sewage treatment system(s), such as onsite, (decentralised) communal or district systems (for definitions see Chapter 2). It is notable that projects in remote areas have no option but to depend on an onsite or decentralised water and wastewater system(s).

1.5 Report aims

The foregoing discussion highlights that a land subdivision with a common property (a community title subdivision) presents a number of opportunities and a mechanism for the development of a DWMS. This report investigates the potential and challenges associated with using a strata and community title (S&CT) land subdivision as the basis for developing a DWMS. The aims of the report are to provide:

- an overview of the potential, challenges, development concepts and terminology for DWMSs and S&CT land subdivisions (Chapters 1 and 2)
- a review of the current regulatory frameworks governing the implementation of S&CT schemes and DWMSs (Chapter 3)
- a compilation of current stakeholder concerns and potential issues with water management initiatives undertaken by bodies corporate (Chapter 4)
- a comparison of the components and characteristics of DWMSs for existing S&CT developments (Chapter 5)
- a compilation of the study's findings followed by recommendations of measures considered necessary to increase the implementation of DWMSs through S&CT land subdivisions (Chapters 6 and 7).

2. Definitions

The development, construction and operation of projects with DWMSs involves a complex array of stakeholders. These include government regulators, water managers in water corporations, developers, technology providers, strata managers, resident or facility managers, lot owners, and local communities. Over time, stakeholders and end-users have developed a range of terms for characterising different water management systems, sources of water, types of development sites, and types of community or strata-title subdivisions that can be involved in water recycling schemes. The following provides definitions of these terms and defines the way they are used in this report. The report's primary focus on New South Wales (NSW), Queensland and Victoria has determined the way some terms are used.

2.1 Decentralised systems

In the twentieth century, water industry professionals initially focused on the establishment of pipe networks and basic treatment systems to provide reliable water supply and sanitation systems to support rapid urbanisation. During the past 20 years, there has been an increasing focus on advancing the capacity and quality of water and sewerage service systems, which today include solutions designed to service any type of development, ranging from individual households to entire cities. Much emphasis has been placed on developing or improving new and existing water and sewage treatment technologies, which cover a range of processing capacities (volume flows) and have provided new opportunities for delivering water from different sources. Integration with rainwater, stormwater and greywater systems has enabled water managers to utilise a broad spectrum of arrangements—technological combinations, property and equipment ownership structures, and operational and management concepts—as alternatives to traditional centralised solutions for designing and implementing water services for modern urban developments. With advances in such water treatment technologies, the water industry started to use, and liberally apply, the term 'decentralised systems' to refer to the new concepts that moved water management away from its traditionally centralised orientation (Abegglen and Siegrist 2006, Al-Jayyousi 2003, Charles et al. 2003, Crites and Tchobanoglous 1998, CSIRO 2009-in press, Friedler and Hadari 2006, Gnirss et al. 2003, Goddard 2006, Hedberg 1999, Hobus and Hegemann 2003, Huang et al. 2006, Kariuki and Schwartz 2005, Lundie et al. 2004, Massoud et al. 2009, Merz et al. 2007, Ogoshi et al. 2001, Otterpohl et al. 2003, Peter-Varbantes et al. 2009, Sample and Heaney 2006, Tadkaew et al. 2007, Wilderer 2001).

The term 'decentralised system' is broad and its meaning varies depending on the geographical and operational context in which it is used. What is considered a decentralised solution for one or several 'townships' in Asia may be of a size similar to a centralised system for a small city in a less populated country such as Australia. Recently, the energy supply industry has also started to refer to 'decentralised solutions' for renewable energy technologies and heat and power cogeneration systems. The under-defined nature of 'decentralised systems' might represent a minimal problem for technical experts; however, government regulators, planners, decision makers and the finance and insurance sector have to integrate these 'decentralised' concepts into their existing regulatory and administrative frameworks. The primary interests of these stakeholders rest in establishing mechanisms that assure safe, reliable and cost-effective operation of water management facilities. This, in turn, requires the assignment of responsibilities and associated regulatory obligations and restrictions.

Due to the wide spectrum of decentralised systems and the general focus of this study (regulatory aspects of ownership models to facilitate long-term operation), the concept of ‗decentralised systems' has been subdivided into three types:

- onsite systems
- communcal systems
- district systems.

Onsite systems service only one or two lots or households, are wholly owned by the lot owner(s), and commonly comprise septic tank systems or other technologies with similar processing capacities.

Communal systems include any communal, privately-owned, water service infrastructure that services more than two, and typically more than five, to possibly 2000 or more lots developed under one principal development application. Private ownership of water service infrastructure can include:

- deeded agreements between all service recipients to own and maintain a water service network as part of a standard land subdivision
- land-title based ownership as part of lot entitlements in common property
- full ownership by a private water service company rather than a government-owned water authority.

With regard to their overall size, developments with a decentralised communal system can be subdivided into two further categories:

- small to medium projects with more than two to around 250 lots, often boutique-style and usually planned and built by a smaller, local developer in two to three stages
- large (themed) projects of around 500 to around 2000 lots, often built by large, national or international development companies in five to ten stages and over five to ten years.

District systems commonly service large to very large projects (typically around 5000 to 20,000 lots) that have been instigated by local or state governments. They are often located on large government land holdings (freehold or leasehold) or land designated by special planning instruments for development of major projects or whole townships. The key characteristic of this type of system is a water service network that is independent of existing centralised infrastructure and that is specifically designed to cover several developments on separate development applications in a specifically defined local service area. In Australia, such district systems are commonly, but not exclusively, owned and operated by a local, mostly government-owned, water authority.

Much of the material and concepts presented in this report focus on communal ‗decentralised' systems, which are frequently but not exclusively associated with strata and community title (S&CT) land subdivisions.

2.2 Recyclable water sources and their common risk factors

2.2.1 Recyclable water sources

To date, there are few explicit and coherent legal definitions for the four principle alternative water sources: rainwater, stormwater, greywater and blackwater (sewage). In lieu, the following ‗source-based' definitions have been compiled from the Australian Guidelines for Water Recycling (Phase 1) and a number of descriptions of water reuse options provided by state and local government authorities to inform end-users (mostly property owners) about policies in relation to water savings and reuse schemes.

Rainwater

Rainwater is generally considered as water collected directly from a non-trafficable roof into a rainwater tank or equivalent holding device installed within a development site, usually close to the roof of the dwelling used for water collection. The water may pass a first-flush diverter connected to a stormwater drain or an urban sewer main. Rainwater can carry animal faeces (and with it pathogens), organic materials, trace metals and other urban debris blown onto roofs. Most rainwater installation guidelines require appropriate screening of inlet and outlet pipes to prevent mosquitoes and other vermin entering the rainwater systems.

Overland flow (stormwater)

The water that constitutes stormwater is perhaps best defined by its presence in stormwater drains, channel pipes, chambers, structures, outfalls or other works used to receive, store, transport or treat stormwater. In other terms, it constitutes water that appears, and is collected in, mostly man-made in-ground or on-ground structures after rain falls. The definition for stormwater can also include overland flow from natural watercourses and drains after very heavy rain events. Stormwater carries higher pollutant loads than rainwater, including rubbish, sediments, animal faeces, human faecal wastes (in some areas, especially near sewer overflows and in areas of aging sewer systems), motor oil, petrol, tyre rubber, trace metals, soil and debris.[10]

Greywater

The term greywater is used primarily for water from laundry, bath, shower and handbasins. In theory, greywater includes water from kitchen sinks and dishwashers. In some jurisdictions (such as Queensland), kitchen waters are excluded from the definition of greywater;[11] this is due to their potential for carrying higher concentrations of contaminants, notably high levels of oil and grease, food scraps (organic nutrients), fungi and bacteria. Other constituents found in greywater may include urine and faeces from nappy washing and showering, as well as soil, hair, detergents, cleaning products, personal-care products, sunscreen, fats, grease and oils (laundry). Cleaning products in greywater can contain boron and phosphates, and the water is often alkaline and saline.

Blackwater (sewage)

Any water that is found in a pipe network or drain connected to a toilet or urinal is considered as blackwater or sewage—commonly the water of non-separated waste streams in internal

[10] Australian Guidelines for Water Recycling Phase 1, 2006, p. 9 Box 1.3.

[11] *Plumbing and Drainage Act 2002* (Qld), s. 128L and s. 128M.

household drains from kitchens, bathrooms and toilets of domestic and other buildings. It is recognised as always carrying sufficient contaminants, notably human pathogens (viruses, bacteria, protozoa), to trigger classification as regulated wastewater which, if released untreated into the environment, is likely to cause environmental harm. Other major contaminants include high levels of nutrients, particularly phosphorus and nitrogen. Another set of chemicals of concern is pharmaceutical compounds such as endocrine disruptors (such as hormones) and antibiotics.

A particular subclass of blackwater or sewage is classified as ‗trade wastes', which is water discharged from manufacturing premises (industrial and commercial).[12] This usually contains higher concentrations and loads of a range of contaminants, particularly chemicals. Other subtypes of blackwater include wastewater from hospitals and many research establishments, which are particularly prone to high levels of medical wastes and biologically hazardous compounds; and so-called ‗yellow' water where urine and faecal matter waste streams are separated.

Wastewater from decentralised systems at the urban subdivision scale tends to have the advantage of carrying lower levels of persistent contaminants and pollutants (such as trace metals and hydrocarbon residues, Diaper et al. 2007) than do large centralised systems where stormwater infiltration is more likely to occur (see s. 2.2.1).

Most guidelines do not deal specifically with recycling of water from industrial and commercial sources. Such waters are generally subject to special trade waste agreements with very specific conditions relating to quality, variability and quantity.[13] Recycling of trade wastes is therefore not considered further in this report.

2.2.2 Risks

Determination of the risk associated with deriving water from alternative sources is complex and generally specific to a particular situation. It depends on the type and location (influx of contaminants) of the development, the volumes required to be treated, the types of source controls available, the possibilities for treatment and storage, and the likelihood of exposure to humans and the environment. It is therefore beyond the scope of this report to reflect on all possible scenarios. The Australian Guidelines for Water Recycling provides the framework for assessing and quantifying the risk of recycling intiatives. Onsite and communal decentralised systems appear, however, to have the advantage of tighter source control relative to centralised systems. For example, inflows into many decentralised systems contain predominantly domestic household and human wastes. The risk and necessary treatment associated with such wastewater can be determined by considering, *inter alia*, the demographic profile and recreational activities of the people served by a particular system. Older people and retirees have a propensity to use more medications, including antibiotics, and are more likely to release higher concentrations of pharmaceutical compounds with lower but more consistent levels of pathogens,[14] whereas families with young children can produce relatively high amounts of highly infectious gastro-enteric viruses, bacteria, and protozoa. Accordingly, water and public health professionals can seek to manage risks by tailoring decentralised water systems in light of the demographic to be serviced. As indicated above, this process of risk minimisation is complex and falls outside the primary focus of this study.

[12] *Water Act 2000* (Qld), Sch. 4 Dictionary.

[13] *Water Act 2000* (Qld), Pt 5 s. 469.

[14] With increasing age, individuals have a greater chance to become exposed to pathogens (e.g. viruses such as herpes, hepatitis A or B and also bacteria and protozoa (giardia or cryptosporidium)), and they are more often asymptomatic carriers of the relevant diseases.

2.3 Greenfield, brownfield and remote sites

When planning and designing water services for new developments, water service providers distinguish between two principal scenarios: developments within declared service areas (existing or already planned service networks), and developments outside these service areas. For the most part, this view overlaps with two terms—greenfield sites and brownfield sites—that are frequently used by planning professionals and policy makers when arguing the merits of restraining urban sprawl. Despite their frequent use, the definitions for these terms still vary (see Adams and Watkins 2002, Alker et al. 2000, Oliver et al. 2005). For the purpose of this report, and to align perspectives of water service providers and planners, these two planning terms are used as described below.

Greenfield sites (mostly land outside declared water service areas) are residential or mixed-use subdivisions of relatively large, freehold title lots covering land previously cleared, or partly cleared, for low-value agricultural practices such as livestock farming. These are commonly located in:

- the outer urban fringe (or peri-urban areas)
- a future node or corridor for urban growth designated as a link between two or more existing centres.

In these sites, water service infrastructure (town water and sewer mains) requires either major upgrades of existing pipe and water treatment facilities or the development of new services and relevant trunk networks.

Brownfield sites (mostly land within a declared water service area) are mostly residential subdivisions within the urban footprint on previously developed land[15] that:

- is or was occupied by a permanent structure (excluding temporary agricultural or forestry buildings), and associated fixed surface infrastructure
- includes old government land holdings (crown land to be converted to freehold, 99-year leasehold, or other forms of tenancy) and land used for mineral extraction and waste disposal where provision for restoration has not been made through development control procedures
- may or may not be subject to contamination or other development constraints (such as flooding, steep slopes).

It is also important to stress that some projects manifest characteristics of both types of development sites and therefore signify a continuum of scenarios between the two categories referred to in this report.

A third category of developments in the context of delivering water services are projects in **'remote' areas**, where either no water service infrastructure exists, or existing networks have such limited capacity that they need to be replaced or completely redesigned in order to accommodate the loads generated by new development. The key triggers for DWMSs in these areas are (a) sufficient rainfall and availability of ground and surface waters for potable uses; and (b) small lot sizes or high building densities envisaged by the developer or approval authority. The alternative to a decentralised communal system—a number of onsite systems (mostly septic tanks)—is no longer practical where a project, or some parts of it, requires subdivision into lots of less than 1000 to 2000 square metres.[16]

[15] Typically old harbour areas, abandoned industrial sites, education facilities, non-viable shopping centres etc.

[16] This depends on state and local planning provisions.

Projects in remote areas destined for DWMSs are commonly located a few hours drive from a major urban centre in localities with high amenity values (such as mountains, seaside) to provide short-term (tourism) accommodation and second homes.

2.4 Strata and community title

During the past five decades, each Australian state and territory has developed, implemented and revised its statutes to enable strata or community title property ownership schemes. This has typically involved subdividing real estate property into lots and common property, with the common property managed by an incorporated body (Ardill et al. 2004, Everton-Moore et al. 2006). Frequent regulatory interventions have generated, despite earlier definitions (Ball 1984), a range of terms relating to such subdivisions and their bodies corporate, including ‗strata', ‗strata schemes', ‗community land development schemes', ‗community title schemes', ‗subdivisions with owners corporations', ‗owners corporations', or ‗owners associations'. For stakeholders outside the S&CT and legal fraternity, the distinction between strata title and community title subdivision can be ambiguous.

To make it clear:

- ‗strata title' is used in this report for building subdivisions that include horizontal subdivisions of multi-storey buildings (including terrace complexes) and vertical subdivisions of townhouses (or row houses) and duplexes, villas and the like. All these divisions are tied to a common property, which is owned communally
- ‗community title' is used for land subdivisions that include detached dwellings on individual lots tied to a common property, which is owned communally either directly or, more commonly, as part of a subsidiary scheme's lot entitlements in the common property of an overarching principal body corporate.

With respect to administrative arrangements, many professional strata managers might argue that these two concepts need not be differentiated. With regard to providing alternative water services, however, strata title complexes are much more limited with respect to applying communal solutions than are detached dwellings in a community title scheme.

As for other definitions used in this report, it is important to recognise that, in practice, these concepts can be integrated with one another—strata subdivisions can be part of community title schemes and community title schemes can be dominated by strata subdivisions. That is, planned communities can be structured to incorporate strata title schemes (such as low or high rise buildings) *and* community title schemes (lots with single detached dwellings). Often these types of schemes are layered and developed in stages over a number of years.

3. Legislative framework in NSW, Queensland and Victoria

This chapter outlines key statutory provisions and requirements contained in environmental and public health management guidelines that determine the opportunities and restrictions for developing DWMSs for community title subdivisions and other projects. Emphasis has been placed on capturing the situation in NSW, Queensland and Victoria, which are the three states with the largest number of S&CT subdivisions. Provisions in other states and territories are only referred to where substantially different control mechanisms apply.

Opportunities for incorporating decentralised water management strategies into multi-unit complexes are, in the first instance, determined by provisions under:

- building codes or standards
- water use and water services legislation
- planning and development control laws
- S&CT management statutes.

These all differ between states and territories, and they are constantly subject to revision and modification. The following overview of the most relevant regulatory constructs in the three states noted above is based on material available as of August 2008. Each of the following subsections addresses one of the questions below:

- What types of water management measures are required under building codes and standards?
- What are the prerequisites for registration (or licensing) as a water service provider, related headworks charges, and required connections to water service networks when supplying water (rainwater, stormwater, treated greywater or recycled water) to unit owners in a strata or community title complex?
- Which mechanisms are available to local and state governments or water authorities to influence the design, and monitor the operation of DWMSs in strata or community title complexes?
- Which provisions under S&CT laws could adversely affect or prevent the implementation and operation of decentralised water management solutions?
- Are there any other provisions at the federal level that could have an effect on DWMSs?

3.1 Provisions for meeting water saving targets under building standards

Responding to concerns about climate change, in 2000 the Australian Government reached an agreement with the states and territories to adopt mandatory minimum energy efficiency building standards. In 2003, these national standards were incorporated into the Building Code of Australia (BCA) for class 1 and 10 buildings (detached houses, terrace houses, town houses, villas). Provisions for other classes of building (including apartments and commercial buildings) were subsequently adopted.

Similar mandatory efficiency standards have not been provided for in the BCA for water, but there has been recognition that a similar national approach is required. More recently, water

efficiency measures have been implemented in some Australian states under state building regulations, and compliance with those measures is assessed during the building approval process. Some states have incorporated the BCA minimum energy efficiency standards with their own water efficiency standards to create a state-based sustainability system for buildings. Until 2008, most regulatory initiatives focused on class 1 buildings, predominantly detached houses (Table 1 below).

In NSW, the Building Sustainability Index (BASIX) has been implemented for new developments in an effort to reduce greenhouse gas emissions and increase water savings, by setting reduction targets. Since its inception in 2004, an average of:

- 95 per cent of BASIX certificates nominated a rainwater tank as the preferred requirement
- 90 per cent chose to connect an alternative water supply to toilets
- 75 per cent connected an alternative water supply for laundry use
- 98 per cent used an alternative water supply for garden watering (Department of Environment and Heritage 2006).

It has been estimated that, during the 2005 to 2008 period, a total of 290 million litres could be stored in installed tanks in NSW (NSW Department of Planning 2008)). The BASIX system, however, leaves room for interpretation and choices between water and energy saving measures. Also, following the issue of occupation certificates, no further compliance checks are mandated to ensure that the proposed water saving measures are in use and have not been disconnected.

The Queensland Development Code has implemented water saving targets (class 1 buildings only, MP 4.2) and alternative water source requirements (commercial buildings, MP 4.3) for new developments in Queensland. Targets can be achieved by installing rainwater tanks or alternative water management systems (dual reticulation, communal tanks, stormwater reuse or approved greywater treatment plants). Strict minimum storage capacity requirements for tanks have been identified in the code. For detached dwellings, a minimum 5000-litre capacity tank is required, and it must supply water internally to all toilets and washing machine cold taps. Alternatively, the use of recycled water or water from alternative sources can substitute for these conditions.

Although Queensland offers some flexibility in relation to the type of system that can be installed to reach the target (and exemptions apply to specified council areas), the requirements mandated appear less flexible than the NSW index. For example, the NSW index allows users to focus on energy efficiency and water saving devices to reach the set target (an overall score of points), whereas Queensland requires users to install either a rainwater tank or a specified system (such as a greywater reuse) to capture or produce water from an alternative source.

In 2005, the Victorian Government introduced a '5 Star‘ standard for energy and water for all new buildings (class 1 and 2). From 1 May 2008, the standard also applied to all house renovations and relocations. The standard for energy efficiency is in line with the BCA minimum requirements. The standard also requires applicable dwellings to be fitted with water-saving tapware, flow reduction showerheads and either a rainwater tank or a solar hot water service.

Table 1: Provisions under building standards and codes in NSW, Queensland and Victoria

	NSW	*Queensland*	*Victoria*
Building standard or code	BASIX [17]	Queensland Development Code, water saving targets	BCA, 5 Star standard [18]
Applicable BCA building classes	Class 1 (single detached dwelling, group of two or more attached dwellings, including town houses, villa units, boarding houses, guest houses and hostels)		
	Class 2 (multi-storey buildings with 2 or more sole occupancy units each being a separate dwelling) Class 4 parts (a dwelling in a building that is predominately commercial (classes 5–9) if it is the only dwelling in the building).		Class 2 (multi-storey buildings with two or more sole occupancy units each being a separate dwelling).
General requirements	A new residential development proposal is required to achieve a score of 40 for Water (representing a 40% reduction in mains-supplied potable water consumption compared to the average NSW dwelling) and a score of 25 for Energy (representing a 25% reduction in greenhouse gas emissions compared to the average NSW dwelling) to obtain a BASIX certificate.	Specified buildings connected to reticulated town water supply system must achieve water saving target specified in Appendix A, MP 4.2 Queensland Development Code[19]. Water saving targets are specified for seven areas identified by LGA boundaries. Targets ranges from 10 to 70 kL per year.	All new houses and renovated or relocatable houses are required to achieve a 5 Star standard. Mandatory measures include the installation of a rainwater tank or approved solar hot water service. Apartment buildings are required to achieve a 5 Star standard for the whole of the building with no individual apartment achieving less than 3 stars. The standard can be achieved by utilising 5 Star standard building fabrics and water saving measures.
Provisions under building legislation	A BASIX certificate must accompany every new development application.[20]	Water management devices are code assessable and have to comply with Queensland Development Code MP 4.2 (formerly Pt 25).[21]	It is the applicant's responsibility when applying for a building permit to provide evidence to the Relevant Building Surveyor that the building design complies with the BCA provisions and for new class 1 buildings and also details of the tank or solar hot water system to be installed.

[17] BASIX is essentially a target index which ensures that new houses and units are designed to use less potable water and energy. A BASIX certificate will not be issued unless it contains a list of commitments by the applicant that meets the state's targets. A number of measures may be selected from an online tool, which is available to applicants for the purpose of assessing the development's sustainability. An occupation certificate will only be granted by the issuing authority if the commitments stated in the BASIX certificate have been complied with s.50 of the Environmental and Planning Assessment Regulation 2000 (NSW).

[18] The 5 Star Rating Standard applies to Class 1 and 2 buildings as classified under the BCA. Section 9 of the *Building Act 1993* (Vic), notes that a building regulation may adopt wholly or partly matters contained in the BCA. Section 109 of the Building Regulation 2006 (Vic) adopts the BCA, which forms part of the regulation. Section 112 of that regulation states that a building is classified in accordance with the BCA.

[19] By either installing a rainwater tank, a greywater treatment plant or an alternative water substitution measure (communal rainwater tanks, dual reticulation or treated storm water) or a combination of these solutions as specified in the relevant local planning scheme, state code or state planning policy.

[20] Environmental and Planning Assessment Regulation 2000 (NSW), Schedule 1, clause 2A.

[21] *Integrated Planning Act 1997* (Qld) s. 4.3.1 and 4.3.2, *Building Act 1975* (Qld) and Building Regulations 2006 (Qld), Sch 1, s. 13.

	NSW	*Queensland*	*Victoria*
Rainwater harvesting	An alternative water source for compliance with water saving targets under BASIX[22]	An acceptable water saving solution[23] Minimum capacity 5000 L (detached dwellings), 3000 L (non-detached dwellings). Rainwater tanks have to be connected to toilets and washing machine	An acceptable water saving solution. For class 1 buildings only, the tank must be connected to all sanitary flushing systems[24]
Building standard or code	BASIX [25]	Queensland Development Code, water saving targets	BCA, 5 Star standard[26]
Stormwater harvesting	Is an alternative water source available under the BASIX, no further requirements stipulated	Treated storm water is an alternative water substitution measure that can be used to achieve targets set under the Queensland Development Code[27]	Not seen as an acceptable water savings solution
Greywater	Both greywater treatment and diversion systems are alternative water sources available under the BASIX	An acceptable water saving solution Queensland Development Code MP 4.2, performance criteria P11: amongst other things, the treatment plant must not have a storage capacity greater than 2000 L, must have a minimum processing capacity to treat volume within 24 hours and an automatic switching device providing supplementary town water	Treated greywater can be an alternative water savings solution
Sewage recycling	Not seen as an acceptable water savings solution		

[22] Under BASIX, there are no tank capacity requirements. A recent audit found that most single detached dwellings had a 4000 L tank installed.

[23] Queensland Development Code MP 4.2, performance criteria P2. There are ten (10) performance criteria that must be observed when installing a rainwater tank under the Code. Such criteria include, measures to prevent contaminants, specific internal fixtures, backflow prevention devices, suitable support structures.

[24] It is a requirement that class 1 buildings install either a rainwater tank for toilet flushing or an approved solar hot water service, it is not however a requirement for class 2 buildings.

[25] BASIX is essentially a target index, which ensures that new houses and units are designed to use less potable water and energy. A BASIX certificate will not be issued unless it contains a list of commitments by the applicant that meets the state's targets. A number of measures may be selected from an online tool, which is available to applicants for the purpose of assessing the development's sustainability. An occupation certificate will be granted by the issuing authority only if the commitments stated in the BASIX certificate have been complied with s. 50 of the Environmental and Planning Assessment Regulation 2000 (NSW).

[26] The 5 Star standard applies to Class 1 and 2 buildings as classified under the BCA. Section 9 of the *Building Act 1993* (Vic), notes that a building regulation may adopt wholly or partly matters contained in the BCA. The Building Regulation 2006 (Vic), s.109 adopts the BCA as part of the regulation. Section 112 of that regulation states that a building is classified in accordance with the BCA.

[27] Queensland Development Code, MP 4.2, performance criteria P1.

Table 1 highlights that, although there is a national approach to energy efficiency in Australia, water efficiency measures vary depending on state regulations. There are inconsistencies in relation to: the classes of buildings affected by water management requirements, the types of alternative water solutions that can be utilised, minimum storage capacity requirements (for tanks), water saving targets, and the degree of flexibility for alternatives.

The information compiled in Table 1 shows that:

- there is no national approach to water efficiency in Australia
- only NSW and Victoria have set minimum water efficiency requirements for class 2 buildings (multi-unit building structures with more than one storey)
- there is no mandatory requirement for multi-unit dwellings (class 2) to install communal rainwater tanks in any of the three states investigated
- water efficiency targets or scores are measured differently in each of the eastern states (NSW – 40 score, Queensland – range of targets depending on location, Victoria – 5 Star standard)
- Queensland is the only eastern state that sets targets depending on location and provides exemptions
- stormwater harvesting and reuse is not seen as an acceptable water saving solution in Victoria
- sewage recycling is not an allowable water savings solution under current building codes and standards in any of the three states investigated.

3.2 Water service provisions

The use, flow and control of most forms of water in each state fall under state‘s rights as vested in the Crown. In practice, these rights carry an obligation on each state to manage the use of water and, depending on the definitions of the types of water covered under these rights, all relevant water services.

The following four areas (further detailed in Tables 1 and Table 3) were considered as the key water service provisions that can impact on (a) a developer‘s desire and choice to implement water management systems within a strata or community title scheme and (b) the ability of a body corporate to provide water and wastewater services both within and outside the scheme (Table 2):

- registration and licensing of water service providers
- connecting to existing water service infrastructure
- headworks charges
- water service charges and water metering.

Table 2: Water service provisions

Aspects of water services	*NSW*		*Queensland*		*Victoria*	
	Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
General registration and licensing	A network operator's licence is required for the construction, maintenance and operation of water and sewerage infrastructure; and a retailer supplier's licence is required for the supply of water or the provision of a sewerage service.[28]	Independent Pricing and Regulatory Tribunal[29]	An LGA, water authority or person who charges for the supply of a water or sewerage services must register as a service provider.[30]	Department of Natural Resources and Water[31]	Upon invitation from the Minister, a person (applicant must be Victorian body corporate or a statutory corporation) can apply for a water, water and sewerage, sewage treatment, drainage or water headworks licence in an area specified.[32]	Department of Sustainability and Environment
Licensing exemptions for communally owned systems	An exemption applies to the general licensing requirements if the water or sewerage infrastructure is wholly situated on premises owned by the one person and that person owns and controls the infrastructure.[33]		An exemption applies to the general requirement if the purpose of the infrastructure is to produce and supply recycled water and no other water or sewerage infrastructure is owned by that person.[34] An exemption also applies for bodies corporate that supply water and sewerage services to the occupants of the lots under the scheme.[35]		No exemptions apply.	

[28] *Water Industry Competition Act 2006* (NSW) s. 5. Note: an application for a network operator's or retailer supplier's licence can only be made by or on behalf of a corporation (s.8).

[29] The Independent and Regulatory Pricing Tribunal administers the operating licences.

[30] *Water Supply (Safety and Reliability) Act 2008* (Qld) s. 20(1).

[31] The department became part of the Department of Environment and Resource Management in 2009.

[32] *Water Industry Act 1994* (Vic), s. 5, NOTE: so far ' areas specified' under this section have been limited to metropolitan Melbourne—other parts of Victoria follow s. 72 of the *Water Act 1989* (Vic).

[33] Water Industry Competition (General) Regulation 2008 (NSW) s. 19. Note: Although neither the *Water Industry Competition Act 2006* (NSW) nor the accompanying regulation define 'person', section 21 of the *Interpretation Act 1987* includes a body corporate under the definition of 'person'.

[34] *Water Supply (Safety and Reliability) Act 2008* (Qld) s. 20(2).

[35] *Water Supply (Safety and Reliability) Act 2008* (Qld), Schedule 3. The general requirement under s. 20 does not apply as noted in the definition of water service and sewerage service.

Aspects of water services	*NSW*		*Queensland*		*Victoria*	
	Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Connection to existing networks	The LGA can compel an owner or occupier of premises to connect to the authority's water or sewerage system.[36]	LGA	A service provider can compel an owner of premises to connect to the provider's water or sewerage system.[37] An owner of premises within a sewered area must ensure that blackwater and kitchen greywater are discharged into infrastructure of a sewerage service provider.[38]	Department of Natural Resources and Water, Department of Infrastructure and Planning	A water corporation can compel an owner to connect to its works.[39] A retail licensee can compel a land owner to connect to the sewer if, after consultation with the relevant authorities,[40] it is of the opinion that it is in the interest of health or the environment,[41]	Water Authority

[36] *Local Government Act 1993* (NSW), orders 23 and 24 s. 124. The local council can order the connection: (1) to a water supply system if the premises are located within 225 metres of the council's water pipe and (2) to a sewerage system if the premises are located with 75 metres of the council's sewerage system. There are no similar provisions under the *Sydney Water Act 1994* (NSW) or the *Hunter Water Act 1991* (NSW) that compel landowners to connect to the Sydney or Hunter waters' systems. However there are provisions under the *Sydney Water Act 1994* (NSW) (s. 64) and the *Hunter Water Act 1991* (NSW) (s. 43 and 45) that allow the corporations to charge an availability levy (and under the *Hunter Water Act 1991*, an environmental levy) on an owner who does not connect to the corporation's sewer or water mains.

[37] *Water Supply (Safety and Reliability) Act 2008* (Qld), s. 168. A notice may be given to a landowner requesting works to be undertaken for the connection.

[38] *Plumbing and Drainage Act 2002* (Qld) s. 128K and 128L.

[39] *Water Act 1989* (Vic) s. 147.

[40] Department of Human Services or the EPA

[41] *Water Industry Act 1994* (Vic) s. 65.

3.2.1 Registration and licensing of water service providers

Following the 1994 Council of Australian Government water reforms, there has been a restructuring and commercialisation of the water service industry in all states and territories. This, together with the advent of new technology, has opened opportunities for private sector operators to compete with large public utilities for a market share in providing water and wastewater services to individual households and industry (Gray and Gardner 2008).

During the past decade, authorities in each of the states reviewed have embarked on developing regulatory frameworks for water service provisions to ensure that, under such partially deregulated conditions, both public and private entities supply safe and reliable water (and sewerage) services. The main issue of interest under these recently promulgated water service provisions relates to the status of a body corporate with a DWMS: would such a body corporate be required to register or be licensed as a service provider in the event that it either (a) services only those lots within the scheme or (b) services lots inside and outside the scheme.

In all three states, regulatory authorities were primarily concerned about services provided by large urban water corporations, their retailers or private entities involved in new irrigation schemes in the wake of new laws under the national water reform. The general view in all three jurisdictions was that the use of any water infrastructure to provide services outside an owner‘s premises is considered a water service. Any person providing such services has to be registered and licensed. Explicit exemptions for S&CT schemes exist only in Queensland, where any water infrastructure owned by the scheme‘s lot owners through their lot entitlements in common property is excluded from the definition of water service infrastructure within the meaning of the *Water Supply (Safety and Reliability) Act 2008* (Qld). Although not explicitly stated, a similar position can be assumed for NSW (Table 2). As soon as a body corporate or owners association intends to sell water produced by its water infrastructure to a lot owner outside the scheme, the general provisions prevail and a licence or registration as a water service provider is required. This includes captured drainage water if it is made available at a cost to parties outside the scheme.

In Victoria, water service schemes outside those operated by large water authorities appear to be unregulated in regard to requirements for registration as water service providers. The case of an owners‘ association being set up with the intention of producing excess recycled water—water not owned by the state—and to sell it to a lot owner outside the scheme has not been considered thus far.

3.2.2 Connecting to existing water service infrastructure

Although the water industry has seen significant changes in recent years, urban water service providers can still retain a monopoly within their declared service areas. In the past, a landowner in a defined service area had very little choice with respect to which water service provider could be connected to. That is, to a large extent, landowners were forced by law to (a) connect to an existing water service network, and (b) enter into a service agreement with the only provider for that particular area. Even though regulatory regimes have been implemented to prevent excessive charges for water and water services (see relevant water industry legislation), landowners are often subject to the discretion of the operator when trying to negotiate permission to operate decentralised systems that require no or much smaller connections to central service networks. The main issue of interest under this heading is whether a water service provider can always compel a landowner (before and after development) to connect to its water and wastewater infrastructure. If a service provider has these rights and enforces them irrespective of altered loads associated with a decentralised system, the cost of connection (including full headworks charges, see below) together with

the cost to install the system could be economically prohibitive. On the other hand, governments and their water authorities will ultimately be responsible for fixing a malfunctioning decentralised system where its owner has consistently failed or refused to act. In serviced areas, a malfunctioning system would be diverted to existing water service networks, which requires provision of relevant powers to either state or local government or water authorities.

For the vast majority of areas, in all three states investigated, governments and water authorities have retained their powers to compel lot owners to connect to existing or planned water service networks. Accordingly, most developments or projects in a declared service area can still be required to connect to a centralised service system if the relevant authority is of the opinion that the decentralised system poses an unacceptable risk.[42] The only exceptions are the water service networks of the Sydney and Hunter water corporations. In these areas, LGAs do not own water service networks and, therefore, s. 24 of the *Local Government Act 1993* (NSW) no longer applies (Table 2). Both the *Sydney Water Act 1994* (NSW) and the *Hunter Water Act 1991* (NSW) do not assign any powers to the areas' water service network owners in regard to compelling lot owners to connect to their services.

In Queensland, the restrictions in regard to operating a DWMS in a serviced area have been taken one step further, as the *Plumbing and Drainage Act 2002* (Qld) introduced penalties for discharging sewage and kitchen greywater unless it is into the sewage network of the local (and registered) water service provider.

3.2.3 Headworks charges

Current legislation empowers LGAs and water authorities to collect 'reasonable and relevant' infrastructure contribution charges from developers for the cost of capital works (including water and sewerage, transport and recreation facilities) they incur in servicing new developments (Frontier Economics 2008). In some jurisdictions, utilities have been given the capacity to charge the fixed infrastructure fee if the water or sewer line passes the property, even if it is not connected (Radcliffe 2003). One significant impediment for a developer wanting to implement a DWMS could be the requirement to pay the standard rates for upgrades and connection to water service networks (commonly referred to as headworks charges) as part of the infrastructure contribution charge for a new development. Headworks charges represent a significant source of revenue for water authorities (Frontier Economics 2008), providing up to one quarter of operating revenue and negating the need to impose extra charges on the end-user (Queensland Water Commission 2007). Theoretically, however, a S&CT scheme with DWMSs might not require all or any of the services of an external service provider and therefore lessen the demand on the authority's services, especially in the case of greenfield developments either side of the peripheral boundaries of a declared service area in a peri-urban environment. In other terms, a reduction in headworks charges could provide a major incentive for implementing decentralised systems. Accordingly, the powers and principles of setting headworks charges in each state can have a considerable influence on developers' decisions as to whether DWMSs are worth pursuing.

In all three jurisdictions, authorities have been given (a) the power to raise headworks charges and (b) the discretion to vary them on a case by case basis (Table 3).[43] For most LGA areas in NSW and Queensland, infrastructure contribution charges are calculated on the basis of the number of equivalent tenements approved under a development application.

[42] For example, in Queensland through compliance or enforcement orders under ss. 780–788 *Water Act 2000* (Qld) in cases of non-compliance.

[43] 'Authorities' include local governments, water authorities or other relevant authorities depending on each jurisdiction.

Table 3: Headworks and water service charges

Aspects of water services	*NSW*		*Queensland*		*Victoria*	
	Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Headworks charges	Contribution costs may be payable by a developer for services as a precondition to granting a certificate of compliance.[44] If a compliance certificate[45] is required for development within the areas of operation of Sydney or Hunter water corporations, contribution costs may be borne by the developer.[46]	LGA Sydney and Hunter water corporations	A development infrastructure levy may be charged to developers for the supply of trunk infrastructure.[47]	LGA	Contribution costs may be borne by a developer if an Authority intends to provide services, which will benefit the property for works that are used or can be used directly or indirectly for the provision of those services.[48]	LGA Department of Planning and Community Development (exemptions)
Water service charges	A local council or water corporation[49] can impose an annual charge for the provision of services such as water supply, sewerage and drainage[50] and a consumption charge.[51]	LGA or relevant water corporation.	A local council can impose a fee for the provision of a water supply and sewerage services.[52]	LGA	A local council[53] and a water and sewerage licensee[54] can impose a fee for the provision of a water supply and sewage services.[55]	LGA or licensee

[44] *Water Management Act 2000* (NSW), s. 306.

[45] A compliance certificate is a certificate issued by the Sydney or Hunter water corporation verifying the compliance of development conditions. Section 70 of the *Sydney Water Act 1994* (NSW) and section 49 of the *Hunter Water Act 1991* (NSW) are the relevant provisions.

[46] *Sydney Water Act 1994* (NSW), s. 75 and *Hunter Water Act 1991* (NSW), s.50

[47] *Integrated Planning Act 1997* (Qld), s.5.1.4. The local government may levy the charges under either an infrastructure charges schedule or a regulated infrastructure charges schedule (as provided for under chapter 14 of the *Local Government Act 1993* (Qld)).

[48] *Water Act 1989* (Vic), s. 268(1).

[49] Sydney Water Corporation or Hunter Water Corporation

[50] *Local Government Act 1993* (NSW) s. 501, *Sydney Water Act 1994* (NSW) s. 60. Water prices in NSW are set by the Independent Pricing and Regulatory Tribunal, an independent government agency.

[51] *Local Government Act 1993* (NSW) s. 502

[52] *Local Government Act 1993* (Qld) s. 973

[53] *Local Government Act 1989* (Vic) s. 162

[54] *Water Industry Act 1994* (Vic) s. 22

[55] The Essential Services Commission may regulate prescribed prices in respect of goods and services supplied by a regulated industry (*Essential Services Commission Act 2001* (Vic) s. 32). A regulated industry is defined as one that provides an essential service, such as water (definition section of this Act, s.3). Section 4B provides that the regulated water industry is a regulated industry. Note: section 24 of this Act relates to owners corporations. A licensee may apportion an amount payable by the owners corporation to the individual unit holders based either on unit entitlements (if so advised by the owners corporation) or by the number of lots affected.

‗Equivalent tenements' is a unit of development that has been designed to estimate the future demand on water services (water and sewage) that are likely to be associated with the number of dwellings erected for an approved project. A standard detached dwelling, for example, may be one unit, whereas a two-bedroom apartment may be 0.5 units, although this will inevitably vary depending on the location.[56] Infrastructure contribution charges per equivalent tenement vary within an LGA or water authority area, depending on the water service precinct (the location of the planned development), yet no standard mechanisms or formulae could be identified to account for reduced water consumption or sewage discharges of a development with a decentralised or more water efficient management system. This leaves practically no other option than to negotiate the charging of schemes on a case-by-case basis, and therefore considerable uncertainties arise for developers when trying to design water sensitive projects at minimal costs to future purchasers and occupants.

3.2.4 Water Service Charges and water metering

The water and sewerage service charges paid to service providers in declared service areas represent another issue for a developer when considering a development with decentralised systems, and whether or not to implement a subdivision under S&CT. Lot owners in an S&CT scheme pay body corporate levies and these will be higher where the body corporate has to operate and maintain its own water service infrastructure. Where an S&CT scheme requires some connection(s) to a local water service network (town water or sewage) and standard water service charges still apply,[57] opportunities will be very limited for off-setting body corporate fees against savings in water consumption and sewage release. Accordingly, a fundamental issue concerns what model should be applied to determine charges for water services provided to an S&CT complex. This raises the question of whether individual lots within S&CT complexes require water meters, how these meters are to be read, and whether mechanisms under water service laws or S&CT legislation would be used to collect water charges, especially those that are outstanding.

For residential premises, most water service providers in NSW, Queensland and Victoria use a two-part tariff system that is based on a fixed service charge supplemented by a consumption-based component (see also Frontier Economics 2008 and Table 4). Sewerage service charges are then added either as a fixed levy or a rate set as a proportion of town water consumption incurred by the lot owner. In the past, most S&CT projects have been built with a single water meter for the whole complex. Accordingly, lot owners were billed for their water use on the basis of the sum of all standard residential service charges applicable to each lot (or the scheme as a whole) plus the water consumption for the whole complex (bulk metering: all individual lots plus the common property) divided by relevant lot entitlements. Mixed-use schemes were often treated as commercial entities, which had to enter into trade waste agreements or special service contracts subject to commercial water service rates.

Bulk metering together with a high proportion of fixed service charges provides little economic incentive for unit owners to implement water-saving initiatives. This situation has been partly addressed, however, since the onset of the last major drought in 2004–05. Major water authorities have started to place more emphasis on consumption-based charges, and Queensland now requires each lot in all new multi-title complexes to be fitted with an individual water meter. The pricing structure for five major water authorities as at November 2008 is presented in Table 4. Average annual water costs per household in five different water authority areas in NSW, Queensland and Victoria are presented in Figure 1. The

[56] See results of household and per capita water consumption in Sydney (Troy et al. 2005).

[57] For a standard household, the service charge component of an individual's water bill can exceed the consumption component by a factor of two or more.

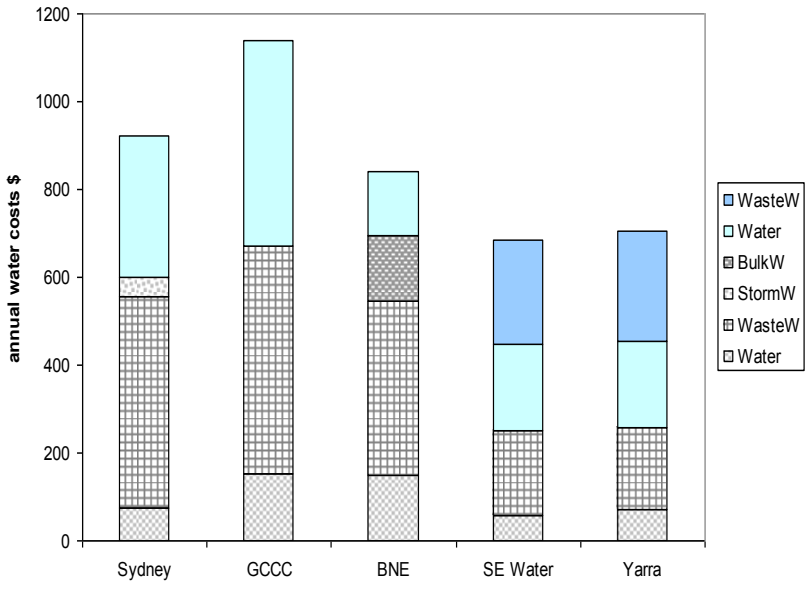
numbers are based on estimated average annual household water consumption in each state. [58]

Table 4: Water charges in selected serviced areas in NSW, Queensland, Victoria (November 2008)

Charges	*Cost item*	*NSW*	*Queensland*		*Victoria*	
		Sydney Water	*Gold Coast City Council*	*Brisbane City Council*	*South East Water*	*Yarra Valley*
Service charges per quarter	Water	$18.94	$38	$37	$14.24	$ ~ 18
	Wastewater	$120.1 (20 mm)	$130	$99.56	$48.16	$ ~ 46
	Stormwater	$11.28	N/A	N/A	N/A	N/A
	Bulk water	N/A	N/A	$37.03	N/A	N/A
Total per annum		$ 601.28	$ 672	$ 694.4	$ 249.6	$ ~ 256
Consumption charges per kilolitre (kL)	Water tier 1	$1.61 (up to 1.096 kL per day)	$1.87 (incl. state bulk water charge of 30c per kL)	$0.59 (for the first 255 kL per year)	$1.0052 (up to 440 L/day)	$1.0192 (up to 440 L/day)
	Water tier 2	$1.83 (in excess of 1.096 kL per day)	N/A	$0.63 (between 226 kL to 310 kL per year)	$1.2206 (between 440-880 L/day)	$1.1957 (between 440-880 L/day)
	Water tier 3	N/A	N/A	$1.12 (in excess of 310kl per year)	$1.9745 (in excess of 880 L/day)	$1.766 (in excess of 880 L/day)
	Wastewater	N/A	N/A	N/A	$1.2565 *	$1.3181 *

Note: N/A = not available, * = estimated on amount of water supplied.

Figure 1: Annual water charges based on average household consumption



Note: grey hatched parts = fixed service charges; blue areas = consumption based charges

[58] NSW = 200 kilolitres per year; Queensland = 250 kilolitres per year; Victoria = 190 kilolitres per year

These calculations clearly indicate that it is only in Victoria that substantial economic gains can be achieved through water savings associated with decentralised systems. Based on the current water billing system (including consumption-based wastewater charges), a 100-lot strata scheme in a serviced area could redirect an estimated $30,000 to $36,000 per annum savings in water service charges[59] to finance decentralised systems by reducing water consumption and sewage production to 20 or 30 per cent of standard household usage levels.[60] Even fixed service charges for multi-title complexes should be reviewed: the water service provider is required only to maintain the pipe network to the main water meter; all the remaining pipes are owned and maintained by the body corporate.

Across the three states investigated, water use and water service provisions, including water-pricing strategies, can be summarised as follows:

- The supply of water to a person who does not own the water infrastructure that provided the opportunity for collecting the water in the first place is considered a water service. Every water service provider is required to be licensed in NSW and Victoria, and registered in Queensland.
- For bodies corporate, an exemption applies in Queensland and may apply in NSW to the general licensing and registration provisions, as long as the infrastructure is situated within the boundaries of the property or scheme and the supply is to the lot owners only.
- In NSW, Queensland and Victoria, a service provider can compel an owner to connect to its works.
- Infrastructure contribution charges (headwork charges) may be imposed on developments as a condition of approval in each of the states reviewed.
- Service providers in each of the states reviewed can impose both a service charge and a consumption charge on lot owners. In NSW and Queensland for most of 2008, approximately one third of the total annual water related charges for an average lot or unit were based on metered water consumption, signfiying only a moderate incentive for end-users to invest in more long-term water saving solutions.

3.3 Planning, implementation and operational control provisions

A key issue of approving a DWMS concerns the mechanisms available to local and state governments or water authorities to influence the design and to monitor the operation of such systems. In each state, relevant mechanisms are tied to the statutory planning and development approval processes. In accordance with the objectives and purposes of respective state planning legislation, a planning authority (usually the LGA) is empowered, and also required, to prepare a local planning instrument that will identify, *inter alia*, areas earmarked for future urban expansion, boundaries of declared water service areas and special development precincts with high residential densities. In other words, LGAs have the power to develop local planning provisions that can compel developers to consider S&CT subdivision and DWMSs in certain areas or, alternatively, ban these types of developments from other areas.

More importantly though, LGAs together with state authorities (with relevant referral bodies) will grant development and building approvals for new projects or upgrades and alterations to existing projects. During the underlying development approval process, relevant authorities

[59] The amount to be paid by all 100 individual lot owners

[60] Note: based on a household consumption of 190 kL per annum. A 20–30 per cent reduction requires supplying bathroom water from rainwater collection systems and reusing all greywater onsite for laundry, car and driveway washing, and landscape irrigation.

must not only ensure compliance with planning, pollution controls and public health standards, policies and schemes, they also set specific conditions relating to the operation and monitoring of water management systems. The following subsections highlight the relevant authorities, their powers and legislation in regard to approvals relating to rainwater tanks, stormwater harvesting works, greywater treatment and re-use systems and effluent recycling schemes.

3.3.1 Rainwater tanks

As noted in section 3.2, the use, flow and control of all water is vested in the Crown. The management of such water is expressly provided for in legislation. The right of landowners to capture rainwater has, in some states, either expressly or impliedly been conferred; this is because the definition of water under the relevant legislation precludes rainwater or the collection of water from roofs.

In NSW, Crown rights extend to water in rivers, lakes, aquifers; water naturally occurring on or below the surface of the land; and ministerially controlled water conserved by works.[61] It is arguable that rainwater captured above the surface of the land and stored in a tank is exempt from the general provision.

Similarly, in Queensland the definition of ‗water' under the *Water Act 2000* generally provides for water in a watercourse, spring or lake, underground and overland flow water and water that has been collected in a dam.[62] A dam for the purpose of the Act excludes rainwater tanks.[63]

The Victorian *Water Act 1989,* however, explicitly confers a right on landowners to capture rainwater that falls on their land and to construct a holding tank for its storage.[64]

Although the capture of rainwater is not heavily regulated, the structure (including the tank) that is required to be built in order to store the water is regulated by local planning and building laws. Local government planning requirements usually determine whether a development approval is required for the installation of rainwater tanks associated with detached houses. For large communal tanks, it is highly likely that a development approval would be required (see Table 5).

For rainwater tanks that are connected to a household (for internal use), or connected to mains water for top-up purposes, state plumbing regulations require a licensed plumber to carry out the works. As noted in Table 1, recent changes to building codes and standards in most states now require rainwater tanks to be connected to a household for toilet flushing, hot water generation, or cold water taps in laundry areas. Although rainwater can be used for drinking and food preparation, most health departments prefer mains water to be used wherever possible. National guidelines have been published for this specific purpose and compliance with the guidelines is required.[65]

[61] *Water Management Act 2000* (NSW), s. 392

[62] *Water Act 2000* (Qld), schedule 4 Dictionary

[63] *Water Act 2000* (Qld), schedule 4 Dictionary

[64] *Water Act 1989* (Vic), s. 8(4)(c) and 10(1)(b). These rights are specifically detailed in Endnote 3, Explanatory Details of the Act.

[65] Australian Drinking Water Guidelines 2004, National Water Quality Management Strategy, National Health and Medical Research Council, Natural Resource Management Ministerial Council, Canberra.

Table 5: Development of communal rainwater tanks in townhouses, terrace houses and multi-storey buildings under integrated planning and associated legislation.

Approvals required		*NSW*		*Queensland*		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	General planning assessment and conditions	Standard assessment of development application (required), conditions of approval within powers of the Act .[66]	LGA	Code assessable development application (required), conditions of approval within powers of the Act [67]	LGA	No specific regulatory approvals are required[68]	LGA in some cases
	Plumbing, drainage and building requirements	A permit may be required for water supply work.[69] A licensed plumber will be required for water supply work.[70]	Sydney Water Corporation, Hunter Water Corporation or LGA	A compliance assessment and certificate is required for regulated plumbing work.[71] Plumbing and drainage work must comply with the Plumbing Code of Australia and Queensland Water Commission.[72]	LGA	A licensed plumber is required for the connection of rainwater tanks to household water and the connection from the gutters to the tank. [73]	Plumbing Industry Commission

[66] State Environmental Planning Policy 4, s.16 outlines compliance requirements for tanks that are exempt development. To be exempt, a tank must, amongst other things, not exceed 10,000 litres, be fitted with a first-flush device, be structurally sound, not exceed three metres in height above ground level, be located at least 450 millimetres from property boundary and be appropriately signed. NOTE: The provision does not apply to land that is a lot within the meaning of the S*trata Schemes (Freehold Development) Act 1973* (NSW).

[67] *Building Act 1975* (Qld), s.21 (sets out building work that is self-assessable), Building Regulation 2006 (Qld), schedule 1(sets out prescribed building work for class 10 structures under s.21 of the act), s. 13 (1)(b) of schedule 1, rainwater tanks for new buildings are exempt from this provision and therefore assessable under *Integrated Planning Act 1997* (Qld), s 3.1.4, s. 13(2) of schedule 1, any rainwater tank less than 2.4 metres in height, five metres length and covering less than 10 square metres for an existing building is self-assessable and therefore not assessable under the *Integrated Planning Act 1997* (and does not require a building certificate). The owner of the property with an existing building still has to comply with relevant codes (in this case: PS codes or the BCA (required under BA S 21 (b)). The Queensland Development Code specifies the standards for the installation of a rainwater tank where a local government requires their installation. It also defines allowable end uses for rainwater—external use, toilet flushing and cold water tap for laundry washing machines. LGA approval is also required for connections from LGA or service provider pipes (carrying water) to rainwater tanks. A backflow prevention device must be installed in those instances. Plumbing and Drainage Standard Regulation 2003 (Qld), s. 45.

[68] However, some LGAs have applied planning controls in relation to the installation of rainwater tanks. A building permit may be required if the tank forms part of the proposed building structure (e.g. rainwater tanks incorporated into the building envelope).

[69] Sydney Water Regulation 2006 (NSW), s.6, Hunter Water (General) Regulation 2005 (NSW), s. 6 applies if there is a connection to the water main of the relevant corporation.

[70] *Local Government Act 1993* (NSW), s. 634, *Sydney Water Act 1994* (NSW), s. 99, *Hunter Water Act 1991* (NSW), s. 64. Water supply work includes water top-up from the water main of the relevant LGA, Sydney Water Corporation or Hunter Water Corporation. All plumbing and drainage works undertaken (within Sydney and Hunter Water areas of operation) must comply with the Plumbing and Drainage Code of Practice.

[71] *Plumbing and Drainage Act 2002* (Qld), s. 81. Regulated work in relation to rainwater tanks includes connection to taps inside the premises but precludes connections for irrigation.

[72] Standard Plumbing and Drainage Regulation 2003 (Qld), s. 8A(1) and 8B(1). The Queensland Water Commission prevails in the event of any inconsistencies.

[73] *Building Act 1993* (Vic), s. 221D (1), Plumbing Regulation 1998 (Vic), s.12.

Approvals required		*NSW*		*Queensland*		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	Public health aspects	No regulatory approvals required					
		Orders from the Minister can be made to prevent public health risks.[74]	Department of Health	A public health order may be given in order to reduce, remove or prevent a public health risk.[75]	Queensland Health	It is an offence to cause or allow a nuisance to emanate from land.[76]	Department of Human Services
Compliance with development application	Pollution control aspects			No regulatory approvals are required.			
		Compliance with development approvals can be ordered.[77]	LGA	Penalties apply for non-compliance with a development approval.[78]	LGA	Not applicable	
Monitoring, maintenance and reporting[79]		A brochure has been produced by the Department of Health to give guidance to owners on maintaining tanks.[80]		A brochure has been produced by Queensland Health to give guidance to owners on maintaining tanks.[81]		Guidelines have been published[82] as a tool for people responsible for establishing and managing rainwater schemes in urban communities.[83]	
				Maintenance of the system is the responsibility of the owner or occupier			

Note: DA = development approval, LGA = local government authority

[74] *Public Health Act 1991* (NSW), s. 5. It is an offence to provide water not fit for purpose under s. 10IA of the Act.

[75] *Public Health Act 2005* (Qld), ss. 21 and 22.

[76] *Health Act 1958* (Vic), s. 42.

[77] *Local Government Act 1993* (NSW), s. 124, order 30. The penalty for non-compliance is provided for in s. 628 of the Act.

[78] *Integrated Planning Act 1997* (Qld), s. 4.3.3.

[79] Most LGAs have produced fact sheets on maintaining rainwater tanks.

[80] Brochure available at: <http://www.health.nsw.gov.au/pubs/2007/pdf/rainwater.pdf>

[81] Brochure available at: <http://enhealth.nphp.gov.au/council/pubs/pdf/watertank_broch.pdf>

[82] Rainwater Use for Communities in Urban Areas: Guidelines for Non-drinking Applications in Multi-residential, Commercial and Community Facilities (2007). Published by the Victorian Government, Department of Human Services. <www.health.vic.gov.au/environment>

[83] The guideline sets out its scope, preventative risk management, the regulatory framework and criteria for a rainwater management plan.

Recently, the National Water Commission released an updated version of the Rainwater Handbook (HB 230)—a guideline that is specifically produced for plumbers and that provides technical and practical information about local government approvals and installation and maintenance standards. Although compliance with the HB230 is encouraged, it is not a BCA standard. The handbook provides technical details for the installation of all rainwater tanks, ensuring that they comply with the relevant state building code standards and helping to minimise any risks associated with this type of infrastructure.

The principal authority responsible for supervising the development (construction, connection, use) of rainwater tanks is the LGA. The majority of rainwater tanks in S&CT subdivisions have to be approved by LGAs as part of the assessment process, either because tanks are implemented as part of a new development, or because the size of the tank to be incorporated exceeds the minimum threshold allowed ‗as of right'. LGAs can set conditions that require regularwater quality monitoring (every six or 12 months) and report back to either the local water authority or the LGA. This would be the only tool to provide feedback about the performance of rainwater harvesting systems to government authorities, since no licences or approvals under pollution control legislation are required. Any non-compliance with monitoring conditions can be enforced.

Although no regulatory approval for the installation or use of rainwater tanks is required by the relevant state health departments, some Australian jurisdictions (specifically Queensland and the Northern Territory) have enforcement legislation that requires all rainwater tanks to be fitted with mosquito proof screens or flap valves at every opening, or other approved vermin contamination prevention devices.[84] Health departments in all the states reviewed for this report have produced guidelines or fact sheets on maintaining rainwater tanks. To protect the quality of captured rainwater, it is recommended by the various state health departments that first flush devices and approved vermin screening be installed and regular desludging occurs.

The maintenance and monitoring of rainwater tanks is left entirely to owners (including bodies corporate). This responsibility is onerous, especially in light of the fact that owners have an ongoing obligation and duty to maintain and monitor a rainwater harvesting facility to prevent liability claims (see section 3.5 below). This is especially relevant for a body corporate where the potential liability can extend to multiple persons if a contamination outbreak occurs.

A significant concern about rainwater tanks that should be considered is whether owners should carry the maintenance responsibility of communal tanks or whether LGAs should invest in a monitoring system to collect information about water quality in large (communal) tanks.

3.3.2 Communal stormwater harvesting systems

Unlike rainwater, stormwater is included in the definition of ‗water' under the relevant regulations in Queensland and NSW. In Victoria, the *Water Act 1989* appears to control only water (including stormwater) in a waterway, which includes a river, lake, lagoon, and creek. There are no regulatory controls for using stormwater falling on privately owned land, although an owner may be liable if an unreasonable amount of water flows onto other land and causes injury or loss.[85]

In Australia, the most common application of stormwater harvesting is found on rural properties. During heavy rainfalls, overland flows are directed into a natural or excavated depression that has been sealed or extended with a dam to form an artificial reservoir for irrigation purposes—the archetypal Australian farm dam. Constructing and operating such

[84] Public Health Regulation 2005 (Qld), s. 2P.

[85] *Water Act 1989* (Vic) s. 16.

farm dams is subject to various (harvestable) water rights or water shares, and a number of specific regulations, water allocation plans and guidelines in each state.[86] In many cases, farm dams are designed to collect water from multiple sources—not only from runoff after heavy rain events, but also from more regularly flowing drainage lines and groundwater resources. Issues associated with stormwater capture in the extended context of farm dams lies beyond the scope of this study.

In Queensland, collection of stormwater in an urban setting requires the construction of an artificial lake[87] or reservoir at the lowest section of a development site to collect overland flow water during major rain events. Regulation of this 'activity' (explicitly including extraction of water collected from overland flows) falls under the development approval process of the *Integrated Planning Act 1997* in conjunction with water resource plans, which have been declared for all major catchments.[88] Individual water resource plans will further define the circumstances under which a water licence or permit is required for harvesting overland flow water (stormwater). Section 8 of the *Water Resource (Gold Coast) Plan 2006*, for example, makes no reference to this type of water and therefore permits the taking of this type of water without an authority under the *Water Act 2000.* This situation is quite different in the Brisbane metropolitan area, where the relevant water resource plan limits the size of overland flow reservoirs to five megalitres total capacity.[89]

In NSW, stormwater extracted from a river, creek, drainage channel, lake or pond would be subject to the provisions of the *Water Management Act 2000* and may require the beneficiary of the water to apply for a water access licence, a water use approval (unless development consent has been granted), and a water supply work approval. In contrast, stormwater harvested from a drainage pipe is not subject to this Act, but an approval would be required from the LGA for drainage work. Approval might also be required for the construction of a harvesting scheme, depending on the relevant environmental planning instrument.

In Victoria, stormwater that is stored in a tank after being collected from privately owned land is regulated only to the extent that local planning provisions apply to the construction of the tank. Stormwater used or extracted from a waterway outside the boundaries of a property, for purposes other than domestic and stock, may require a water use licence and will still require assessment and approval by either the relevant LGA or Melbourne Water as part of a development application. A licence under the *Water Act 1989* (Vic) may be required for the construction of a dam (depending on the size of the dam); and the construction of a harvesting scheme may require LGA approval under the relevant planning scheme.

Table 6 summarises the legislative framework for systems developed for communal harvesting of stormwater.

[86] For example see Department of Sustainability and Environment (2008) Victorian regulatory framework relating to farm dams, ground water and afforestation. Department of Sustainability and Environment, Melbourne.

[87] This is also considered a 'dam' under the *Water Act 2000*, sch. 4 dictionary: definition for a dam.

[88] *Water Act* 2000 (Qld), s. 38.

[89] *Water Resource (Morton) Plan* 2007 (Qld), s. 85.

Table 6: Legislative framework for communal stormwater harvesting systems

		NSW[90]		*Queensland*[91]		*Vic*[92]	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	General planning assessment and conditions	A development approval is required for carrying out of stormwater drainage work[93] and the construction of a stormwater harvesting and reuse scheme.[94]	LGA or Minister for Planning.	A development approval may be required.[95]	LGA	A development approval may be required.[96]	LGA
	Plumbing, drainage and building requirements	A permit may be required for stormwater drainage work.[97] A licensed plumber is required for stormwater drainage work.[98]	Sydney Water Corporation; Hunter Water Corporation and/or LGA	A compliance assessment and certificate is required for regulated plumbing work.[99] Plumbing and Drainage work must comply with the PCA and Queensland Water Commission.[100]	LGA	A licensed plumber is required for any works that involve the treatment and reuse of stormwater.[101]	Plumbing Industry Commission

[90] A water supply work approval may be required from the Department of Natural Resources for a stormwater harvesting scheme if the work (tank or dam) is constructed for the purpose of capturing or storing rainwater runoff or water from a water source (*Water Management Act 2000* (NSW), s. 90). The Act gives an exemption to this approval under s. 53 for landholders who construct and use a dam for the purpose of capturing and storing rainwater runoff (only in accordance with the relevant harvestable rights order). A water supply work approval may still be required if the runoff is captured and stored in a tank.

[91] As noted above, water is vested in the Crown. The *Water Act 2000* (Qld), s. 20(4), allows an occupier of land to take overland flow water collected in a dam for domestic or stock purposes only. Generally, all other overland flow water can be taken but subject to the limits stated in a moratorium notice or water resource plan. The *Water Act 2000* (Qld), s. 38(4) confers a right on the Minister to prepare a water resource plan to regulate the taking of overland flow water.

[92] *Water Act 1989* (Vic), s. 8(4)(c), 10(1)(b). Rights are conferred on occupiers of land to use rainwater that falls on their land and to construct a storage tank for rainwater capture.

[93] *Local Government Act 1993* (NSW) s. 68. A person does not need a s.68 approval to operate a water harvesting scheme. A s. 68 approval is not required for the carrying out of such work if it is within the area of operation of the Sydney or Hunter water corporations.

[94] Dependent on the provisions in the relevant environmental planning instrument.

[95] A development permit is required for assessable development under the *Integrated Planning Act 1997* (Qld), s. 3.1.4. Schedule 8, table 4, item 3(i) provides that the taking of overland flow water is an assessable development if the relevant water resource plan mentions that the operations are assessable.

[96] *Planning and Environment Act 1987* (Vic), s.47. An application for a permit to develop land is required in accordance with the relevant planning scheme. There are no specific regulatory approvals required for the taking of stormwater.

[97] Sydney Water Regulation 2006 (NSW), s.6, Hunter Water (General) Regulation 2005 (NSW), s. 6 applies if there is a connection to the stormwater drain of the relevant corporation.

[98] *Local Government Act 1993* (NSW), s. 634, *Sydney Water Act 1994* (NSW), s. 99, *Hunter Water Act 1991* (NSW), s. 64. All plumbing and drainage works undertaken (within Sydney and Hunter water corporation areas of operation) must comply with the Plumbing and Drainage Code of Practice.

[99] *Plumbing and Drainage Act 2002* (Qld), s. 81. Regulated work in relation to stormwater harvesting includes connection to taps inside the premises but precludes connections for irrigation.

[100] Standard Plumbing and Drainage Regulation 2003 (Qld), s. 8A(1) and 8B(1). The Queensland Water Commission prevails in the event of any inconsistencies.

[101] *Building Act 1993* (Vic), s. 221D(1), Plumbing Regulation 1998 (Vic), s.12.

		NSW[90]		*Queensland*[91]		*Vic*[92]	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
	Pollution Control Aspects	No licensing provisions apply					
Develop-ment approval and compliance	Health Aspects	No licensing provisions apply. [102]					
		Orders from the Minister can be made to prevent public health risks.[103]	Department of Health	A public health order may be given to reduce, remove or prevent a public health risk.[104]	Queensland Health	It is an offence to cause or allow a nuisance to emanate from land.[105]	Department of Human Services
		Compliance with development approvals can be ordered.[106]	LGA	Penalties apply for non-compliance with a development approval.[107]	LGA	Penalties apply for non-compliance with a development approval.[108]	LGA
Monitoring, mainte-nance and reporting[109]		Guidelines have been published as a tool for people responsible for establishing and managing stormwater harvesting and reuse schemes.[110]	Department of Environment and Conservation	No specific guidelines available for private schemes.[111]		No specific guidelines available for private schemes.	

[102] There is no reference to stormwater recycling in the *Public Health Act 1991* (NSW).

[103] *Public Health Act 1991* (NSW), s. 5.

[104] *Public Health Act 2005* (Qld), s. 21 and 22.

[105] *Health Act 1958* (Vic), s. 42.

[106] *Local Government Act 1993* (NSW), s. 124, order 30. The penalty for non-compliance is provided for in s. 628 of the Act.

[107] *Integrated Planning Act 1997* (Qld), s. 4.3.3.

[108] *Planning and Environment Act 1987* (Vic), s. 126 and 127.

[109] The Environment Protection and Heritage Council, the National Health and Medical Research Council and the Natural Resource Management Ministerial Council have drafted (for comment) Australian Guidelines for Water Recycling Stormwater Harvesting and Reuse. Available at: <http://www.ephc.gov.au/pdf/water/200805_WQ_GL_Draft_AGWR_SHR.pdf> . The primary focus of the guidelines is to provide guidance on managing potential risks associated with harvesting stormwater for reuse.

[110] *Managing Urban Stormwater: Harvesting and Reuse* (Department of Environment and Conservation 2006). These guidelines set out, amongst other things, the potential application of stormwater use (toilet flushing, gardening and irrigation, car washing and industrial); the potential benefits and limitations; statutory requirements; risk management; planning considerations; design considerations; treatment and operational considerations as well as a number of case studies.

[111] Some LGAs have prepared fact sheets on managing stormwater harvesting schemes.

There has been formal recognition in NSW that stormwater harvesting and reuse is a valuable contributor to water conservation. The NSW Department of Environment and Climate Change produced a guideline specifically for stormwater harvesting and reuse. Neither Queensland nor Victoria has yet released any final guidelines or water management policies regulating stormwater harvesting and reuse.

As noted in Table 6, a development approval is required in NSW for the harvesting and reuse of stormwater, but a development approval in Queensland and Victoria depends on the relevant local planning scheme. No specific pollution or health controls, such as a licence to operate, are required in any of the reviewed states. The responsibility for the operation and construction for stormwater facilities rests with the LGA.

Larger stormwater harvesting schemes for district ‗decentralised' systems, equivalent in size to the Salisbury stormwater Aquifer Storage and Recharge (ASTR) Project in South Australia (probably the largest scheme of its kind in Australia), would not be approved without explicit requirements for extensive monitoring programs and a Hazard Analysis and Critical Control Plan (Page et al. 2008).

3.3.3 Communal greywater reuse and sewage treatment and recycling systems

Although most jurisdictions clearly distinguish between greywater and blackwater,[112] the regulatory framework that underpins the treatment and reuse of this water either has mirror provisions (for greywater and blackwater) or uses the generic term of sewage (combining greywater and blackwater). It appears that the potential for contamination of greywater from human faecal material (washing of dirty nappies, infants defecating in bathwater, release of urine in showers) has placed greywater, from a regulatory perspective, in the same category as blackwater. Therefore, instead of replicating the regulatory controls relating to greywater and blackwater, the following section has combined the legislative review of both types of alternative water sources into one.

The high likelihood of wastewater carrying human pathogens has prompted regulatory authorities to apply much tighter controls to these water management systems than to other systems such as rainwater tanks or stormwater harvesting schemes. As for the two previous sections, the purpose of this brief legislative review is to determine which regulatory bodies (local government, environment, health, building and plumbing) can exercise some control over these systems, the requirements necessary to install and operate a system, and how the systems are monitored and reported on once operational.

It should be noted that, in accordance with the National Water Recycling Guidelines, each state reviewed recommends that recycled greywater and blackwater be used only for non-drinking purposes.

[112] The schedule to the *Plumbing and Drainage Act 2002* (Qld) defines greywater as wastewater from a bath, basin, kitchen, laundry or shower, whether or not the wastewater is contaminated with human waste. Blackwater is defined as waste discharged from a human body into a toilet; and water used for the discharge (s. 128K(2)). In Victoria, greywater is defined as all household wastewater excluding blackwater; and blackwater means wastewater from a toilet or urinal (*Plumbing Regulation* 2008). In NSW, the *Code of Practice for Plumbing and Drainage* (2006) defines greywater as household wastewater of baths, showers, basins, laundries and kitchen and sewage is defined as water containing greywater and blackwater.

Table 7: Legislative framework for communal greywater reuse and sewage treatment and recycling systems

		NSW		*Queensland*[113]		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	General planning assessment and conditions	A development approval is required for designated development[114] if the project includes sewerage systems or works with an intended processing capacity of more than 2500 persons equivalent capacity or 750 kL per day.[115]	LGA	A code or impact assessable development approval[116] and an EPA registration certificate[117] are required for the operation of sewage treatment works of 21 equivalent persons or more.[118]	LGA	A development approval may be required depending on the relevant local planning schemes[119]	LGA
	Plumbing, drainage and building require-ments	A permit may be required for the installation of a device to divert or treat greywater.[120] A licensed plumber is required for sewerage work.[121]	Sydney Water Corporation, Hunter Water Corporation, LGA	A compliance permit is required for onsite sewerage work that includes greywater treatment and blackwater treatment (in sewered areas only).[122]	Department of Infrastructure and Planning	Must be carried out by a licensed person.[123]	Plumbing Industry Commission

[113] *Plumbing and Drainage Act 2002* (Qld), ss. 128K and 128L make it an offence in sewered areas to discharge kitchen greywater or blackwater into anything but the infrastructure of a service provider. Amendments to the Act are currently being considered to allow for a small number of controlled trials of blackwater reuse schemes in the South East Queensland region.

[114] Under s. 91of the *Environmental Planning and Assessment Act 1979*, development consent and an environmental protection licence under the *Protection of the Environment Act 1997* (NSW) is required for integrated development which includes a system with an intended processing capacity of more than 2500 persons equivalent capacity, or 750 kL per day, and involves the likely discharge to land or water. The LGA as the consent authority must refuse the development approval if the referral authority (Department of Environment and Climate Change) refuses to grant the environmental protection licence (s. 91A). An LGA must not approve the installation or construction of a sewage treatment facility with an intended processing capacity of less than 2000 litres per day unless the authority is satisfied that it is accredited by the Department of Health, or falls under a specified exemption (ss. 40, 41 of the Local Government General Regulation 2005 (NSW).

[115] *Environmental Planning and Assessment Act 1979* (NSW), s. 77, 77A, Environmental Planning and Assessment Regulation 2000 (NSW), s.4. A system with an intended processing capacity of more than 20-person equivalent or 6 kL per day and is located within 250 metres of a dwelling not associated with the development (or located within a number of other regulated locations such as a water drinking catchment) also requires development consent under this section.

[116] A development permit is required for assessable development under the *Integrated Planning Act 1997* (Qld), s. 3.1.4. Schedule 8, table 5, item 1 provides that an environmentally relevant activity is an assessable development.

[117] *Environmental Protection Act 1994* (Qld), s.73D.

[118] *Environmental Protection Act 1994* (Qld), s. 427, Environmental Protection Regulation 1998 (Qld), s.4 and schedule 1.

[119] *Planning and Environment Act 1987* (Vic), s.47. An application for a permit to development land is required in accordance with the relevant planning scheme.

[120] Sydney Water Regulation 2006 (NSW), s.6.

[121] *Local Government Act 1993* (NSW), s. 634, *Sydney Water Act 1994* (NSW), s. 99, *Hunter Water Act 1991* (NSW), s. 64. All plumbing and drainage works undertaken (within Sydney and Hunter water areas of operation) must comply with the Plumbing and Drainage Code of Practice.

[122] *Plumbing and Drainage Act 2002* (Qld), s. 83(1). A compliance permit will only be granted for a greywater use facility if it complies with conditions set out in section 85B of the *Plumbing and Drainage Act 2002* (Qld). Such conditions include: the premises generates more than 3 kL of greywater a day, the facility has been approved by the chief executive or the diversion device has plumbing code authorisation. Similar conditions apply for blackwater treatment facilities in unsewered areas. If greywater is to be used for purposes other then irrigation (for example, toilet flushing, washing machine supply, car washing), the water must be treated to the standard outlined in the Queensland Plumbing and Wastewater Code unless the greywater treatment plant is capable of treating more than 50 kL of greywater a day (*Plumbing and Drainage Act 2002* (Qld), s. 128PA). It is a requirement that the LGA monitors greywater facilities to ensure that their operation is in accordance with the compliance certificate conditions (*Plumbing and Drainage Act 2002*, s. 143B).

[123] *Building Act 1993* (Vic), s. 221D(1), Plumbing Regulation 1998 (Vic), s. 13.

		NSW		*Queensland*[113]		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	Pollution Control Aspects	Council approval is required for the carrying out and operation of sewerage work.[124] An environmental protection licence is required for sewerage systems that have an intended processing capacity of more than 2500 persons equivalent or 750 kL per day and discharge waste or by-products to land or water.[125]	LGA Department of Environment and Climate Change	A registration certificate is required for the operation of sewage treatment works that have an intended processing capacity of 21 or more equivalent persons.[126]	EPA	A works approval[127] and a licence[128] is required for systems with a design or actual flow rate that exceeds 5 kL per day if the sewage effluent is discharged to the environment.	EPA
	Health Aspects	No regulatory approvals are required					
Compliance with develop-ment		Orders from the Minister can be made to prevent public health risks.[129] Compliance with development approvals can be ordered.[132]	Department of Health LGA	A public health order may be given in order to reduce, remove or prevent a public health risk.[130] Penalties apply for non-compliance with a development application.[133]	Queensland Health LGA	It is an offence to cause or allow a nuisance to emanate from land.[131] Penalties apply for non-compliance with a development application.[134]	Department of Human Services LGA

[124] *Local Government Act 1993* (NSW), s. 68. A s. 68 approval is not required for the carrying out and operation of sewerage works if a licence under the *Protection of the Environment Operations Act 1999* (NSW) is in force. A s. 68 approval is not required for the carrying out of sewerage works if such works are carried out within the area of operation of the Sydney or Hunter water boards.
[125] *Protection of the Environment Operations Act 1997* (NSW), s. 47 and schedule 1. Note: treated wastewater is not precluded from this provision.
[126] *Environmental Protection Act 1994* (Qld), s. 427.
[127] *Environment Protection Act 1970* (Vic), s. 19A. A works approval is not required if an effluent reuse scheme or activity meets the specifications of the EPA (s. 11(d), Environment Protection (Scheduled Premises and Exemptions) Regulations 2007 (Vic)).
[128] *Environment Protection Act 1970* (Vic), s. 20. An occupier can apply to the EPA for a licensing exemption if the waste is solely discharged or deposited to land (not water) and the design capacity is less than 100 kL/day. A licence is not required if an effluent reuse scheme or activity meets specific EPA specifications as detailed in publication 1015, Guidelines for Environmental Management (GEM): Dual Pipe Water Recycling Schemes – Health and Environmental Risk Management (**extends only to use of recycled water in the scheme** not construction). This GEM presents a framework (performance objectives) for managing human health and environmental risks associated with the use of Class A recycled water in urban areas. In order for a scheme to be approved under this guideline, a proponent must prepare and submit a 'Health and Environmental Management Plan ' to the EPA, which will be referred to the Department of Human Services for endorsement. See also 'Monitoring, maintenance and reporting' section below.
[129] *Public Health Act 1991* (NSW), s. 5.
[130] *Public Health Act 2005* (Qld), s. 21 and 22.
[131] *Health Act 1958* (Vic), s. 42.
[132] *Local Government Act 1993* (NSW), s. 124, order 30. The penalty for non-compliance is provided for in s. 628 of the Act.
[133] *Integrated Planning Act 1997* (Qld), s. 4.3.3.
[134] *Planning and Environment Act 1987* (Vic), s. 126 and 127.

		NSW		*Queensland*[113]		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
application							
Compliance with licence		Contravention of a condition of a licence is an offence and penalties apply.[135]	Department of Environment and Climate Change	Contravention of a standard environmental condition is an offence and penalties apply.[136]	Environmental Protection Agency	Contravention of a condition of a licence is an indictable offence and penalties apply.[137]	EPA
Monitoring, mainten-ance and reporting		LGA have the right to inspect systems.[138] Guidelines have been published for uses of private recycled water schemes servicing more than a single dwelling.[139]	Department of Water and Energy	Guidelines have been published for uses of private recycled water schemes. [140]	Department of Natural Resources and Water	Guidelines have been published as a tool for suppliers and scheme managers[141] of dual reticulation schemes.[142]	EPA

[135] *Protection of the Environment Act 1997* (NSW), s.64.

[136] *Environmental Protection Act 1994* (Qld), s. 435A.

[137] *Environment Protection Act 1970* (Vic), s.27(2).

[138] Local Government (General) Regulation 2005 (NSW) , s.45. Requires the person operating the system to provide evidence of compliance with the regulations and conditions of approval and provide details of the way in which it is operated whenever requested.

[139] See *Interim NSW Guidelines for Management of Private Recycled Water Schemes* (Department of Water and Energy 2008). These guidelines accord with the Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1) 2006: <http://www.ephc.gov.au/pdf/water/WaterRecyclingGuidelines-02_Nov06_.pdf>.

[140] Water Quality Guidelines for Recycled Water Schemes (2008) (http://www.nrw.qld.gov.au/water/regulation/recycling/pdf/water_quality_guidelines.pdf) published by the Department of Natural Resources and Water. Auditing and annual reporting guidelines are currently being developed and will be published by the Department of Natural Resources and Water.

[141] Includes home owners, owners corporations, property managers etc.

[142] Although the emphasis of this guideline is on dual pipe reticulation, the Chairman of Victoria's EPA and the Director of Public Health and Chief Health Officer advised that compliance with this guideline and the GEM: Use of Reclaimed Water (which does not specifically address domestic reuse), is a requirement for all schemes regulated by the Victorian EPA. This guideline has been published specifically for sewage treatment systems with a design capacity greater than 5 kL per day, but the guideline can be applied to other water sources including grey water and stormwater. The Guideline provides: a regulatory framework for approvals for these schemes; roles and responsibilities for supplies, managers and end-users including a recommendation to prepare an agreement between the parties (supplier, manager and end-user) with appropriate mechanism to address system failures and parties' responsibilities and roles; systems assessment; risk management controls and auditing requirements (see also: http://epanote2.epa.vic.gov.au/EPA/Publications.NSF/PubDocsLU/1015?OpenDocument).

For systems with a design capacity of less than 5 kL per day, there are a number of guidelines available including GEM: Guidelines for Aerated Onsite Wastewater Treatment Systems (publication 760), GEM: Septic Tanks Code of Practice (publication 891) and Code of Practice for Small Wastewater Treatment Plants (publication 500). Due to the constraints of this project, the research team have explicitly excluded systems with an intended processing capacity of less than 5 kL, as the focus of this project is on large strata and community title developments which would require systems with an intended capacity of more than 5 kL per day.

The key differences and commonalities in regulating greywater reuse and effluent recycling in the three states of interest can be summarised as follows.

Communal greywater reuse and sewage treatment and recycling systems are the most complex and inconsistent area of regulatory activity. Each of the states that was investigated has a differing position on the authority in charge of decision making, licensing requirements, pollution control (especially relating to discharge), and areas of operation.

In NSW, the decision-making aspect and supervision of systems suitable for use within an S&CT scheme rests predominantly with the LGA. In Queensland and Victoria, both the LGA (for development approval) and the relevant environmental protection authority (licensing, registration for works and operation) or the Department of Environment and Resource Management are the main decision-making bodies.[143] To complicate matters further, the administration of applications for large greywater treatment systems (up to 50 kL per day) in Queensland has been moved to the Department of Infrastructure and Planning, which is the authority administering the *Plumbing and Drainage Act 2002* (Qld).

An environmental licence or registration certificate for the construction and operation of a treatment system is required in each state, but the precise conditions depend on the intended processing capacity of the system. In Queensland and Victoria, pollution control licences or registration certificates are required from relevant state government authorities for wastewater treatment systems exceeding five kilolitres per day capacity—approximately 21 equivalent persons. In NSW, however, an environmental licence issued by the relevant environmental protection authority is required for very large systems only (exceeding 750 kilolitres per day). It would be unlikely that such a large system would apply to an S&CT development. In most situations in NSW, an approval from the LGA is therefore all that is required to operate such a DWMS with a wastewater treatment plant.

In NSW, the control of a wastewater treatment plant with an intended processing capacity of les than 750 kilolitres per day rests solely with the LGAs. It is therefore expected that the relevant LGA has the knowledge, capacity and resources to control these systems. Even though LGA approval is required for smaller wastewater treatment plants in Queensland and Victoria (starting at about five kilolitres per day), the system must be approved and certified by either the Public Health Services Department (for systems in Victoria) or the Department of Infrastructure and Planning (for systems in Queensland). If the facility does not have an approval, it cannot be installed.

In NSW and Victoria, licences are not required under pollution control legislation for wastewater treatment systems that do not discharge to the environment (land or water). Therefore, if a treatment plant is installed and has an intended processing capacity exceeding five kilolitres per day (in Victoria) or 750 kilolitres per day (in NSW), but the recycled water is used only internally or for another purpose which contains the water, no licence is required. The loophole does not extend to systems in Queensland.

Rather than publishing guidelines, Queensland authorities have relied on statutory provisions—powers under the *Plumbing and Drainage Act 2002*—to explicitly prohibit the use and treatment (recycling) of certain types of wastewaters. Their application depends on the location of the proposed development—whether they are proposed for sewered or unsewered areas.

There are also differing positions in each state in relation to contamination risks for certain types of recycled water. In Queensland in particular, kitchen greywater is treated similarly to blackwater and must be (in serviced areas) discharged to the infrastructure of a service

[143] This department became part of the Department of Environment and Resource Management in 2009.

provider. Both Victoria and NSW do not distinguish between kitchen greywater and greywater from other sources.

In Victoria, the EPA has taken on a more prominent role in controlling wastewater treatment systems by publishing a number of specific guidelines for environmental management for a range of onsite and decentralised systems. These guidelines were developed in addition to general recycled water management and quality guidelines. These guidelines have been developed to introduce more specific guidance for planning, managing and operating alternative water supply solutions, including decentralised systems with dual reticulation pipe networks.

In 2007–08, NSW and Queensland started to follow the initiative of the EPA in Victoria by developing or even adopting guidelines for decentralised recycled water systems.[144] These guidelines, however, were not developed by the authorities responsible for licensing larger wastewater treatment systems, namely the EPA or relevant elements in the Department of Environment and Climate Change, but by authorities responsible for managing water resources. Despite the efforts spent in developing these guidelines, government authorities continue to develop water treatment technologies and regulations.

3.3.4 Sewer mining

Sewer mining (or water mining from a sewer) is a special form of effluent recycling that is available only in sewered areas. Instead of collecting sewage onsite—from within the complex—a wastewater treatment plant is directly connected to a local sewer main to extract sewage for treatment and reuse. This can include extraction of treated effluent from effluent trunk mains prior to discharge into the environment (Sydney Water 2006). Sewer mining is becoming more common, especially in and around Sydney. Extracting sewage and treating it onsite to generate recycled water reduces sewage volumes and nutrient loads discharged into surrounding waterways and coastal waters through centralised systems and their already existing sewage treatment plants.

At the time of writing this report, there were four schemes operational within the Sydney Water area boundary and 14 sewer mining exclusion zones had been declared. Irrigation is the most prominent use for recycled water that has been extracted using this method. Many large parks, sporting fields and golf courses irrigate using this water. Another well-known example of an inner city office building with non-potable waters supplied from sewer mining (and also rainwater) is the Melbourne City Council House 2. Although no sewer-mining scheme in the context of an S&CT development is currently operational within the Sydney Water boundary, some are under construction in Queensland and also planned elsewhere. Many are schemes that connect to an effluent trunk mains downstream of a municipal treatment plant.

As noted above, the key component of a sewer-mining system is a wastewater treatment plant. Accordingly, many of the provisions listed in section 3.3.3 also apply. The key difference, relates to the binding location of these systems: they are in close proximity to a major sewer network. Table 8 lists the relevant provisions that determine which regulatory bodies (local government, environment, health, building and plumbing) ultimately control these systems, the requirements necessary to install and operate a system, and how the systems are monitored and reported on once they are operational.

[144] See Qld: Interim Final Queensland Guidelines for Decentralised Wastewater Systems (2007) (not yet finalised; NSW Guidelines for Management of Private Recycled Water Schemes (2008))

Table 8: Legislative framework for sewer mining (purpose of use)

		NSW		*Queensland*		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	General planning assessment and conditions	Council approval is required for the carrying out and operation of sewerage work.[145] A sewer-mining system or works that extract and treat more than 1500 kL of sewage per day is designated development and requires development consent.[146]	LGA	A development approval[147] and an EPAregistration certificate[148] are required for the operation of sewage treatment works of 21 equivalent persons or more.[149]	LGA	A development approval may be required depending on the relevant local planning schemes[150]	LGA
	Plumbing, drainage and building requirements	A permit is required for the pipe connection to a water corporations works.[151] A licensed plumber is required for sewerage work.[152]	Sydney Water Corporation, Hunter Water Corporation, and LGA	A compliance permit is required for onsite sewerage work.[153]	Department of Infrastructure and Planning	Must only be carried out by a licensed person.[154] It is an offence to interfere with the works of an authority or corporation[155]	Plumbing Industry Commission

[145] *Local Government Act 1993* (NSW), s. 68. A s. 68 approval is not required for the carrying out and operation of sewerage works if, a licence under the *Protection of the Environment Operations Act* is in force. A s. 68 approval is not required for the carrying out of sewerage works if such works are carried out within the area of operation of the Sydney or Hunter water boards.

[146] *Environmental Planning and Assessment Act 1979* (NSW), s. 77, 77A, Environmental Planning and Assessment Regulation 2000 (NSW), s.4.

[147] A development permit is required for assessable development under the *Integrated Planning Act 1997* (Qld), s. 3.1.4. Schedule 8, table 5, item 1 provides that an environmentally relevant activity is an assessable development.

[148] *Environmental Protection Act 1994* (Qld), s.73D.

[149] *Environmental Protection Act 1994* (Qld), s. 427, Environmental Protection Regulation 1998 (Qld), s.4 and schedule 1.

[150] *Planning and Environment Act 1987* (Vic), s.47. An application for a permit to develop land is required in accordance with the relevant planning scheme.

[151] Sydney Water Regulation 2006 (NSW), s.6, Hunter Water (General) Regulation 2005 (NSW), s. 6.

[152] *Local Government Act 1993* (NSW), s. 634, *Sydney Water Act 1994* (NSW), s. 99, *Hunter Water Act 1991* (NSW), s. 64. All plumbing and drainage works undertaken (within Sydney and Hunter Water areas of operation) must comply with the Plumbing and Drainage Code of Practice.

[153] *Plumbing and Drainage Act 2002* (Qld) s. 3(1). A compliance permit will only be granted for a greywater use facility if it complies with conditions set out in s.85B of the Act. Such conditions include: the premises generates more than three kilolotres of greywater a day, the facility has been approved by the chief executive or the diversion device has plumbing code authorisation. Similar conditions apply for blackwater treatment facilities in unsewered areas. If greywater is to be used for purposes other then irrigation (for example, toilet flushing, washing machine supply, car washing), the water must be treated to the standard outlined in the Queensland Plumbing and Wastewater Code, unless the greywater treatment plant is capable of treating more than 50 kilolitres of greywater a day (*Plumbing and Drainage Act 2002* (Qld), s. 128PA). It is a requirement that the LGA monitors greywater facilities to ensure that their operation is in accordance with the compliance certificate conditions (*Plumbing and Drainage Act 2002* (Qld), s. 143B).

[154] *Building Act 1993* (Vic), s. 221D(1), Plumbing Regulation 1998 (Vic), s. 13.

[155] *Water Act 1989* (Vic), s. 288.

		NSW		*Queensland*		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Develop-ment approval	Pollution control aspects	Council approval is required for the carrying out of a connection of a private drain to a public sewer and operation of sewerage work.[156] An environmental protection licence is required for sewerage systems that have an intended processing capacity of more than 2500 persons equivalent (or 750 kL per day) and discharge waste or by-products to land or water.[157]	LGA Department of Environment and Climate Change	A registration certificate is required for the operation of sewage treatment works that have an intended processing capacity of 21 or more equivalent persons.[158]	EPA	Although there are no specific regulations relating to sewer or water mining, a works approval[159] and a licence[160] is required for systems with a design or actual flow rate that exceeds 5 kL per day if the sewage effluent is discharged to the environment.	EPA
	Health aspects	No regulatory approvals are required.					
		Orders from the Minister can be made to prevent public health risks.[161]	Department of Health	A public health order may be given in order to reduce, remove or prevent a public health risk.[162]	Queensland Health	It is an offence to cause or allow a nuisance to emanate from land.[163]	Department of Human Services

[156] *Local Government Act 1993* (NSW), s. 68. A section 68 approval is not required for the carrying out of a connection of a private drain to a public sewer and operation of sewerage works if a licence under the *Protection of the Environment Operations Act* is in force. A section 68 approval is not required for the carrying out of sewerage works or connection of a private drain to a public sewer if such works are carried out within the area of operation of the Sydney or Hunter Water Board.
[157] *Protection of the Environment Operations Act 1997* (NSW), s. 47 and schedule 1. Note: treated wastewater is not precluded from this provision.
[158] *Environmental Protection Act 1994* (Qld), s. 427.
[159] *Environment Protection Act 1970* (Vic), s. 19A. A works approval is not required if an effluent reuse scheme or activity meets the specifications of the EPA. See section 11(d) of regulation.
[160] *Environment Protection Act 1970* (Vic), s. 20. An occupier can apply to the EPA for a licensing exemption if the waste is solely discharged or deposited to land (not water) and the design capacity is less than 100 kilolitres per day. A licence is not required if an effluent reuse scheme or activity meets specific EPA specifications as detailed in publication 1015, Guidelines for Environmental Management (GEM): Dual Pipe Water Recycling Schemes – Health and Environmental Risk Management (**only extends to use of recycled water in the scheme** not construction). This GEM presents a framework (performance objectives) for managing human health and environmental risks associated with the use of Class A recycled water in urban areas. In order for a scheme to be approved under this guideline, a proponent must prepare and submit a 'Health and Environmental Management Plan' to the EPA, which will be referred to the Department of Human Services for endorsement. See also Monitoring, Maintenance and Reporting section below.
[161] *Public Health Act 1991* (NSW), s. 5.
[162] *Public Health Act 2005* (Qld), s. 21 and 22.
[163] *Health Act 1958* (Vic), s. 42.

		NSW		*Queensland*		*Victoria*	
		Provision	*Authority*	*Provision*	*Authority*	*Provision*	*Authority*
Compliance with development application		Compliance with development applications can be ordered.[164]	LGA	Penalties apply for non-compliance with a development application.[165]	LGA	Penalties apply for non-compliance with a development application.[166]	LGA Authority
Monitoring, maintenance and reporting		Sydney Water manages agreements with sewer miners for the construction, operation and maintenance of their sewer-mining connections and the return of waste to the sewerage system. Sydney Water has published a booklet on how to establish a sewer-mining operation. [167]	Sydney Water[168]	Guidelines have been published for uses of private recycled water schemes (including water mining). [169]	Department of Natural Resources and Water	No specific guidelines are available.	

[164] *Local Government Act 1993* (NSW), s. 124, order 30. The penalty for non-compliance is provided for in s. 628 of the Act.
[165] *Integrated Planning Act 1997* (Qld), s. 4.3.3.
[166] *Planning and Environment Act 1987* (Vic), s. 126 and 127.
[167] Available at: <http://www.sydneywater.com.au/Publications/FactSheets/SewerMiningHowToEstablishASewerMiningOperation.pdf#Page=1>
[168] The Independent Pricing and Regulatory Tribunal arbitrates sewer-mining disputes.
[169] Water Quality Guidelines for Recycled Water Schemes (2008) published by the Department of Natural Resources and Water. The guidelines are available at: <http://www.nrw.qld.gov.au/water/regulation/recycling/pdf/water_quality_guidelines.pdf>. Auditing and annual reporting guidelines are currently being developed and will be published by the Department of Natural Resources and Water.

Table 8 summarises the key legislative provisions relating to sewer mining. As noted above, sewer-mining provisions are almost as complex as decentralised wastewater treatment plants. For sewer-mining systems, the main observations are below.

NSW (particularly the Sydney Water Corporation) is more proactive than the other reviewed states in promoting and considering strategies and local implementation of sewer-mining systems.

As noted above in the summary relating to wastewater treatment plants, relevant LGAs in NSW are the sole decision-making bodies for approvals relating to sewerage works with a processing capacity of less than 750 kilolitres per day. For a sewer-mining system, a pipe connected to a centralised system will always be needed, which in turn requires additional approvals from relevant water corporations (Sydney Water or Hunter Water). Approvals for sewer-mining systems are therefore more likely to be the result of extensive collaboration between LGAs and relevant water authorities.

Sydney Water and Hunter Water also require an agreement to be entered into for the construction, operation and maintenance of the connection.

The same approvals, registration and licences are required for sewer-mining systems as for wastewater treatment plants in the states of Queensland and Victoria

3.4 Strata and community title legislation

This section provides a broad overview of the key principles of a land subdivision under S&CT.

In each Australian jurisdiction, there are laws that give effect to the subdivision of land and buildings in order to create planned communities within the general community. These communities vary in size, shape and purpose, and they include horizontal and vertical divisions, or both. Some states allow for different types of schemes including layered (grouping of schemes),[170] mixed use (different classes of use, such as residential and retail), and staged (generally developed in stages over many years) schemes.

As indicated above (section 2.4), the terms used to describe these subdivisions, the requirements that give effect to the registration of the title, the lot boundaries, and the provisions relating to the management of the schemes vary depending on the relevant state laws. For example, both subdivided land tied to common property as well as subdivided buildings are referred to as community title schemes and subdivisions with an owners corporation in Queensland and Victoria, respectively. In NSW, subdivided land tied to common property is referred to as community title, whereas a subdivided building is referred to as a strata title scheme.

In order to create these schemes, a plan of subdivision (which identifies the lots and the common property within the scheme) must be registered in the relevant state title office along with supporting documentation. Amongst other things, the supporting documentation will generally provide for the creation of the body(ies) corporate or owners corporation(s), the by-laws (rules) for a scheme and details of its lot entitlements and liabilities.

[170] Queensland and NSW

The common property (real property not contained in scheme lots) is either owned or vested in the ownership of the proprietor(s) as tenants in common in shares apportioned according to lot entitlements,[171] or it is vested in the body corporate as an agent for the owners.[172]

The body corporate is a legal entity, the members of which are the lot owners comprising the scheme. A body corporate committee must be formed in order to carry out the functions of the body corporate. An executive committee must be chosen at the annual general meeting of the body corporate (unless the functions of the body corporate are delegated to a community or strata manager), and positions are filled by members of the body corporate on a voluntary basis.

S&CT schemes are unique and differ from traditional subdivisions in that the lot owners (represented by the body corporate) must collectively govern every aspect of the scheme, including maintaining its short-term and long-term financial viability and making decisions about its management. Such matters include: establishing and administrating a fund for the day to day running of the scheme (administrative fund); making decisions and, as required, establishing a fund for capital expenditure and maintenance (sinking or maintenance fund); in some cases providing services and amenities to lots; establishing and varying communal rules (by-laws); and ensuring that the necessary insurances are in place to cover property and public liability.

A body corporate may also be required to:

- maintain and operate (either itself or through external contract arrangements) equipment or infrastructure, including water management systems
- enter into a leasing arrangement with a third party (water authority or water service provider) for:
  - using part of the common property (land) as a location for its water infrastructure
  - using part of the common property (land and infrastructure) where the infrastructure is located on the land and owned by the owners or vested in the body corporate
- a combination of the first two points, where some components are owned by a body corporate and other components owned by a third party
- enter into a contractual arrangement with a third party (water authority or water service provider) to provide recycled water to the lots and common property comprising a scheme.

In the event that a water management system has been constructed by a developer and is an asset, a body corporate would need to understand its legal obligations and responsibilities relating to the operation (including licensing requirements) and maintenance of the system.

In using water (either collected rainwater or stormwater, or recycled greywater or blackwater) for the benefit of the community or outside parties, a body corporate would need to ensure that:

- there are no legislative prohibitions in servicing water to a lot(s)
- funds are available or can be levied for the servicing, maintenance and repair of the infrastructure (both in the short and long term)
- emergency funds are available to rectify a system failure that may endanger personal safety

[171] Queensland and Victoria

[172] New South Wales

- public liability insurances are in place and cover any potential future claims[173]
- there are no legislative prohibitions in on-selling water.

Theoretically, an S&CT scheme could produce enough collected or recycled water to service the lots within the scheme (for toilet flushing and cold water to laundries), irrigate parklands and garden areas and on-sell excess water to neighbouring lots. The practicality of an S&CT scheme achieving this depends on the state legislation that governs S&CT and water management.

In regard to the five points of interest raised above, observations provided in Table 9 (below) highlight the following points.

A body corporate can provide services, such as water and wastewater, to lot owners. It appears that such services cannot be provided to third parties for a charge. This corresponds to the provisions in most states and territories that prohibit a body corporate from running a business.

In all the states reviewed, a body corporate can lease part of the common property. In Queensland and NSW (except for Community and Precinct association property) part of the common property can be sold. This right is important in the management of water infrastructure, as it allows a body corporate to lease a part of the common property to a third party, who may own or lease the DWMS, or parts of it. The third party could be a community company established by the lot owners for the purpose of on-selling excess water produced in order to circumvent provisions that prohibit a body corporate from running a business, or an independent third party such as a registered or licensed water service provider.

A body corporate can establish a fund for the maintenance, repair and replacement of equipment associated with the common property. Under the relevant legislation, a body corporate in Queensland must establish a sinking fund for anticipated expenditure over a nine-year period. In NSW a fund must be established for schemes with two or more lots for anticipated expenditure over a ten-year period (these time periods may be viewed as short since a typical pump can have an expected life of 20 years). In Victoria, on the other hand, a fund needs to be established only if the scheme comprises more than 100 lots or has an annual turnover exceeding $200,000 and the maintenance plan is approved. If the plan is not approved by the body corporate, the fund need not be established. As the relevant Act in Victoria only came into force in 2008, the extent to which bodies corporate will establish a sinking fund is yet to be seen. The obvious challenge for DWMSs is that, without an established fund for ongoing maintenance and repair, a body corporate would need to raise or collect funds, presumably by a levy or loan. Depending on the funds needed, it may be difficult in some schemes to raise the necessary funds, which may ultimately lead to the system failing and, subsequently, being turned off.

In NSW and Victoria, there are no general limitations on a body corporate spending funds in emergency situations. In Queensland, a body corporate can only spend above the prescribed amount if authorised. This is important in the event that a DWMS fails and immediate repairs are required to safeguard the community from potential contaminates. As just noted, a challenge for implementing DWMSs is the need for a body corporate to ensure that funds are available for immediate use if such a failure occurs. A sinking fund may be the only mechanism enabling immediate access to the necessary funds. The fund would need to be maintained at an appropriate level.

[173] A body corporate may be liable for an injury or harm caused to a person due to the supply of recycled water. Such causes of action include negligence and nuisance and are discussed further in section 3.6 of this report.

Table 9: Legislative framework for S&CT

	NSW[174]	*Queensland*[175]	*Victoria*
Services provided by the owners corporation	An owners corporation may provide services and amenities to lots.[176]	A body corporate may provide services and amenities to lots if it is for maintenance, communication or domestic services.[177]	An owners corporation may provide services to lots.[178]
Selling, leasing and licensing of common property	Common property can be transferred or leased.[179]	Common property can be sold, leased or licensed.[180]	Common property can be leased.[181]
Establishment of an administration fund	Must be established by an owners corporation.[182]		May be established by owners corporation.[183]
Establishment of a sinking fund	If more than two lots, must be established by an owners corporation.[184]	Must be established by a body corporate.[185]	Upon approval of a maintenance fund by the owners corporation.[186]
Payments made from sinking fund	Amongst other things, expenses of a capital nature.[187]	Amongst other things, expenses of a capital nature.[188]	In accordance with the approved maintenance plan.[189]

[174] The research team has purposefully used the generic term 'owners corporation' when referring to scheme committees under the *Community Land Development Act 1989* (NSW) and the *Community Land Management Act 1989* (NSW) for convenience only. The research team acknowledges that under these specific acts, the appropriate term used to describe the scheme's committee is an association. The research team has also used other generic terms such as 'sinking fund', 'administration fund', 'maintenance plan' and 'by-laws', but acknowledge that different terms are used depending on the state.

[175] The research team has only reviewed the provisions of the *Body Corporate and Community Management Act 1997* (Qld) and the Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld) but acknowledge that other modules (specifically Commercial and Accommodation) may be pertinent and should be considered when dealing with schemes that have predominantly accommodation or commercial lots. According to s.3(2) of the Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), this regulation applies to community title schemes if no other regulation module applies. It is for this reason that the research team has adopted this module to review.

[176] *Strata Schemes Management Act 1996* (NSW) s, 111 and *Community Land Management Act 1989* (NSW), s 22.

[177] Body Corporate and Community Management (Standard Module) Regulation 1997 s. 119.

[178] *Owners Corporation Act 2006* s. 12.

[179] *Strata Schemes (Freehold Development) Act 1973* (NSW), s.25. An owners corporation can execute the necessary documents only by special resolution. A community, precinct or neighbourhood association can lease part of the association's property, however, there are no provisions under the act for a community or precinct association to transfer part of the common property. *Community Land Development Act 1989* (NSW), s 17 and 24.

[180] Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s 161.

[181] *Owners Corporation Act 2006* (Vic), s 14.

[182] *Strata Schemes Management Act 1996* (NSW), s. 66 and *Community Land Management Act 1989* (NSW), Schedule 1, s. 12(1); Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s. 100 (1).

[183] *Owners Corporation Act 2006* (Vic), s. 23.

[184] *Strata Schemes Management Act 1996* (NSW), s. 69 and Schedule 1, *Community Land Management Act 1989* (NSW), s 12(1).

[185] Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s. 100 (1).

[186] *Owners Corporation Act 2006* (Vic), s. 40.

[187] *Strata Schemes Management Act 1996* (NSW), s. 75(2) and Schedule 1, *Community Land Management Act 1989* (NSW), s 13(2).

[188] Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s. 101.

	NSW[174]	*Queensland*[175]	*Victoria*
Limit on spending funds: general	An owners corporation must not spend an amount greater than the pre-determined amount (as resolved at the annual general meeting) plus 10 per cent unless by resolution at a general meeting.[190]	A body corporate can only spend above the relevant limit[191] if: authorised by ordinary resolution of the committee; or by written authority from all lot owners; or by order from an adjudicator for emergency purposes; or statutory or court order.[192]	Money may be paid out of a maintenance fund only in accordance with the plan or by special resolution.[193]
Exemptions to spending fund limits	The general limitation does not apply for expenditure undertaken for emergency purposes.[194]	Not applicable	The general limitation does not apply for expenditure undertaken for emergency purposes.[195]
Requirements to provide a maintenance plan	A 10-year plan of anticipated expenditure must be prepared.[196]	A sinking fund budget must be adopted which provides for amongst other things, anticipated expenditure for at least nine years. [197]	A 10-year plan outlining, amongst other things, anticipated expenditure, must be prepared for prescribed owners corporations.[198]
Owners corporations running a business	The relevant Acts and regulations are silent on this issue.[199]	A body corporate must not carry on a business unless the activity is necessary to properly carry out its functions and invest amounts not immediately required.[200]	An owners corporation cannot carry on a business, but may be a member of another body that does.[201]
Public liability insurance	An owners corporation or body corporate must take out insurance for death or bodily injury for not less than $10,000,000. [202]		

[189] *Owners Corporation Act 2006* (Vic), s.43.

[190] *Strata Schemes Management Act 1996* (NSW), s 80A. This section only applies to large strata schemes, i.e., a scheme comprising more than 100 lots or prescribed by regulation.

[191] The relevant limit for a committee is an amount set by an ordinary resolution of the body corporate, or if not set, an amount determined by multiplying $200 by the number of lots in the scheme.

[192] Body Corporate and Community Management (Standard Module) Regulation 2008 (Qld), s. 151. If the spending is for major spending (as set by an ordinary resolution of the body corporate, or if not set, the lesser of (a) an amount worked out by multiplying $1,100.00 by the number of lots in the scheme or, (b) $10,000.00) a quote is required to be given to each lot owner in addition to the requirements noted in section 151.

[193] *Owners Corporation Act 2006* (Vic), ss. 43 and 44 .

[194] *Strata Schemes Management Act 1996* (NSW), s 80C.

[195] *Owners Corporation Act 2006* (Vic), s. 45. An example is if the expenditure is necessary for personal safety.

[196] *Strata Schemes Management Act 1996* (NSW), s. 75A. The Plan is to commence from the first annual general meeting of the owners corporation and must be reviewed by the fifth annual general meeting.

[197] Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s. 94(3).

[198] *Owners Corporation Act 2006* (Vic), s 36 and 37. A prescribed owners corporation is a corporation which either levies annual fees in excess of $200,000 per year or consists of more than 100 lots (section 5 of the Owners Corporation Regulation 2007 (Vic)).

[199] The Act allows an owners corporation to enter into agreements with owners and occupiers to provide services and amenities (*Strata Schemes Management Act 1996* (NSW), s. 111) and to make payment to owners for monies received from the transfer or lease of the common property (*Strata Schemes Management Act 1996* (NSW), s. 112).

[200] *Body Corporate and Community Management Act 1997* (Qld), s. 96. The section provides an example – leasing part of the common property or selling body corporate assets.

[201] *Owners Corporation Act 2006* (Vic), s.13.

	NSW[174]	*Queensland*[175]	*Victoria*
Strata manager functions	An owners corporation can delegate almost all of its functions to a manager.[203]		
Making of by-laws	An owners corporation can make, amend or repeal by-laws.[204]	A body corporate can make, amend or repeal by-laws by recording a new community management statement.[205]	An owners corporation can make, amend or repeal rules.[206]

[202] *Strata Schemes Management Act 1996* (NSW), s. 87(1)(b) and *Community Land Management Act 1989* (NSW), s. 40 (2)(b); Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s.136; *Owners Corporation Act 2006* (Vic), s. 60.

[203] *Strata Schemes Management Act 1996* (NSW), s.28; *Body Corporate and Community Management Act 1997* (Qld), s.119 and Body Corporate and Community Management (Standard Module) Regulation 1997 (Qld), s. 37B; *Owners Corporation Act 2006* (Vic), s. 120.

[204] *Strata Schemes Management Act 1996* (NSW), s. 47. The by-laws must be for the control, management, administration, use or enjoyment of the common property or a lot.

[205] *Body Corporate and Community Management Act 1997* (Qld), s.56 (2). The by-laws must be for the control, management, administration, use or enjoyment of the common property or a body corporate asset.

[206] *Owners Corporation Act 2006* (Vic), s. 138. The rules must be for the control, management, administration, use or enjoyment of the common property or a lot.

All bodies corporate in the reviewed states are required to take out public liability insurance for not less than $10 million. It may be necessary for bodies corporate with DWMSs to increase the coverage, but this depends on the likely exposure to a contaminant. Multiple claims and protracted litigation could easily lead to settlements in excess of the threshold amount.

All bodies corporate can delegate their functions to an S&CT manager. Usually, the role of an S&CT manager is to facilitate the administrative functioning of the body corporate. By delegating its functions, the body corporate entrusts the manager to make executive decisions on its behalf and to implement decisions. If an S&CT scheme has implemented a DWMS, the manager under delegated authority would be the only person responsible for the operation, maintenance and monitoring of the system.

A body corporate in the three reviewed states has the power to amend or make a by-law or rule, although by-laws or rules are restricted to matters prescribed in the relevant legislation. Usually, a by-law can provide for the administration, management and control of common property; regulate the use and enjoyment of the lots in a scheme, the common property and the body corporate assets; and prescribe the behaviour of occupiers and invitees whilst on common property. The creation of by-laws by a body corporate may be pertinent in relation to schemes that have implemented DWMSs if the functionality of the system is reliant on the behaviour of occupants. For example, it may be beneficial to only use phosphate-free detergents. It is arguable that a corresponding by-law, which requires an occupant to use a certain detergent or powder, could be challenged by an aggravated lot owner and declared invalid.

3.5 Legal liability

A body corporate or owners association that owns and operates infrastructure is often considered a fourth tier of government. As the owner of infrastructure that is accessible to residents in the scheme and (in many cases) the general public, bodies corporate can be held liable for damage or loss caused by malfunctioning, defunct or inappropriately used infrastructure and equipment. The extent of such liability is of particular interest to regulators and local government authorities where they decide to relinquish direct control over sensitive equipment (such as a sewage treatment system) by approving its construction under private ownership. This section briefly discusses the general and strata-specific liability constructs pertaining to an S&CT complex.

3.5.1 Common law liability

There are three main common law causes of action that might arise against the supplier of recycled water. These causes of action are known as torts. They arise under the general principles of common law, rather than under legislation.

Negligence

The law of negligence requires a person to take reasonable care to ensure that the person‘s actions or omissions do not cause harm to another person, where that harm should have been reasonably foreseeable. There is a duty of care to others. If a person breaches that duty and causes injury or harm to another, they may be liable in negligence for the consequences.

The duty of care

Naturally, a body corporate operating a water recycling system will have a duty of care to the occupiers of lots in the community titles scheme using the water. In addition, it may also have a duty to third parties who may be affected by the water. For example, it will need to ensure that no untreated water escapes onto a neighbour‘s property, causing damage to persons, animals or property. If the public has access to any parks in the scheme, then there is likely to be a duty to ensure no member of the public becomes ill due to the use of recycled water for irrigation.

The breach

In order to avoid breaching its duties of care, the body corporate must ensure that it has the proper treatment and monitoring systems in place. As long as it takes all reasonable steps in this regard, including compliance with all statutes and guidelines, the risk of liability for breach can be managed and should be minimised. As already noted, because the members of a body corporate are highly unlikely to have the expertise to operate a water treatment facility, it would appear appropriate for the operational and monitoring aspects to be outsourced to an expert contractor. Although the body corporate may still be primarily liable for the neglect of the contractor, since it cannot delegate its duty of care, it should be able to pursue the contractor or its insurer for any loss sustained.

The damage

It is worth noting here that claimants will confront difficulties in taking action against a body corporate. In order to be successful in a negligence action, the person(s) alleging the negligence would need to show that the breach of the duty of care caused harm at a point that is not too remote from the precinct controlled by the body corporate.[207]

Nuisance

An action may constitute a nuisance due to the unreasonable interference with a person‘s use and enjoyment of his or her property. For example, if a water treatment facility or storage area emits a bad odour, occupiers in the community titled scheme or neighbours may have a nuisance claim against the body corporate. Another example might be a claim due to water runoff, whether or not intentional. A claim against a body corporate would succeed only if the interference was found to be unreasonable. This requires a court to balance the rights of the parties to use and enjoy their properties.

The above examples represent claims for private nuisance, where the claim is directly connected with the ownership or occupation of private property. There may also be situations giving rise to a public nuisance, where nuisance is caused to a member of the public who has no particular interest in property affected by the nuisance. This might apply to a member of the public disturbed by odours from the treatment facility while using a nearby park.

Breach of statutory duty

Where a statute provides for the performance of a particular duty and a person fails to perform the duty, the person may be liable to a person injured as a result of that failure or for loss or damage that occurs as a result of that failure. This type of liability could apply to a body corporate if injury or damage results from its failure to comply with an obligation under a statute. This kind of liability will not be discussed in detail, as it is more likely that an action in

[207] See the discussion in Jackson (2005)

negligence would be taken in the majority of circumstances where there was an action for breach of statutory duty.

3.5.2 Contract law—liability under a water supply agreement

Express contractual terms

The supply of recycled water by the body corporate to occupiers of lots is likely to be governed by a supply agreement, signed by individual occupiers. This agreement may contain obligations placed on the body corporate in terms of the quality and quantity of water provided. If the body corporate breaches these obligations and so causes health or other problems, it may be liable to lot owners for damages resulting from the breach.

Contractual terms implied by statute

The *Trade Practices Act 1974* (Cwlth) implies certain conditions with respect to agreements between a corporation and a customer for the supply of goods and services in trade and commerce. In general terms, the provisions apply to corporations acting in trade or commerce or in the course of a business. There may be some argument that a body corporate operating a water management system within its own scheme is not carrying on a business (as it is prohibited under the relevant Queensland and Victorian S&CT laws), signifying it falls outside the provisions of the *Trade Practices Act 1974*. However, if lot owners establish a community company in order to avert the restrictions and on-sell recycled water to a third party, then the provisions under this Act can be expected to apply. Either way, it would be prudent to assume that the *Trade Practices Act 1974* provisions apply, particularly in light of the many similar provisions contained in the state fair trading and sale of goods legislation (see also comments in Jackson 2005). Similar provisions may also be implied at common law.

The *Trade Practices Act 1974* conditions of fitness for purpose[208] and the product liability provisions[209] would be particularly relevant to the supply of recycled water.

3.6 Summary of key legislative provisions

The following summary highlights the key legislative provisions relating to DWMSs developed and operated in the context of S&CT subdivisions. This summary focuses on three key S&CT stakeholders: developers who wish to implement DWMSs in S&CT developments, bodies corporate (and owners and S&CT managers) who may inherit a decentralised system from a developer, and LGAs who have to make final decisions on development applications for such developments and are often responsible for monitoring the performance of privately owned water infrastructure associated with DWMSs.

In the first instance, developers and LGAs need to be aware of the requirements for meeting water saving targets under the relevant state building standards and codes. In each of the reviewed states, water saving targets for class 1 buildings, which include single detached dwellings within S&CT schemes, are relatively straightforward. More opportunities, and therefore more complex combinations, exist for attached class 1 buildings such as townhouses, terrace houses and villas. It is noteworthy that in NSW and Victoria, but not in Queensland, class 2 (multi-storey) buildings are also included in mandatory water saving targets. Although these targets require certain scores to be achieved and alternative water sourcing solutions are encouraged, there are no requirements to install communal rainwater

[208] *Trade Practices Act 1974* (Cwth), s. 71
[209] *Trade Practices Act 1974* (Cwth), Pt. VA

tanks in class 2 buildings, and sewage recycling is not seen as an acceptable solution in any of the reviewed states.

The second area of review relates to water service provisions, and it is relevant to both developers and bodies corporate. Generally, a licence or registration is required from the relevant state authority for the provision of water or wastewater services. In NSW and Queensland, relevant water industry Acts provide an exemption to this general requirement for communally owned systems that provide services only to lots included in the community scheme. It is therefore arguable (but so far not tested in practice) that if a developer, a community company (where the lot owners in an S&CT scheme are the shareholders) or a body corporate as owner of the water and wastewater infrastructure supplies a service to a property outside the scheme, the exemption may no longer apply and a licence or applicable registration is required. This is an important point, as the viability of a DWMS in some communities may depend on selling excess water to third parties. Although, in Queensland and Victoria, a body corporate is prohibited from running a business and therefore may be unable to provide a chargeable service to a third party, the lot owners under a community company or the developer could retain ownership (through leasing agreements with the body corporate) to provide such a service. Furthermore, for any entity wishing to on-sell water or wastewater services, a number of state and federal regulations may apply, including the *Trade Practices Act 1974* (Cwth), the *Income Tax Assessment Act 1936* (Cwth), and relevant state fair trading and sale of goods Acts.

Within this area of review, it is also important to note that water authorities (LGAs, water corporations, registered service providers) can compel owners (including bodies corporate) to connect to a centralised system. The only exemption to this requirement appears to be areas covered by Sydney and Hunter water corporations. Currently in Queensland, an owner of premises within a sewered area must ensure that kitchen greywater and blackwater is discharged only into the infrastructure of a service provider. This requirement ensures that in all sewered areas in Queensland in particular, a lot owner (or body corporate) is reliant on the services of a water authority. Similarly, the provisions in NSW and Victoria that enable a water authority to require a connection may adversely affect the emergence of DWMSs with a water reuse or recycling capability. These requirements are likely to render the implementation of these systems unviable when coupled with the fact that authorities can charge developers for headworks (the provision of works, services and facilities due to the likely demand for services and amenities in the development area) and impose annual charges on lot owners for the provision of water and wastewater services. As detailed in Figure 1, annual fixed water service charges exceed the consumption component, particularly in Queensland and NSW.

The third regulatory area, which is initially most relevant to developers and LGAs, relates to planning approvals, plumbing and drainage requirements, pollution control provisions and monitoring, maintenance and reporting requirements. Although in most instances a DWMS is in place by the time a body corporate takes control, it is vital that a body corporate understands the processes involved in implementing a system and, in particular, the conditions imposed by relevant authorities. Section 3.3 of this report summarises the key regulatory requirements relating to the five types of systems outlined. It is essential that owners and their body corporate understand that in dealing with DWMSs, the onus is in the first instance on them to maintain and monitor the system. The body corporate should ensure that the developer provides it with all documents relating to the approval of the system (construction and operation) by the relevant authorities. Representatives of a body corporate should also ensure that they thoroughly understand the conditions imposed by the relevant authorities in the approvals, certificates and licences granted and also the orders and penalties that could be imposed by the relevant environmental and health departments in the event that a system causes or is likely to cause a risk (to the environment and the public).

The final area of the review outlines the key provisions relating to the management of S&CT schemes and how these provisions impact on or facilitate the implementation of DWMSs. The three main obstacles in relation to the viability of a DWMS in the ownership of a body corporate are: the ability of the body corporate to fund the costs of maintaining, monitoring, repairing and replacing (if need be) the system; the ability to provide water and wastewater services; and the ability to cover (with public liability insurance) any potential claims in the event that a system fails, causing owners, occupiers or visitors to be exposed to harmful contaminants.

The establishment of an administrative and sinking fund can overcome the first obstacle. Although the relevant acts in NSW and Queensland compel bodies corporate to establish an administrative and sinking fund, the Victorian Act requires only that a sinking fund be established for large bodies corporate and only if a maintenance plan is approved by the body corporate.[210] Without the establishment of these funds at adequate level(s), a body corporate would need to constantly raise special levies or borrow to pay for the costs. This can cause difficulties if some owners do not contribute or if emergency (immediate) funding is required for repair works. Delays in raising these funds may unnecessarily expose a body corporate to potential claims if a system cannot be repaired in a timely manner and injuries result from contamination.

The second obstacle for a body corporate is whether it can provide water and wastewater services. Although the relevant state Acts allow bodies corporate to provide services for domestic use, bodies corporate in Queensland and Victoria are excluded from running a business. That is, a body corporate can provide a service and charge for the costs of providing that service, but cannot run a business for profit. As noted above, this restriction could impact on the viability of a system if the cost to the body corporate for the running, maintenance and monitoring is excessive and excess water produced is unable to be on-sold to a third party for a profit.

Sufficient insurance coverage for public liability is the third obstacle that a body corporate needs to be aware of. Although the legislative minimum in all reviewed states is $10 million, a body corporate would need to assess the potential risk of simultaneously exposing occupiers and visitors to contaminants in captured or treated water ($10 million coverage is unlikely to be sufficient for any reasonably large operation). For very large communities with more complex DWMSs, the potential for exposing a large number of individuals to pathogens is obviously greater than for a communal rainwater tank used in a 20 unit complex. The potential for protracted legal action and the volume of potential claimants in very large schemes should be carefully considered by bodies corporate, strata managers and insurers.

[210] Note: there are no timelines or deadlines (post initial registration of the scheme) defined in the Victorian act with respect to when an owners association has to have the first payments accumulating in its sinking fund.

4. Stakeholder interviews and survey

Development and operation of DWMSs in the S&CT context involves many different stakeholders. Their experiences, views and opinions about existing schemes or alternative water management systems operating under current regulatory frameworks are critical for highlighting the opportunities and potential challenges of DWMSs within the S&CT context.

Stakeholder theory developed by Donaldson and Preston (1995), Freeman (1984), Phillips (2003), Rowley (1997) and Woods (1991), together with knowledge from previous work (Ardill et al. 2004, Blandy et al. 2006, Cassidy et al. (in rev), Everton-Moore et al. 2006, Warnken et al. 2003), was used to generate a diagram of stakeholder groups, their actions and interactions related to water and S&CT management over the lifecycle of a scheme with decentralised water supply infrastructure (Figure 2 below). The complexity and the large number of stakeholders in each group necessitated narrowing the focus to those groups considered most influential in the development and, more importantly, the subsequent operation of DWMSs in an S&CT scheme. An analysis of the linkages apparent in Figure 1, feedback from workshops conducted in each of the three states, and the review of relevant legislation (overviewed in Chapter 3) indicate that there are five key stakeholder groups:

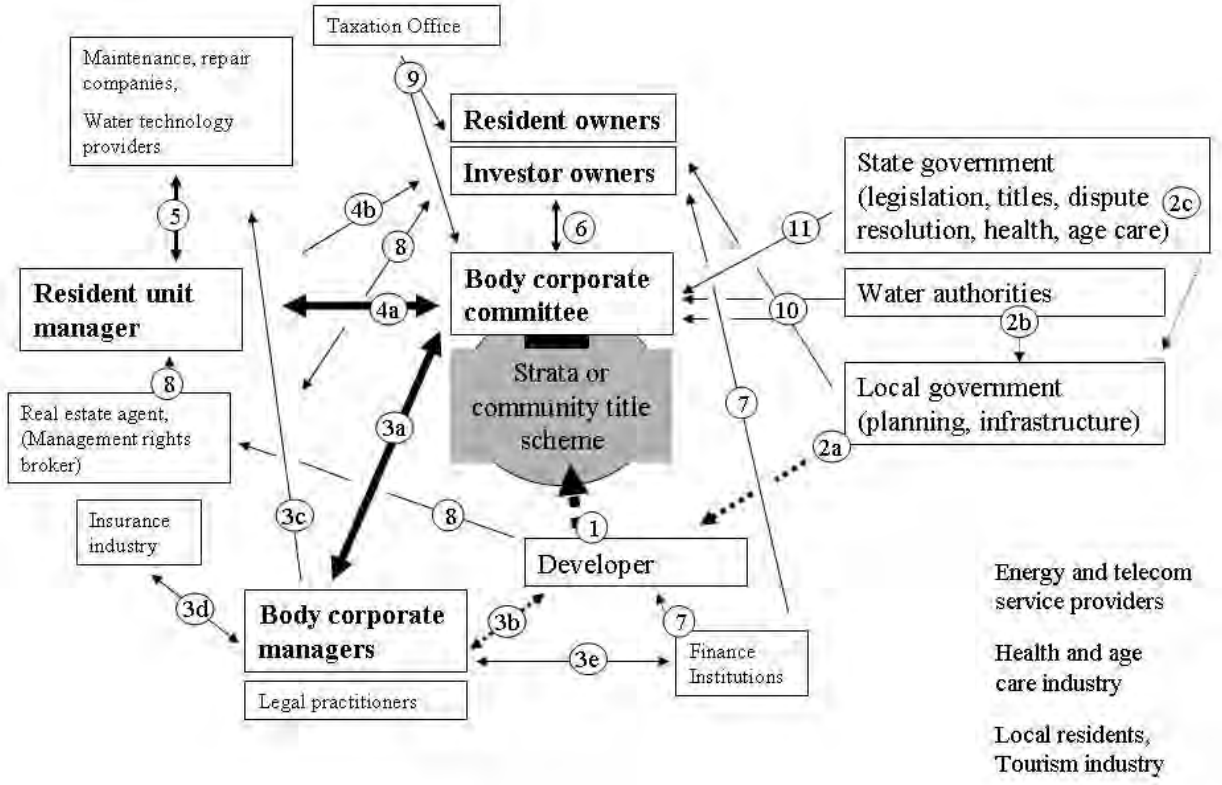
- developers, who lay the foundation of the scheme by designing the concept, layout and structure, and negotiate planning relaxations, special conditions and exemptions with LGAs and state government agencies
- water authorities, that control and manage centralised systems and provide feedback and advice about water management systems to government
- state government regulators (such as pollution control, health, land and water authorities), who set policies and design regulatory provisions governing the use of DWMSs and, also, the creation and operation of S&CT schemes
- strata managers, who are the executive arm of a body corporate committee and administer all financial and operational aspects of a scheme
- unit owners, who ultimately buy into, and live within, an S&CT scheme.

A consulting expert of the water industry, who played a key role in designing and promoting several DWMSs, was also included to represent an important bridging link between the chain of key stakeholders involved in the development of DWMSs.

Local government authorities (LGAs) were initially considered as another important key stakeholder group. The sampling effort required to compile a representative view of the many individual positions of LGAs was considered too time consuming for a timely completion of this project.[211] The interests of larger LGAs providing water services were, in several ways, closely aligned with government-owned water corporations. Much of the regulatory framework for planning decisions and advice on water treatment systems was provided by state government regulators. For these reasons, representatives from LGAs have not been included in the list of key stakeholders interviewed for this report.

[211] This is a result of the considerable variation between LGAs in size, experience with S&CT subdivisions, geographical location, and environmental constraints

Figure 2: Stakeholders and their interactions with regard to decentralised water management in an S&CT complex



Bold arrows show frequent interactions over the lifetime of a scheme, hatched arrows indicate actions or interactions restricted to a limited time period.

LEGEND:

1 = design of complex and titles' scheme
2a = planning approvals, headworks charges
2b = advice on technical aspects, headworks charges
2c = pollution control licensing, water service provider registration
3a = administrative arrangements
3b = advice on design of scheme, drafting of 1st by-laws (lawyers) and budget (strata managers)
3c = collection of quotes for service contracts, recommendation to body corporate committee
3d = arrangement of insurance contracts, commission on contracts
3e = management of maintenance and sinking funds
4a = day-to-day facilities management, report on service works
4b = short-term letting
5 = supervision of service works, collection of quotes for service contracts
6 = report to owners, election of committee members, decisions on body corporate matters during AGM
7 = rules for providing access to loans, finance
8 = sales of units and management rights
9 = taxation rules on depreciation, exemptions on income tax and GST for bodies corporate,
10 = water service charges
11 = regulatory framework for S&CT schemes, dispute resolution

4.1 Interview methodology

Representatives of relevant key stakeholder groups were identified by contacting state government authorities, or senior staff in relevant stakeholder organisations or industry positions, or through industry collaborators. Once the initial contact was made by either the industry collaborator or by a member of the research team, an email was sent to each potential interview subject with a description of the study, a brief outline of the types of questions to be asked in the interview and a copy of the Griffith University approved

informed-consent document. A member of the research team arranged an interview with all subjects who agreed to be interviewed. All interviews were held at a venue specified by the interview subject.

The process of scheduling interviews became time consuming as many of the stakeholder groups, particularly regulators and water authority representatives, were under-resourced due to staff departures, and many had been actively involved in reviews of legislation, policies and guidelines relating to DWMSs.

Interviews lasted between 30 and 60 minutes, and were guided by a range of generic and stakeholder specific questions (see list below). Most interviews were attended by two interviewers, although some were attended by a single interviewer. All of the interviews followed Griffith University's ethics protocol; interviews were digitally recorded and subsequently transcribed. Each interview subject gave permission for the interview to be recorded, and an invitation was provided to all interview subjects to advise a member of the research team if they required the recorder to be turned off.

A total of 27 interviews were conducted in three states (NSW, Queensland, Victoria) in the period May to August 2008. At least one representative for each key stakeholder group was interviewed in each state, with the exception of the water technology industry, of which the sole representative was located in Queensland (Table 10).

Table 10: Stakeholders interviewed in NSW, Queensland and Vic.

Key stakeholder	Representative(s)	NSW	Queensland	Victoria	TOTAL
Strata manager	Senior staff or specialists from leading firms	2	3	3	8
Developer	Project managers of national and local companies	3	4	1	8
Regulator	Policy adviser (EPA or Department of Natural Resources)	1	1	1	3
Water authority	Group leaders with an interest in decentralised systems	1	1	2	4
Owners	Unit owners association representatives	1	1	1	3
Water technology industry representative	Planner (and engineer)	—	1	—	1
TOTAL		8	11	8	27

In all interviews, the research team asked each stakeholder representative the following questions:

1. What are your (or your organisation's) views, positions, main concerns or experiences concerning DWMSs *and* systems under private ownership in particular?
2. Have you heard about DWMSs (other than your own, where applicable) in S&CT complexes?
3. Do you think that the ownership of DWMSs should be retained by a body corporate?
4. Would you consider strata (or community) title as a potential driver for decentralised water systems?
5. Any other comments or remarks?

Some tailored key questions were asked of the following stakeholder groups:

Developers and owners

- What would be the main reasons for a developer choosing community title (in general) and where would these community title subdivisions most likely be found (greenfield, brownfield, or inner urban)?
- Are DWMSs implemented due to buyer demand, government stipulation, or developer initiative?
- What do you perceive as the main barriers and main drivers for a development including a DWMS?
- If there would be concessions on headworks charges or other costs, would you be more inclined to look at other alternative water management solutions?

Regulators and water authorities

- Do you think that DWMSs have a future?
- Which systems (or combination of systems) are considered as a viable option in sewered and also unsewered areas and why?
- Would there be interest from water authorities or LGAs in managing a larger number of privately owned DWMSs?
- Would there be any consideration given to reducing headwork charges for developments that implement DWMSs?
- Generally, how do LGAs deal with privately owned DWMSs?

Strata managers

- What is your view on bodies corporate downscaling sinking fund contributions (less than [the value] advised by a quantity surveyor)?
- Do you think that a body corporate is more likely to shut off a water management system and revert to the centralised system if the system becomes quite costly to maintain?
- Would you advise a body corporate to increase its public liability insurance for schemes with decentralised systems?
- Can a body corporate recover its costs through on-selling excess water produced?
- Can sinking fund monies be used for emergencies (for example, if the system breaks down) and how long does it take a committee to make a decision on the expenditure?
- Can you use by-laws to regulate owner behaviour (for example, ensuring that owners use a particular type of washing powder)?

Although the four generic questions noted above and the stakeholder specific questions were posed to the interviewees, it should be noted that when answering, some interview subjects digressed from the topic of the question without providing a clear answer to the original question.

4.2 Ownership model

As already indicated in sections 1 and 3.2 of this report, the question of who should own, and therefore be responsible for, the decentralised water service infrastructure in a multi-titled complex is a fundamental factor that needs to be addressed. Table 11 summarises the

responses obtained from stakeholder representatives with respect to this issue. Specific statements highlighting the views summarised in Table 11 are provided below.

Table 11: Ownership of decentralised water service infrastructure

Question	*Stake-holder*	*NSW*			*Queensland*			*Victoria*		
		Yes	*Other*	*No*	*Yes*	*Other*	*No*	*Yes*	*Other*	*No*
Should a body corporate retain ownership?	SM	–	–	2	2	–		2	depends	
	D	1	–	1	1	problem	1	–	–	1
	R	–	n.p.	–	1	–	–	–	–	–
	WA	–	–	1	–	depends	–	–	not ideal, depends	–
	IR	–	–	–	1	–	–	–	–	–
	OA	–	–	1	–	–	–	–	depends	–
Your view on allowing or promoting private ownership?	R	–	problem	–	–	–	–	–	–	–
	WA	–	problem	–	–	n.p.	–	–	problem	–
	—	–	–	–	–	–	–	–	–	–
Should a water authority take on the management of decent systems?	SM	2	–	–	–	–	–	–	–	–
	D	1	–	–	–	–	–	1	–	–
	WA		not keen	–	–	–	–	–	interested	–
	OA	1	–	–	–	–	–	–	–	–

Note: SM = Strata or Community Title Manager, D = Developer, R = Regulator, WA = Water Authority; IR = Industry Representative (planner, engineer etc.), OA = Owners Association Representative, n.p. = no position

The stakeholder views on ownership and related issues summarised in Table 11 will now be elaborated upon, as follows:

- There was no general consensus amongst the stakeholders with respect to whether a body corporate should retain ownership of DWMSs. For the ambivalent stakeholders, most were concerned about bodies corporate shutting off viable systems and also effectively managing the risks associated with DWMSs. Many stated that the issue was not about ownership but operation and the competency of the operator.
- Generally, stakeholders in Queensland showed a preference for bodies corporate owning this type of infrastructure. These stakeholders felt that a water industry expert would need to be involved in the running of these systems and also that such infrastructure would be a benefit to a community.
- Victorian stakeholders appeared generally more ambivalent. Issues that concerned these interviewees included: risk management, unscrupulous operators setting up systems, the responsibility placed on a body corporate committee to manage these types of systems, and the possibility of a body corporate shutting off a system.
- Overall, strata managers appeared to be the most supportive group for bodies corporate retaining ownership of DWMSs. The general view was that DWMSs are similar to any other type of plant and equipment. One manager commented:

> Look, owners corporations have swimming pools, some people in the building have got no idea about swimming pools, yet they are always well maintained and there is no trouble with it because they pay an outside company. That person might come in once a week; he makes sure the chlorine balance is ok, off he goes, and once a month they do a big clean out of the filters and that's it. Now if they can look after a swimming pool, why couldn't they have looked after a greywater or a water treatment plant? There are no reasons. There is nothing stopping them.

- Both NSW managers agreed that a water authority should retain ownership. One manager commented:

> … at this point in time, it means I don‘t need to be the expert in the polishing plant, the community association has no liability in the event that anything happens to the polishing plant. I don‘t think there is sufficient knowledge in the sector yet. It‘s far better to have it in the hands of the community than an individual. Because of the concentration of knowledge, it is simply better to have it back in the hands of the council …

- Regulators and water authority representatives thought it problematic to allow or promote DWMSs. Several regulators were concerned about the lack of standardised systems in the marketplace and problems with not connecting to water mains and a sewerage system (as a back-up). One water authority representative suggested that the best way to deal with decentralised systems was to develop:

> … standardised treatment system so you don‘t have to go through the pains of verifying it … and so that you have got similar spares, the operators all know what they are doing. If they are going out to do their half day at each treatment plant, its the same, they don‘t have all these minor differences … I think you need to identify the operator of the treatment plant before you design and construct it. Now ideally, you would have design constructs and the operator would be the one person. That way you don‘t get an issue where you try to find an operator and they are trying to operate at a non-standard unconventional type treatment plant.

- A water authority representative voiced the following concern regarding the increase of decentralised systems in the marketplace:

> I guess in the back of our minds we probably think there‘s a risk in it if we don‘t start getting involved with these decentralised systems and that‘s why we did that audit six months ago just to figure out to what extent of an issue this is. In the back of our minds we‘re thinking, maybe we need to get involved because we might get forced to take ownership of those things by the local government, or they just get shut down. It‘s probably one of those issues that other people try to ignore, but it might come back to bite certain people I think.

Although some stakeholders preferred water authority ownership of DWMSs, one authority commented that:

> We would be interested, but we‘re not going to subsidise that. We would offer our services at full cost, which in most cases would probably have them go and seek services from someone else, because our fees are generally higher because our standards are very high. We are a quality assured company, so we‘re not going to encourage them, but if someone asked us to operate then we would offer our services and see what happens.

4.3 Financial aspects

The long-term sustainability of a project with a DWMS cannot be considered in isolation from its economic viability. Depending on a project‘s setup, costs for providing water services can be transferred from a local water authority to the developer and, later, the lot owners in the complex.

In unserviced areas, these costs will have to be borne by the developer and then passed on to lot owners. Here, the installation of a sophisticated water management scheme with decentralised sewage treatment and effluent recycling can offset relatively high development costs through increases in residential densities and more up-market themes than would a standard land-subdivision that is reliant on onsite systems (septic tanks).

In serviced areas, economic viability can be affected by the degree to which standard headworks charges apply and whether excess water can be sold offsite (for example to neighbouring retail or commercial precincts, or even light industry). The following two tables

and supporting interviewee quotes summarise the current views of relevant stakeholders on these two issues.

Table 12: Stakeholder views on headworks charges

Question	*Stake-holder*	*NSW*			*Queensland*			*Vic*		
		Yes	*Other*	*No*	*Yes*	*Other*	*No*	*Yes*	*Other*	*No*
If no penalties for headworks, inclined to look at alternatives?	D	1	–	–	4	–	–	2	–	–
Have reductions in headwork charges been granted?	WA	1	–	–	–	–	–	–	–	1
	D	1	–	1	–	–	–	–	–	–
	IR	–	–	–	–	–	1	–	–	–

Note: D = Developer, WA = Water Authority, IR = Industry Representative (planner, engineer etc.).

With respect to interviewees' views on headworks charges, it was noted that:

- There was a general consensus amongst developers that they would be more inclined to implement DWMSs if headworks charges were reduced.
- Most developers commented that they had approached local authorities to discuss such reductions, but generally found that it was too difficult and time consuming to deal with the authority (usually council). One developer stated that:

  > Because, one you get hit up. It's for full headworks, plus you are spending more money on it [decentralised plant] anyway, but if headworks were halved, it virtually pays for what you put in the ground … There really is no argument; it's not _no we don't see why we should do that', its normally just a blank refusal to discuss it [reduction of charges]. Because it takes it down a path of more work to do, you have to justify it to councillors. They don't really work basically. If it was all done, with honesty, you would just go, _No, there is no need for us to charge that', but council officers don't see that, because it is a loss of money out of their pocket."

- The reluctance by authorities to reduce the charges mainly relate to the need to provide enough capacity in the system if the DWMS failed. As stated by one authority:

  > The issue being that we have to provide enough capacity in our system for their worst case scenario, and that is their treatment plant fails, and 90 per cent's going to sewer, and because we have to design and bring capacity to meet that, how can you give them a discount on the head that runs the developer contribution or the headworks charges. They will get a discount on their volumetric collections charges, and in terms of headworks. We struggle to see how we can give them a discount there.

Views on other relevant economic factors—the sale of excess water and the possibility of higher costs prompting bodies corporate in serviced areas to switch back to centralised systems—are summarised in Table 13.

Table 13: Stakeholder views on selling excess water

Question	*Stake-holder*	*NSW*			*Queensland*			*Victoria*		
		Yes	*Other*	*No*	*Yes*	*Other*	*No*	*Yes*	*Other*	*No*
Can a body corporate recover costs through on-selling excess water?	SM	–	perhaps	–	–	–	2	2	–	–
	D	–	–	–	–	–	1	–	–	–
	OA	–	–	–	–	–	–	–	problem	–
Do you think that a body corporate would switch off system and revert to centralised system due to cost?	SM	1	–	–	1	–	–	–	depends	1
	D	1	–	–	2	–	–	–	–	–
	WA	1	–	–	–	–	–	1	–	–
	OA	–	–	–	–	–	–	1	–	–

Note: SM = Strata or Community Title Manager, D = Developer, WA = Water Authority, OA = Owners Association Representative

With respect to interviewees' views on selling excess water:

- Queensland strata managers commented that a body corporate would not be in a position to sell excess water produced, as it would be unable to run a business due to legislative restraints. Victorian managers incorrectly advised that no such constraints existed and that they could not see any real restriction in selling excess water to third parties. An owner, however, raised the concern that on-selling excess water to third parties may potentially expose a body corporate to further and unmanageable risks. Managers in Queensland who had been actively involved in developments that implemented systems that produced excess water had advised their clients to establish a community company whereby each owner was a shareholder in the company and the company either entered into a leasing arrangement with the body corporate, or purchased the water infrastructure and leased part of common property in which the infrastructure was erected. A manager in NSW advised that although the on-selling of water would be allowed under a management statement, the biggest issue is the tax implications for each lot owner. He stated that:

  > The biggest issue is the Australian Tax Office, which would see that as non-mutual revenue, and instead of just offsetting it against levies, they will tax that revenue in the hands of each individual owner.

- There was a general consensus across all stakeholder groups that a body corporate would be more likely to turn off a decentralised system if the costs of maintenance and repair are viewed as considerable. Most managers commented that legislation would need to be implemented to prevent a body corporate shutting off a system. As one manager commented:

  > This is where it becomes a bit of a problem … putting these systems in place is this huge amount of money, and the maintenance of them is a huge amount of money, then if there is no net benefit saving, then owners corporations definitely will say 'Yep, pull it out, we would rather [the] town water supplier right through us all.' And absolutely it will happen. But if the legislation says if your development starts off with no water, you would never get any water. Well there is no reason why it couldn't do that.

4.4 Knowledge and experience

Another critical aspect of DWMSs, particularly for those with water treatment facilities, is the availability of technical expertise and the experience of stakeholders with these systems. Not many of the interviewees had acquired experience with S&CT-based DWMSs. Table 14, together with the supporting cited quotes, highlight the views and opinions of those with such experience. Several individuals revealed some concerns about access to expert knowledge or the quality of expert support for a DWMS in operation. Despite this view, it should be pointed out that some elements of the knowledge and skills base to manage these systems already exists. Some of the trade, certificate and tertiary courses do offer pertinent training elements. If such systems were to be more widely introduced, a larger base demand can be expected to generate a growth in the services and skills available.

Table 14: Stakeholder perspectives on knowledge and experience of decentralised, S&CT-based, water management schemes

Question	*Stake-holder*	*NSW*			*Queensland*			*Victoria*		
		Yes	*Other*	*No*	*Yes*	*Other*	*No*	*Yes*	*Other*	*No*
Are there water management specialists available?	SM	–	–	–	–	not really, limited	–	–	WA involved	–
	D	–	–	–	–	problems	–	–	–	–
	IR	–	–	–	–	problems	–	–	–	–
Do you find it difficult to deal with LGA about decentralised systems?	D	1	–	–	2	problems	–	–	–	–
	R	1	depends	–	–	–	–	–	–	–
	IR	–	–	–	–	depends	–	–	–	–
Are managers capable of managing water infrastructure?	SM	1	–	1	–	–	–	1	depends	
	R	–	question-able	–	–	–	–	–	–	–

Note: SM = Strata or Community Title Manager, D = Developer, R = Regulator, IR = Industry Representative (planner, engineer etc.), WA = Water Authority

The interviewees commented that there were very few water management specialists (outside the water authorities) in the marketplace.

Of concern to many, including regulators and water authority representatives, was the issue of technology companies promoting, selling and installing decentralised systems without high quality service contractors maintaining them. As one developer stated:

> We have found that their [water technology company] service is diabolical. They are very good, I think, at marketing and sales. I'm not sure necessarily, bit hard for them to follow through on service.

Generally, it appeared most stakeholders experienced difficulty dealing with local government authorities on issues relating to DWMSs, except for councils in rural areas. Many developers commented that council bureaucracy and lack of knowledge prevented them from implementing some types of systems because of the effects on the overall cost of the project of the time it took, or would have taken, to debate the issues with council impacts. One developer stated:

> This is a hard sell with Council. So, whilst they agree to the concept, it took them seven months to approve operational works approval, because they said it doesn't fit our town planning scheme, there are no boxes we can tick, to approve it. So we had to think outside the box … It's too hard … if you had a smaller business than what we run, we are one of the 10 largest developers in Australia. You wouldn't do it because it chews up money and time."

Another developer remarked:

> I think the public mindset has changed quicker than the legislation in council. I think they are miles behind. I think the more agencies and councils can put out what they want to end up with, the better you will have a chance to say that's what we want, that's what we want to achieve, that's the checklist we want.

Most strata managers viewed their role purely as administrative. Many commented that the role of a strata manager was to facilitate the running of a body corporate. When asked whether the management of a DWMS was within a strata manager's capabilities, one manager commented:

> It doesn't frighten me … it will frighten some people, but it doesn't frighten me. But the idea of a swimming pool frightens me. I don't have a swimming pool. I wouldn't even know the first thing about maintaining one. But yeah, plenty of my buildings have got them and they operate fine.

> Why? Because I have got professional people doing it. You have got cooling towers in another development. They always seem to be maintained and there are no problems and yet, I am sure if I took the average person off the street and said hey, you have to maintain this pool and cooling tower, the first thing they will think of is I've got to do the work myself. With an owners corporation manager, we're not rolling up our sleeves and doing it, we are the orchestra leader, you know, we are the conductor of the orchestra. The orchestra is the tradespeople, and we are just simply orchestrating, and conducting and so its as simple as letting our contract out to make sure that equipment is maintained.

The general view from water authorities and regulators in relation to strata managers facilitating the operational and maintenance components of a DWMS was summed up by one regulator:

> You look at strata managers and things like that, you look at strata bodies, they have no dealings with these types of systems in the past, I mean the biggest issues have been lifts … and they are very simple systems, they are a mechanical system which has to be checked and monitored and needs a mechanical contractor. It doesn't require a mix of people. Normally if they break down, they don't work, and that will pose a public health risk.

Strata managers (who had experience with managing DWMSs) and water authority representatives raised the issue that these systems may not be financially viable. It was noted that if a property is tenanted, the increased cost for maintaining the DWMS is a direct cost to the lot owner, but the savings in utilising the recycled water is a benefit to the tenant. Managers commented that it is difficult to increase the rent to offset the increase in the body corporate fees, and some existing systems are being subsidised by water or local government authorities, and therefore the true cost of operating and maintaining the system is not having a direct effect on the finances of the body corporate. Most authorities commented that the cost to a private owner or body corporate for a water authority to operate and maintain a DWMS would be prohibitively high.

Due to the limited number of systems currently operational, there was no clear consensus on whether these systems would be successful within an S&CT scheme, although most authorities recognised that DWMSs would continue to emerge in the marketplace. One regulator made the comment that:

> We know from onsite management of single household systems, basically they go in and they are working, within a few years they have failed. The reason why they have failed is that they are not maintained, not operated correctly, they don't undertake maintenance. When something goes wrong, people don't have the money to fix them and this problem, we can't see that they are any different with strata management.

4.5 Risk management and insurance

Where a body corporate retains ownership over a scheme's water service infrastructure, the body corporate needs to ensure it is in a position to effectively manage the risks associated with such infrastructure, particularly with respect to possible equipment failure. Protection of the body corporate against potential claims is vital and sufficient public liability coverage and access to emergency funding to repair failing equipment needs to be ensured. Table 15 and the subsequent comments provided summarise the opinions of managers and owners with respect to questions relating to public liability insurance requirements, access to funds for emergency expenditure, and regulating owner behaviour.

Table 15: Perceived risks

Topic and questions	*Stake-holder*	*NSW*			*Queensland*			*Victoria*		
		Yes	*Other*	*No*	*Yes*	*Other*	*No*	*Yes*	*Other*	*No*
Funding of major capital expenditures:										
• Should public liability insurance for DWMSs be increased?	SM	–	–	–	2	–	–	–	–	–
Funding of emergencies:										
• Would a body corporate downscale sinking fund contributions	SM	–	–	–		problem	–	–	problem	–
	OA	–	–	–	–	–	–	–	problem	–
• Can sinking fund monies be used?	SM	1	–	–	–	restrict-ions	–	1	depends	–
Control of occupier behaviour:										
• Can you implement by-laws to regulate behaviour?	SM	–	–	–	–	perhaps	–	–	–	1
	OA	–	–	1	–	–	–	–	–	–

Note: SM = Strata or Community Title Manager, OA = Owners Association Representative

Key points:

- Queensland managers advised that, for developments with decentralised systems, they recommend a threshold limit of $20 million for public liability insurance. This is $10 million more than the regulated minimum. Many experienced managers remarked that the costs associated with litigation and potential pay-outs would exceed the mandated amount.
- One manager mentioned that an insurer had been advised of the implementation of a treatment plant, but subsequently the premium and liability cover had not been increased.
- Managers and owners commented on problems associated with downscaling sinking funds to values lower than than what had been quoted by quantity surveyors. One manager commented on the situation in the United States, where appropriate levels had not been maintained in sinking funds for schemes that had implemented DWMSs:

  > This is why a lot of projects in America, the large ones, are technically broke, because they have not had the discipline of putting enough money away to replace the sewerage treatment plants, or their rainwater harvesting systems, and now they are stuck with when a problem happens, they either dip into funds which were used for something else or they introduce special levies. And there is no regulator overseeing that … We have suggested to the government what people should do when they buy and sell property is to disclose what their sinking fund is, and what the forecast said they should have. And what we will find is that people will look at that and say hey, you are grossly under-contributed to on the sinking fund.

- Managers in the reviewed states had differing opinions about whether a body corporate could utilise funds for emergency purposes without the consent of the members of the body corporate. A Queensland manager commented that expenditure of less than $20,000 could be used without authorisation, but remarked that often a body corporate will also spend in excess without authorisation. One Victorian manager commented that a levy would need to be raised. Some managers alluded to the statutory restrictions and exemptions in relation to emergency spending.

- In Victoria, managers and owners advised that sinking funds represent a contentious issue and that many bodies corporate agreed not to establish a fund for capital expenditure and maintenance. The general position was summed up by one manager:

  > The owners took the view of why should I put money into a sinking fund and have it sitting there not doing anything, number 1. Number 2, if I sell, I lose that, it goes to the benefit of the new owner. And number 3, I can budget my funds better than a body corporate can anyway, so if you want $5000 to paint the building, just let me know and I will write a cheque out. In the meantime, I haven't got my $5000 sitting there, just in case I have to sell. So for that reason there were very, very few bodies corporate in Victoria that had a sinking fund.

- Mangers were asked whether by-laws (rules) could be implemented to regulate behaviour, in particular whether a body corporate could compel a resident to use a particular type of washing powder (e.g. phosphate free). Most advised that policing such a by-law would be difficult and that the best approach would be to educate the residents about safeguarding the system implemented.

Interviewees were asked about their experiences with DWMSs. Table 16 identifies the stakeholder groups, the types of systems they have been exposed to and general comments about water use.

Table 16: Stakeholder exposure to different water management systems

Stakeholder	*Comment*
Rainwater tanks	
SM	We have a high-rise development. There is rainwater harvesting that goes to the basement area where it is used for toilets [maybe] and irrigation. It is not treated in any way.
SM	We have not used any for internal (toilet flushing etc). We have lots of tanks used only for landscape.
SM	I have heard some strata managers speak about how to deal with rainwater tanks.
D	We have implemented communal rainwater tanks (half a megalitre), people can wash cars or water gardens etc.
OA	Communal tanks for gardens and lawns
SM	Communal tanks for park irrigation
Greywater and blackwater treatment plants	
SM	It was an initiative of the council [to implement a greywater system]. As I understand it, it was part of the development criteria
SM	Some developers are starting to pursue grey and blackwater treatment systems Heavy reliance on consultants to understand the system Difficult to get answers of how to manage these systems, what the system is, how much it will cost to manage There is a lot of hesitation in getting any real facts
D	There is a greywater station on neighbouring council parkland that we are utilising through a subsoil irrigation system to irrigate property – general condition of approval Greywater not treated
SM	Manage scheme with greywater treatment system
D	Blackwater recycling system – commercial building
Sewer mining	
WA	Completely new developments

Note: SM = Strata or Community Title Manager, D = Developer, OA = Owners Association Representative, WA = Water Authority

4.6 General issues

As indicated above (section 4.1), opinions were sought from representatives across all the stakeholder groups, to draw out a current, general perspective on S&CT and its role in facilitating the delivery of DWMSs. Despite asking the same, or very similar questions, some stakeholder representatives became quite enthusiastic about some particular and often minute detail pertaining to a strata title or water management issue and avoided providing an answer to the original question. Table 17 summarises those responses that could be extracted from the transcribed interviews.

Table 17: S&CT and DWMSs—general issues

Question	*Stake-holder*	*NSW*			*Queensland*			*Vic*		
		Yes	*Other*	*No*	*Yes*	*Other*	*No*	*Yes*	*Other*	*No*
General position?	SM	–	no position	–	–	supportive	–	–	reserved	–
Is S&CT a driver for DWMSs?	SM	1	–	–	2	–	–	–	–	–
	D	1	not per se	–	1	–	–	–	–	–
	R	–	depends	–	–	–	–	–	–	–
	WA	–	has potential	–	–	depends	–	–	–	–
	IR	–	–	–	–	–	–	–	–	–
	OA	1	–	–	–	–	–	–	–	–
Is there a future for DWMSs in general?	SM	1	depends on system type	–	1	–	–	1	–	–
	R	1	–	–	–	–	–	–	–	–
	WA	–	–	–	–	–	–	–	–	1
	IR	–	–	–	1	–	–	–	–	–
Are DWMSs welcomed by owners?	SM	–	no negative responses	–	–	depends	–	–	depends, sceptical	–
Are DWMSs implemented as a developer initiative?	D	–	no negative responses	–	–	–	–	–	–	–
	OA	–	If aware from outset	–	–	–	–	–	depends	–
	SM	1	–	–	–	sometimes	–	–	sometimes	–
	D	2	–	–	3	–	–	1	–	–

Note: SM = Strata or Community Title Manager, D = Developer, R = Regulator, WA = Water Authority, IR = Industry Representative (planner, engineer etc.), OA = Owners Association Representative

The overall viewpoints summarised above are now elaborated upon:

- Most managers and developers agreed that DWMSs were not implemented in reponse to buyer demand. Most projects with a DWMS, particularly those with a wastewater treatment plant, were developer or sometimes council initiatives. The majority of the developers reported that the reason for implementing decentralised systems was two-fold. Firstly, because they had an environmental conscience, and secondly, these initiatives differentiated them in the marketplace. However, some developers and managers commented that residents not care about where the services come from. One developer remarked:

  > I think the consumer really doesn‘t care where his services come from, as long as he isn‘t paying too much for them and they are of the same standard. And that doesn‘t matter whether it‘s a sustainable attribute or whatever. I think there is almost an expectation, well there is an

> expectation, that those things will be provided and that is not unreasonable … So I don't think it really is driven by the consumer. It is probably a way of developers differentiating themselves from competitors, demonstrating that these are the reasons why you should come and live in our estate … your parks will always be green and irrigated with the system we will put in place.

- Managers currently dealing with decentralised systems commented that very few residents were opposed, or responded negatively, to these systems, although one developer mentioned that in one day, there were two sewer blockages due to people putting paper towels down the toilet. He remarked:

  > You can never underestimate the stupidity of people.

- Developers suggested that one of the main reasons for choosing community title rather than traditional title was to ensure that the visual integrity of the development was maintained. One developer also commented that:

  > We [developer] just disappear one day … We are building in a redundancy [via the body corporate] for ourselves, like we walk away, then there is in our budget there is a Community Officer, there's security built in, so we provide it up to a certain date, we walk away, principal body corporate steps in behind us and it is a seamless thing for the community, that lifestyle continues.

- Most stakeholders were of the opinion that decentralised water management had a future. However, as one regulator commented:

  > I think it will be big, in the next 30 years … I think the timeframes that people expect this to occur in is not going to be done. And I think what you are going to see is a lot of teething … and I think you are going to see a few problems, and I can see state governments stepping in down the track to put in the right procedures, but I don't think the state governments are at the moment … I think they are in many ways at the moment, people are looking at the market to manage itself, but markets don't, they need some regulatory structure, they need some guidance.

- One water authority representative raised concerns over the impact DWMSs may have on the centralised system. He commented:

  > If tomorrow we woke up and there were fifty thousand of these units around the place, then water quality is a big challenge for us. But if it was seen that these systems were going to become more prevalent, then those implications would afford capital planning. Do we actually augment this water supply system or do we augment the sewage treatment system in response to these, whatever they turn out to be? They affect the water supply and the sewage production.

- Some interviewees provided comments specific to rainwater tanks. A Queensland regulator commented:

  > Rain water tanks … not an issue. They are not regulated, there are no real water quality issues with rainwater tanks, contrary to some understanding of process, Queensland Health doesn't have an embargo on drinking rainwater … They are basically saying that in accordance with the Australian Drinking Water Guidelines, people should draw their drinking water from the best possible source … But with the rainwater tank, it's at the mercy of whatever is on the roof. Should you choose to drink that rainwater, your call (your call), don't come back to the Council, don't come back to the Health Department. The minute you do it you take it on your own back. So in a body corporate sense.

- A Victorian regulator also provided a perspective on rainwater tanks:

  > I think the communal rain water tanks have still potential of contamination. OK, they don't need as high level of treatment, but if you have got communal rainwater tanks, people treat them differently to have high level of exposure to them because they think it is rainwater. But look, we have got communal rainwater tanks in camping grounds and we get gastro outbreaks from them. Communal rainwater tanks situated outside toilet blocks and you get contamination out of the taps with people washing their hands. So it is people's exposure to these type of things that people in Australia, in many areas, in some rural areas it is not so much, but they turn on a tap, it is clean water, they don't think twice about it.

4.7 Strata industry survey

Further insight into current opinion on the potential of S&CT subdivisions to operate DWMSs was sought from S&CT experts attending the National Community Title Institute (NCTI) conference, Darwin, August 2008. This biennial conference represents a forum that informs strata managers about latest developments in S&CT legislation and management and business innovation opportunities. Not every strata management company or legal expert is a member of the NCTI, but most leading firms from all states and territories (apart from Tasmania and the ACT) were represented at the conference. Most larger firms also operate or collaborate with teams of experts, including senior strata managers, legal practitioners, insurance brokers and financiers from all parts of Australia. This assembly of experts was asked to record participants views on the current degree of penetration of DWMSs in S&CT complexes and related issues. The data collection was facilitated by way of a four-page questionnaire (Appendix 1).

4.7.1 Survey methodology

All conference participants were invited to complete the research questionnaire (see Appendix 1)—entry to a prize draw was provided as an incentive to participate. Seventy-nine of the conference delegates participated in the study.

The questionnaire comprised four main sections, three of which contained closed questions. The first section asked participants three generic questions about their role within the S&CT sector, the state in which they operated, and the types of buildings they managed. The second section comprised seven questions concerned with water consumption and water management systems. The third section contained twelve questions that were designed to determine participants‘ attitudes, beliefs and opinions concerning the S&CT sector, DWMSs and how the implementation of such systems can be expected to impact on the S&CT community. A Likert scale was used to measure participants‘ responses for sections 2 and 3. The final section comprised an open-ended question, which asked participants about their views on DWMSs in S&CT developments.

4.7.2 Survey results

Of the 79 participants, 68 completed the questionnaire and 11 partially completed it. Table 18 details the responses to the first section of the questionnaire. The vast majority of participants who completed the survey were strata managers of residential buildings, working in either NSW or Queensland.

The findings emanating from the second section of the survey are outlined in Table 19. This section focused on participants‘ knowledge relating to bodies corporate and ways to reduce water consumption within an S&CT development as well as awareness of different types of DWMSs.

Findings relating to reductions in body corporate water consumption indicated that, on average, the issue had been raised occasionally over the past year, with only a moderate increase of enquiries during the past five years, a time that coincides with the the worsening of the urban water crisis.

Table 18: Overview of survey sample at NCTI 2008 conference

Role	*no.*	*State or territory*	*no.*	*Type of building managed*	*no.*
Strata manager	56	ACT	0	Residential	33
Consulting lawyer	8	Northern Territory	6	Commercial	0
Resident manager	0	NSW	18	Mixed use	6
Financier	1	Queensland	23	Other	1
Specialist accountant	0	South Australia	9	All types	39
Other	12	Tasmania	0		
More than 1 role	2	Western Australia	5		
		Victoria	10		
		All states	8		
Total	79		79		79

Table 19: Responses to Part 1 of the questionnaire

Topic	*mean*	*s.d.*	*no.*	*Likert scale*
Issue of reducing water consumption raised by bodies corporate (owners corporations)?	3.63	2.13	78	1 = Infrequently 4 = Frequently 7 = Occasionally
Enquiries about reducing water consumption increased over the past five years?	3.86	2.25	78	1 = Not at all 7 = To a great extent
Rainwater (roof water) collection systems—outdoor connections	3.23	1.69	77	
Rainwater (roof water) collection systems—indoor & outdoor connections	2.66	1.74	75	
Stormwater (general surface runoff) harvesting—outdoor connections	2.48	1.69	77	
Stormwater (general surface runoff) harvesting—indoor & outdoor connections	2.07	1.53	75	
Greywater (shower, sinks, laundry, etc.) treatment and re-use systems—outdoor connections	2.47	1.64	77	1 = Not heard of 4 = Occasionally 7 = Always
Greywater (shower, sinks, laundry, etc.) treatment and re-use systems—indoor & outdoor connections	2.15	1.51	74	
Sewage (all household water combined) recycling—outdoor connections	1.77	1.20	74	
Sewage (all household water combined) recycling—indoor & outdoor connections	1.57	1.07	74	
Sewer mining—outdoor connections	1.15	0.57	74	
Sewer mining—indoor & outdoor connections	1.11	0.42	74	

Although participants were most aware of rainwater management systems, the responses suggested that they had not heard of their implementation more than ‗occasionally'. The responses also indicate that stormwater harvesting was less noticed or heard of than rainwater tanks, and that greywater treatment and reuse systems were even less noticed than stormwater harvesting. Most participants had not heard of, or had very infrequently heard about, the implementation of sewage recycling systems or sewer-mining schemes. For each category of water management system (rainwater, stormwater, greywater, sewage, sewer mining), participants felt these systems were used for more for outdoor than indoor use.

The results emanating from the third section of the survey are summarised in Table 20. This section asked participants how strongly they agreed or disagreed with a set of statements about their role and their interaction with DWMSs (using a Likert scale measure).

As is perhaps to be expected from such a heterogonous group, participants on average neither strongly agreed (average score of 2 or less) nor disagreed (average score of 6 or more) with any of the questions reported on in Table 20. Typically, responses were either neutral or were oriented towards a positive (agree) position to the statements.

Table 20: Survey respondent views on selected issues raised during interviews and workshops

Question	*mean*	*s.d.*	*no.*
Developers are still designing projects without much consultation or understanding of S&CT management issues.	2.52	1.21	75
A strata manager who has been instructed by the body corporate committee to obtain a set of quotes for maintaining, servicing or repairing a particular building component will select and contact contractors and collate the quotes for the committee.	2.61	.128	75
Costs are the most determining factor for the decision of a body corporate whether or not to abandon a decentralised system and connect (revert) to a centralised water and sewerage system.	2.69	1.19	74
Bodies corporate generally respond swiftly (if necessary by raising additional funds) to arrange the repair or replacement of a major piece of equipment in the event that it malfunctions and may pose a risk to the occupants of a complex.	2.89	1.49	74
In the event that a body corporate can charge the lot owner for his or her water use on a consumption basis, a strata manager would bill lot owners and collect charges for such water use.	3.00	1.53	74
In strata titled complexes where individual lots have water meters and the body corporate owns the water service infrastructure, a body corporate can charge the lot owner for his or her water use on a consumption basis.	3.19	1.66	73
In order to deal effectively with DWMSs, strata managers will have to become more qualified or specialised in this area of management.	3.24	1.27	75
A strata manager could effectively facilitate the operation and maintenance of a DWMS in a strata-titled complex.	3.41	1.48	73
Most large bodies corporate established during the past two years maintain sinking funds adequate to fund replacement of major equipment items if they are out of warranty.	3.68	1.44	74
There are no significant differences between lift or cooling tower management and the management of decentralised water systems.	3.97	1.24	75
The prescribed minimum public liability insurance is sufficient to cover S&CT developments that have implemented DWMSs.	4.15	1.38	74
When developers move out of a development (are no longer the owner), all necessary information about a complex's service components is passed on to the body corporate and its strata manager.	4.33	1.61	75

Note: Likert scale used in questions reported on in Table 20

Strongly agree		Agree		Neutral		Disagree		Strongly disagree
1	2	3	4	5	6	7		

The following represents a summary of the more noteworthy observations:

- Although participants tended to agree with the statement that strata managers would need to become more qualified or specialised in order to effectively manage DWMSs, they were also positively disposed to the statement that a strata manager could effectively facilitate the operation and maintenance of a DWMS.
- Participants agreed that developers designed projects without much understanding of S&CT issues.
- Participants believed that costs were the most important determining factor for a body corporate considering abandoning a DWMS and reverting to a centralised system.
- Participants agreed that strata managers select and contact contractors and collate quotes for a body corporate committee, once instructed to do so.
- Participants agreed that a body corporate could respond swiftly and arrange for repair works in the event that a system failed and posed a health risk.
- Participants generally agreed that a body corporate could charge lot owners for water use on a consumption basis (if individually metered) and that a strata manager could bill the lot owner and collect the charges.
- Participants felt that large, recently established (two years) bodies corporate tend to have sinking funds at an adequate level to replace major equipment items.

Several issues were highlighted by those respondents who filled out the open-ended ‗comments' section at the end of the questionnaire. The most frequently identified impediment to implementing water sensitive infrastructure in S&CT complexes was the extra costs associated with such systems, either to the developer or the body corporate.[212] The next most common issue cited by the respondents (13 out of 35) related to knowledge and the need to educate owners, bodies corporate and also service suppliers (technical experts) with respect to understanding the need to balancing maintenance expenditure with the responsibilities and risks associated with DWMSs. Another repeatedly identified concern related to resistance against DWMSs from LGAs and also government regulators.

4.8 Summary of stakeholder feedback

Generally, stakeholders were of the opinion that DWMSs had a future in the marketplace, especially in light of climate change concerns. Although most stakeholders acknowledged that DWMSs would continue to be developed, the majority of stakeholder groups raised a number of issues and qualifications concerning their potential.

There was no real consensus across the stakeholder groups as to whether a body corporate should own a DWMS, although concerns were raised about the potential consequences for a body corporate if a system was inadequately managed. The broader issues that were identified by stakeholders related to: a current lack of standardised systems in the marketplace, the limited number of specialist contractors that could manage different types of systems, the marketing of these systems to developers (which can ultimately become the responsibility of the body corporate), the inability of legislative reform to keep up with advances in technology, and the potential risks (health, environmental and insurance) associated with improper maintenance and monitoring of these systems.

Generally, the developers' perspective on DWMSs in S&CT developments was that the systems not only fostered their environmental conscience, but also provided a distinguishing

[212] 24 out of 35 questionnaires with comments to section four

feature in the marketplace, enabling them to promote a development that would maintain the landscape even in times of drought. For this stakeholder group, the main issues preventing the implementation of a whole range of DWMSs related to the non-reduction of infrastructure contribution charges and the inability of LGAs to understand and approve these systems in a timely manner. On the issue of reducing headwork charges, water authority representatives' main concern related to the potential failure of a privately owned system. Their centralised water services could be called upon as a backup to prevent exposure to contaminants and other environmental impacts. For water managers, it is a preventative measure to have the funds available to upgrade the necessary infrastructure if, for example, a body corporate decides to revert to a centralised system or have a centralised system connected to the development from the outset.

Water authorities also recognised that if a system failed under the ownership and management of a body corporate, the continued viability of the system might ultimately rest with a water authority. The concerns here related to the costs of maintaining and monitoring the systems and the number of non-standardised systems in the marketplace. Ultimately, if a system that was in the ownership or management of a body corporate was required to be placed in the hands of an authority, the cost of managing such a system may be unreasonable.

For strata managers (interviewees and survey participants), the exposure to DWMSs has been limited. It appears that most managers have no experience with schemes that have implemented complex systems like communal greywater or sewage treatment plants or sewer-mining systems. For some managers, a decentralised water system was seen no differently to any other plant and equipment that required servicing and monitoring. The majority of strata managers, especially those surveyed, indicated a need for more training and qualifications to improve their confidence in facilitating the maintenance and monitoring of DWMSs and to manage these types of systems efficiently and effectively.

Generally, managers agreed with other stakeholder groups that a body corporate might switch off a decentralised system (in a serviced area) and revert to a centralised system if the costs of maintaining and monitoring the system become cost prohibitive. Although there was no consensus about whether a body corporate could on-sell excess water to a third party (Queensland managers all agreed that a body corporate was prohibited from doing this), managers who had experience with these systems (particularly in Queensland) and other more complex infrastructure agreed that a community company could be established for the purpose of on-selling recycled water generated within an S&CT scheme.

Of concern to the interviewed managers in relation to the implementation of these systems was the adequacy of sinking funds, maintenance, and also public liability insurance. For different reasons, managers and owner representatives were of the opinion that legislative reform was required to ensure sinking funds were firstly established and then maintained at appropriate levels. Although survey participants slightly favoured the view that recently established schemes are likely to maintain adequate sinking funds, this view may be somewhat specific to Queensland and NSW. In relation to public liability insurance, Queensland managers were of the view that bodies corporate should increase their coverage in strata schemes with a DWMS, as such systems carry the potential to cause harm to a large number of occupants in a development. It was their belief that the minimum threshold amount legislated for was insufficient. Survey participants, which included lawyers and insurance brokers, appeared to be less adamant in their view on this issue. They indicated only weak disagreement with the statement that the prescribed minimum was sufficient.

The biggest concerns for owners related to bulk water metering and the inability to install individual meters. Owners frequently commented on the failure of developers and water authorities to install, or to request installation of, sub-meters for individual lots. It was evident

that the practice of basing lot liability on a bulk water meter was a very contentious issue, particularly in NSW and Victoria. The general sentiment was that, in the context of bulk metering, owners would not feel a need to conserve water because their individual water charge was determined by the use of all owners divided by their lot liability. Renters were seen as being even less conscious about their water consumption, as in most cases water charges were paid by their landlord—the lot owner. The owners noted that without sub-meters, a similar situation would emerge with the implementation of DWMSs and the use of recycled water. Another issue raised by owners was the disparity in professionalism across S&CT managers. Although it was acknowledged that there was a definite tiering of the level of professionalism, owners were concerned about unscrupulous operators who appeared to be primarily associated with small S&CT developments.

5. Existing and under construction S&CT projects with DWMSs

To further illustrate the evolution of S&CT based DWMSs, this section identifies key characteristics of existing S&CT complexes and S&CT developments under construction that have implemented some form of decentralised water management. Despite a number of initiatives over the past five years,[213] in 2008 there was no comprehensive list of developments subject to S&CT land subdivisions. Accordingly, the information provided below is not comprehensive. Much of this data was obtained from leading strata managers in Queensland, notably those with head offices on the Gold Coast. Even though it can be argued that the Gold Coast constitutes Australia's S&CT capital, it is to be expected that there are other projects in other locations that have not come to the attention of the research team.

Many S&CT developments with DWMSs were in the very early planning and development approval phases. Projects without preliminary approvals or a similar form of affirmation were not included in the list below because most of their water management strategies were still to be finalised at the time of data collection. Further, an even larger number of non-S&CT projects existed in 2008 that have incorporated at least one of the four types of alternative water sources listed in section 2. As for planned S&CT projects, these were not included in the analysis below due to their ownership structure—they were owned by a single owner (usually a commercial entity) or a trust. Accordingly, the tables in this section list S&CT developments in serviced and unserviced areas (Table 21, Table 22, Table 23).

When analysing developments that were already in operation or under construction, it is important to note that most of these complexes were initiated and planned four, five or even 10 years prior to the conduct of this study. At that time, alternative water management systems tended to be implemented with a view to improving the water quality of surface waters linked to a development, or to save costs for major upgrades to existing water service infrastructure. Saving water to reduce urban water consumption was rarely the primary objective. The ongoing, i.e. post-development, energy consumption of such alternative water supply and treatment systems appears to have been rarely considered.

5.1. Developments in serviced areas

S&CT developments with DWMSs in declared water service areas were discovered in all three states reviewed in this report. The projects listed in Table 21 vary greatly in size (fewer than 20 lots to more than 1600 lots), types of uses (residential, commercial, mixed use) and their DWMS components. Despite the fact that most of these developments were designed before water saving targets became commonplace, with the exception of one, all had either communal rainwater tanks or rainwater tanks on individual lots.

[213] For example NAIAD database (CRC Water Quality and Treatment); CSIRO (2009 – in press) *ICON Water Sensitive Urban Developments*. National Research Flagships Report. CSIRO, Canberra.

Table 21: Strata and community title complexes (existing, under construction) with DWMSs in declared water service areas

Name	*Location*	*Character-istics*	*Infra-structure ownership*	*Water management schemes*				
				Rainwater tanks		*Greywater*	*Effluent recycling*	*Storm water*
				Individual lots	*Common property*			
Queensland								
Elysee	Gold Coast	24 apartments	B/C	–	Yes, for irrigation	–	–	–
Emerald Lakes	Gold Coast	1,600 + lots, detached houses, duplexes, apartments	B/C	Houses and duplexes since 2007	–	–	–	From existing drain, for irrigation
Genesis	Gold Coast	500+ lots, (detached houses, apartments)	LGA	Yes, for laundry, hot water and bathroom	–	–	Municipal plant, for irrigation and toilets (2008)	–
Helens-vale Central	Gold Coast	69 apartments and shopping centre	B/C	–	Yes, toilets and irrigation	–	Sewer mining (operational end of 2008)	–
Pacific Harbour Golf	Sunshine Coast	600+ lots (detached houses, apartments), & golf course	B/C	Yes, for toilet and irrigation	Yes, for toilets and irrigation	–	Municipal plant, for irrigation (planned)	From runoff, for irrigation
Payne Road Project (Silva Park)	Brisbane	22 detached houses, 6 lots completed	B/C	Yes, for all internal uses	Yes, top-up for individual tanks	Greywater	–	–
River-stone Crossing	Gold Coast	718 detached houses	B/C	Yes, for irrigation	Yes, for irrigation and pool	–	–	–
Sphere	Gold Coast	400+ lots, (apartments, duplexes)	B/C	–	Yes, for car washing and cleaning	–	Yes, from external sewer (sewer mining), for irrigation	–
Victoria								
Inkerman Oasis	St Kilda	245 apartments, 3 retail tenancies	B/C	–	–	GTS (50%) of units for toilets, irrigation	–	–
Pentridge Village	Coburg	1100+ lots (apartments, terraces, retail)	B/C	–	Yes, for swimming pool and toilets	–	–	Yes, for irrigation

Name	*Location*	*Character-istics*	*Infra-structure ownership*	*Water management schemes*				
				Rainwater tanks		*Greywater*	*Effluent recycling*	*Storm water*
				Individual lots	*Common property*			
NSW								
Garigal	Belrose, Sydney	83 units, light industrial	B/C	–	Yes, for irrigation	–	Yes, for toilet	–
Heritage Mews	Castle Hill, Sydney	56 townhouses	B/C	Yes, toilet flushing & irrigation; linked to communal stormwater polishing system	–	–	–	Only treatment for discharge
Kogarah Town Square	Kogarah	194 apartments, retail and commercial space	B/C	–	Yes, for toilet, car wash, & water features	–	–	From drains, for irrigation

Note: B/C = body corporate; GTS = greywater treatment system

Amongst respondents, stormwater harvesting was regarded as more common than effluent recycling. This is despite our view of effluent recycling as encompassing sewer mining, recycled water delivered through purpose-built district systems, and decentralised sewage treatment plants. The predominance of stormwater harvesting was particularly evident for large developments. Greywater treatment and reuse were the least popular systems for S&CT complexes in declared service areas.

The popularity of rainwater tanks can be understood on the following basis:

- rainwater tanks can be constructed without having to obtain any major or special approval (see section 3.3.1)
- where used for irrigation, rainwater tanks technology is well developed and can be easily installed at lower cost than other DWMSs
- rainwater is generally regarded as the safest alternative water source
- in water service areas, incorporation of rainwater tanks still requires connections to a town water network (top-up) and local sewer mains for each dwelling unit. This pre-empts any arguments for reducing infrastructure contribution (headworks) charges and water service fees, thereby eliminating any resistance from water authorities that rely on income from these charges.

Stormwater harvesting systems were used because of a combination of problems or issues with stormwater quality, flows or retention prior to development and, in some cases, the need for large volumes of water for landscape irrigation (especially for large community title developments).

The use of recycled effluent (combined greywater and blackwater) represents a more complex issue. As stated in section 3.7, provisions under the *Plumbing and Drainage Act 2002* in Queensland prevented the construction of decentralised sewage treatment plants for developments in declared water service areas. As a result, developers in Queensland have resorted to sewer-mining schemes (Helensvale Central, Sphere) or complied with planning provisions that stipulate the use of recycled effluent from district systems (Genesis, Pacific

Harbour Golf). It is noteworthy that recycled water from district systems was becoming available (Genesis) or was scheduled for delivery (Pacific Harbour Golf) only in 2008, or up to four years after the initial decision for a district system was finalised. In NSW and Victoria, decentralised sewage treatment systems can be incorporated into the DWMS for an S&CT complex, even in a declared service area. At the time of the study, most existing systems in these states were for either very small developments or for those that produce low volumes (commercial developments such as Garigal).

Communal greywater treatment systems were found only in projects that were considered 'model projects'. The two existing developments (Inkerman Oasis, Payne Road) were initiated by, or in close collaboration with, LGAs, and they received considerable support from water authorities and other relevant government agencies in the form of technical advice on operational manuals and management plans and also water quality testing. Despite such direct and indirect subsidies, both projects have faced financial difficulties and have been passed to new developers.

The rainwater tanks and stormwater harvesting systems noted in this study were found to be always owned by individual lot owners or a body corporate. The same applied to the majority of sewage treatment plants; however, ownership of some plants with membrane bioreactors was still subject to negotiations between developers and specialist water technology companies.

5.2 Ecovillages and developments in unserviced areas

In areas outside declared water service areas (unsewered areas), DWMSs were mostly used for small to medium S&CT developments (about 20 to 250 lots) and ecovillages, which are an S&CT land subdivision subtype with a strong community ethos (see Tables 22 and 23). Without access to a municipal sewer system, all projects in this category had either a sewage treatment plant with a recycled water irrigation system, or composting toilets. A greywater system was implemented only for the single ecovillage in a serviced area (Westwyck Village) that was in this study. Stormwater harvesting has been found to be rare.

Generally, the supply of potable water represents a challenge in most unsewered areas. In one case (Era), however, the development site was close enough to a serviced area where access to municipal town water was achievable without major upgrades to the existing, centralised system. All other projects, in particular those in remote areas with a tourism focus, have to provide potable water from rainwater tanks, supplemented by groundwater bores during water shortages.

An interesting facet of these developments is that in some cases the developer retained ownership over parts of the water service infrastructure (usually the sewage treatment plant), or, for most ecovillages, the 'developer' was a company controlled by the initiators and original owners of the land for the scheme, who also purchased at least one lot in the new development.

Table 22: S&CT complexes (existing or under construction) with DWMSs outside declared water service areas

Name	*Location*	*Character-istics*	*Infra-structure ownership*	*Water management schemes*				
				Rainwater tanks		*Grey water*	*Effluent recycling*	*Storm water*
				Individual lots	*Common property*			
Queensland (unserviced areas)								
Sunrise 1770	Agnes Water	179 detached houses	Body corporate	Yes, for all taps	—	—	STP (A+), for irrigation	—
Manly West	Brisbane	22 townhouses, offices	Water technology provider	—	Yes, for all taps (prior biological treatment)	—	STP (A+), for irrigation, toilets, car wash	—
O'Reillys Mountain Barrow	Beaudesert	48 eco-villas	Developer	Yes, for drinking & internal use	Yes, for swimming pool top up	—	STP (A+), for toilet use, washing buses	From drain, fed to STP for reuse
Couran Cove Resort	Gold Coast	118 pole home units, 36 villas, 24 duplexes, 107 eco-cabins	Developer (a resort management company)	—	—	—	STP, for subsurface irrigation and indirect reuse	—
Noosa Beach Road	Noosa	90 detached houses	Developer	Yes, for all taps	—	—	STP (A+), for irrigation, car wash and toilets	—
Era	Capalaba	Expected 250 homes	Body corporate	—	—	—	STP (A+), for irrigation, car wash and toilets	—
NSW (unserviced areas)								
Bingara Gorge	Wilton	1165 detached dwellings, golf course	Unknown at this stage	Unknown at this stage	Unknown at this stage	—	STP (A+), for toilet use, car washing & irrigation	Unknown at this stage

Notes: STP = Sewage treatment plant

Table 23: Strata and community title ecovillages (existing, under construction) with DWMSs inside (italics) and outside declared water service areas

Name	*Location*	*Characteristics*	*Infra-structure ownership*	*Water management schemes*				
				Rainwater tanks		*Grey water*	*Effluent recycling*	*Storm water*
				Individual lots	*Common property*			
Queensland, Western Australia and South Australia								
Currum-bin Eco-village	Gold Coast (Queensland)	144 lots (detached houses, shops)	B/C	Yes, for all internal uses	Yes, for taps in shops	—	STP (A+), for irrigation	From run off, for irrigation
West-Wyck	Brunswick	7 apartments, 5 townhouses	B/C	Yes, for all taps	Yes, for solar hot water	Yes, for toilet and laundry	Yes (biological), for irrigation	—
Somer Ville Eco Village	Chidlow (Western Australia)	104 lots, single, duplex and triplexes	B/C					
Aldinga Eco Village	Adelaide (South Australia)	150+ dwellings	B/C	Yes, for internal & external use	—	—	STP, for irrigation	

5.3 S&CT and district systems

Some LGA and state planning departments have promulgated urban planning schemes that stipulate recycled water supply together with mixed-style (class 1, class 2 and other buildings) and mixed use (residential, commercial, retail) development for large new satellite areas. Table 24 identifies some of these large projects that are earmarked for S&CT subdivision or that have a high percentage of dwellings built under such a scheme. Several of these projects were still in their planning phases at the time of data collection, and they will be developed during the next 10 to 15 years. The developer of one of the largest developments, Yarrabilba, was still considering private ownership over the project‘s sewage treatment plant. This is a clear example of how an S&CT subdivision can play a major role in delivering water sensitive infrastructure.

Table 24: Land subdivision with community title projects (existing, under construction) with district water management systems

Name	*Location*	*Character-istics*	*Infra-structure ownership*	*Water management schemes*				
				Rainwater tanks		*Grey water*	*Effluent recycling*	*Storm water*
				Individual lots	*Common property*			
District systems								
New Rouse Hill	Sydney, NSW	1800 mixed dwellings	Local water authority	—	—	—	Yes, for toilet, irrigation	—
Yarrabilba	Logan City, Queensland Seeking planning approval	Expected 22,000 homes	?	Details are still to be finalised, but will include rainwater tanks on individual allotments and water recycling				
Pimpama Coomera Water futures	Gold Coast, Queensland	7000 ha, expected 120,000 persons	Local water authority	Yes, for bathroom, laundry	Planned for some projects	—	Yes, for toilet, irrigation	—
Sandhurst Club	Sandhurst, Victoria	1250 home sites, 2 golf courses	Local water authority	Yes, for laundry	—	—	Yes, for toilet, irrigation, car washing	—

6. Summary and discussion: DWMS and S&CT subdivision in the future

The main aim of this section is to (a) draw out the current trends and directions for implementing DWMSs in the context of S&CT land subdivisions, (b) highlight the challenges for bodies corporate that manage a DWMS, and (c) provide some views on emerging DWMS solutions for the three key development scenarios (brownfield, greenfield and remote), taking into account the feedback and observations reported in the previous sections of this report. The following does not purport to represent a definitive answer to the question of how DWMSs should be implemented. It will, however, comment on design aspects for urban DWMSs under S&CT that should be considered in order to minimise the energy consumption of such systems. The discussion will not be so broad as to include a review of radically different approaches to urban sanitation that would require a major change in end-user behaviour (for example, separation of urine and faecal matter) or other solutions that are applicable only to low density developments in rural settings (for example, small diameter pipe and treatment systems for communities on septic tanks).

6.1 Introduction

The two key stakeholder arguments concerning the financial cost of DWMSs (headworks charges and water service fees) highlight the general water savings potential of these systems. Where no, or only minor, upgrades of centralised infrastructure are needed, and therefore lower headwork charges and water service fees should apply, less water will be consumed from existing (traditional) and already stressed urban water resources. To some extent, and particularly for projects in unserviced areas that could be declared as water serviced areas in the future, the same argument would apply to pollution loads to be discharged into the environment by municipal sewage treatment plants.

The role of S&CT subdivision in progressing the implementation of DWMSs depends largely on the type of project to be developed and its location relative to existing centralised water service infrastructure. Projects with high returns on investment, such as inner city office towers, or industrial and commercial buildings, are generally not reliant on S&CT subdivision. On the other hand, it has almost become the norm in Australian urban areas to develop buildings that provide retail space, food outlets, residential or short-term accommodation and particularly combinations of these uses, and sell them off on a lot-by-lot basis under an S&CT scheme.

Two other trends are starting to emerge that extend the potential of S&CT subdivision for DWMSs into peri-urban and even remote areas. In some regions, most notably in the merging conurbations in South East Queensland, investors in residential properties have come to appreciate the advantages of living in ‗lifestyle communities' with high quality services provided by a body corporate rather than a local government. This has promoted the development of a number of large community title projects during the past decade.

Another trend and point of interest has been the demand for investment in up-market ecovillages with long-term residences, ecotourism resorts, or nature-focused tourist accommodation projects in remote scenic locations with high amenity values. The residential densities aspired to by the designers of such complexes, combined with the often challenging need for providing water for household use and also treating wastewater in a manner that has minimal environmental impact, signify that these complexes depend on a reliable wastewater collection and treatment system that provides superior performance to traditional septic tank systems. Accordingly, these types of projects were a driver for DWMSs under S&CT long before concerns about the urban water crisis spawned the wider application of this concept.

Table 25: Comparison of key characteristics and DWMS for residential development scenarios under a standard land subdivision or an S&CT subdivision

Site location	*Standard land subdivision*					*S&CT subdivision*				
	Common building types	*Centralised services*		*Alternative water sources*		*Common building types*	*Centralised services*		*Alternative water sources*	
		Water	*Sewage*	*Prescribed*	*Option*		*Water*	*Sewage*	*Prescribed*	*Option*
Brownfield (re-development)	Generally not practicable due to high land values					Duplexes, townhouses, 2 storey to high rise apartments	✓	✓	Rainwater tanks connected to toilet and/or laundry; OR Greywater treatment system	Communal RWT; stormwater harvesting; effluent recycling
Greenfield	Single detached dwellings	✓	✓	RWT connected to toilet and/or laundry; OR direct diversion greywater system	Stormwater harvesting; effluent recycling (district system owned by water service provider)	Detached dwellings, duplexes, townhouses, 2 to 4(5) storey apartments	✓	✓	Rainwater tanks connected to toilet and/or laundry; OR Direct diversion greywater system; OR Greywater treatment system	
Remote	Single detached dwellings (on lots > 2,000 m2)	Not available		RWT connected to all taps supplemented by a bore or surface water; OR direct diversion greywater system; onsite sewage treatment system	Connected small diameter decentralised systems linked to septic tanks (US model)	Detached dwellings, duplexes, townhouses, terrace houses, 2 storey apartments	Not available		Rainwater tanks connected to all taps supplemented by bore or surface water; OR Direct diversion greywater system; decentralised sewage system	

Note: ✓ = present; ✓ = likely to be available; ✓ = less likely to available

The other factor shaping the type and probability of a DWMS being developed in the context of an S&CT project—their location relative to the nearest town water and sewer network—is best illustrated by considering the three development scenarios described under section 2.3: development in brownfield, greenfield and remote areas. Table 25 provides a comparison of likely building forms for residential developments, and the most common DWMS applications for alternative water sources in response to the relative availability of centralised water service infrastructure.

In the absence of a guaranteed higher tariff for renewable energy, as an economic imperative to feed all locally generated electricity from renewable energies back into the grid,[214] S&CT can provide more options for refining and integrating the design of a DWMS to locally match energy and water saving targets within a single development. Other issues relating to S&CT based DWMSs are more location specific.

6.2 DWMSs for brownfield sites

Residential developments on brownfield sites have to develop a product that can accommodate high land values (or, alternatively, extensive costs borne by often substantial site remediation works) and the regulatory requirements of high residential densities embedded in widely promoted policies for urban consolidation. With few exceptions,[215] this leaves little room for anything other than a subdivision under S&CT. From a water management perspective, the high residential densities envisaged by developers and government town planners translate into three basic challenges:

- high internal water demands per square metre of site area
- low per capita yields for rain water collection due to a low ratio of roof area per tenant
- small areas for the disposal of recycled water by surface or subsurface irrigation.

On the other hand, communal facilities such as carwash bays and elaborate landscaping can provide additional opportunities for using recycled greywater or blackwater. These factors signify that DWMSs for brownfield sites need to be designed to maximise rainwater collection, energy-efficient use of rainwater for supplementing town water for bathroom and kitchen taps, and use of treated greywater or blackwater for toilet flushing, laundry, car washing and landscape irrigation. Based on the findings from this study, data from the literature, information from industry officials and other research projects in progress, and environmental and water quality management guidelines, a DWMS for an S&CT subdivision on a brownfield site could, in theory, incorporate:

- communal rainwater tanks with town water top-up, particularly in buildings with small roof area to tenant ratios (most multi-storey apartment complexes)
- central collection and treatment of rainwater (i.e. polish, where necessary – which could also allow reuse of water from fire testing)
- rainwater tank connection to intermediate rooftop storage tanks for supplying gravity-fed water to bathroom taps and solar hot water systems installed on communal roof spaces[216]
- town water for kitchen taps to reduce the risks of ingestion of contaminants likely to be contained in urban rainwater

[214] For example, unlike Germany, where renewable energy (primarily wind and solar) has to be bought at a guaranteed, higher price (Erneuerbare-Energien-Gesetz (EEG) 2000 (Germany), §§ 4-8).

[215] For example, mixed-used developments (office towers with residential components) in central business districts of major capitals.

[216] To minimise energy costs: one major pump designed to be switched on only to fill up the intermediate tank for the day and a small pressure booster system only for penthouse and subpenthouse.

- a grey or blackwater treatment (depending on local constraints) and recycling system producing high quality water for surface irrigation, car washing and toilet flushing, and possible supply of excess water to surrounding properties.

A blackwater recycling system with nearly the same monitoring, maintenance and documentation efforts[217] carries the advantage of reducing biosolid loads (commonly associated with toilet water),which will otherwise increase the risk of silting and blocking existing sewer mains. This is a particularly important factor in areas where water saving measures have successfully reduced volumetric flows, but not the overall loads of household water wastes that are released into drains with gradients designed for much higher water to solids ratios. Treating blackwater (including kitchen water) and greywater together would also provide higher organic carbon concentrations to operate bioreactors with activated sludge systems, which help to reduce nutrient concentrations of recycled water. Finally, such effluent recycling systems would reduce construction costs relative to a greywater system, as dual wastewater pipe networks within the complex would no longer be needed.

In a brownfield development environment, wastewater treatment plants for individual projects can still be connected to sewer mains to guarantee a safe discharge of untreated water in case the wastewater treatment plant requires maintenance, malfunctions or fails. Provided the effluent recycling system incorporates an appropriately sized holding tank to hold and buffer peak wastewater flows (mornings and evenings),[218] connections to sewer mains could still be much smaller in diameter than those required for a similar development without an effluent recycling system.

6.2.1 Water charges

Complex DWMSs, as described above, have not yet been implemented on brownfield sites. The information collected from stakeholders (section 4), however, clearly indicates that such developments should be fitted with water meters for all individual lots and the common property, and that tenants should be charged for their actual water consumption.[219] This has so far been recognised only in Queensland, where mandatory provisions were introduced for all lots in all new S&CT developments approved after 1 January 2008 (all lots in class 2 to 8 buildings are to be fitted with individual water meters[220]). In other terms, future DWMSs in S&CT complexes will require cost-effective (energy and monetary) monitoring systems to track the water consumption of individual lots in multi-unit complexes. Current smart meters allow data collection and transfer through Internet-based solutions. They can also provide instant feedback to consumers by displaying daily consumption. On the other hand, smart meters and their requirements for data bundling, transmission and analysis software are more expensive and require energy for data collection, transfer and processing. Larger S&CT complexes often employ an onsite resident manager, who could check and manually read water meters at appropriate intervals. Irrespective of the way data are collected, the body corporate and the local water authority still need to develop mechanisms for billing individual lot owners. This matter requires further thought and political direction. In Queensland, for example, all water meters installed in single and multi-title dwellings will be owned and

[217] Greywater and blackwater (sewage) essentially require the same licences, approvals and hazard and management programs (S 3.3.3).

[218] This would enable the release of untreated wastewater at a constant rate during off-peak times, thereby remaining within the transportation capacities of existing sewer mains.

[219] Traditional single water meters for an entire scheme would fail to encourage tenants to use water wisely and, therefore, maximise the use of water from alternative sources.

[220] Pt 4, P1 Queensland Plumbing and Wastewater Code: The water supply to a meterable premises must be fitted with a device (water meter) to measure the amount of water supplied to the premises. Under the Code, meterable premises are:

….. (b) each lot within a community title scheme, including the common property, in a water service provider's area; and (c) the sole occupancy unit of a class 2, 4, 5, 6, 7 or 8 building in a water service provider's area; and …..

monitored by the relevant local water authority.[221] Such statutory requirements for outsourcing water billing for presumably yet another fee could erode much of the economic gains realisable from using water from an alternative source. This seems at odds with provisions under the *Water Supply (Safety and Reliability) Act 2008* (Qld), where all other parts of water infrastructure of an S&CT complex are exempt from provisions relating to water service providers. Leaving the collection of water charges to the body corporate, on the other hand, may create problems with collecting outstanding amounts. Some strata managers commented that, in their view, excessive consumer protection concepts have rendered mechanisms for collecting outstanding body corporate fees by bodies corporate or owners' corporations too cumbersome and expensive for amounts that are likely to be relatively small.[222] To reduce water consumption under both models, water charges should be paid for by the tenant and not the lot owner, or the lot owner where he or she is a resident owner. However, an owner would be liable for outstanding amounts should a tenant default.

6.2.2 Financial securities

Sewage treatment plants are too risky to be operated without water authorities having immediate access to funds in case they have to repair an effluent recycling scheme to protect its own system from damages. For major equipment items, this would only become necessary where a body corporate has acted negligently or without diligence, and where relevant manufacturers' warranties have elapsed. The financial security could be in the form of a set proportion of a sinking fund, a guarantee for a line of credit, or a performance bond as part of a licence.

At the same time, bodies corporate with a DWMS should be required by law to take out insurance cover up to a multiple of the minimum amount for public liability insurance ($10 million), with the multiplication factor determined by the number of lots in the scheme. An undetected failure of a DWMS, especially one with a sewage treatment plant, carries the potential of simultaneously affecting a large number of people and inflicting long-term health problems, particularly on vulnerable people such as children and the elderly.

6.2.3 Ownership

As highlighted in section 3.2, ownership is the biggest issue concerning DWMSs in an S&CT context. There are many ownership possibilities, including combined ownership arrangements. For some components in an S&CT development—such as communal rainwater tanks—the answer is relatively straightforward. As these systems are easy to monitor and maintain, they are often incorporated in building envelopes (especially in high density developments), and they should be viewed as part of either:

- the common property and owned by the lot owners through their lot entitlements, or
- the property owned by the body corporate (this depends on the legislative approach taken in the state or territory where a strata title scheme is located).

The same applies to pipe networks, which in most cases, are already part of the common property.

A more complex situation arises for schemes with treatment systems for greywater reuse and effluent recycling. The post-treatment pump and irrigation systems are similar to existing irrigation systems that use town water and are managed by bodies corporate. These

[221] S. 35(2) *Water Supply (Safety and Reliability) Act* 2008 (Qld) The meter is the property of the service provider even if it is installed inside the boundary of the premises; AND S. 20 (1) (a) (i) *Body Corporate and Community Management Act 1997* (Qld) – excludes water meters from being included as utility infrastructure in common property.

[222] Reference to the situation in Victoria

components should also be incorporated as assets into the common property. This is particularly relevant for subsurface irrigation systems. Ownership of the actual greywater or sewage treatment system would depend on the location and size of the system. Small systems servicing schemes with only 20 to 40 lots should be incorporated as an asset in a scheme's common property, without posing too much of a risk to local water service providers. Even if these systems were to fail completely, their daily volumes are small, and the water can be captured in holding tanks prior to removal by trucks operated by licensed sewage service providers. Even if owners vote for abandoning their water reuse or recycling schemes and connect back to the sewer mains, mains systems are commonly designed with considerable safety margins capable of handling stormwater infiltration and such small load increases.

Other S&CT water infrastructure ownership scenarios are not as straightforward. Larger treatment systems for schemes with 50 to 250+ lots should perhaps be owned and operated by a specialist water technology company rather than a body corporate, certainly in Queensland and NSW. The primary argument for this stems from the basic space constraints associated with high density (re-)developments in brownfield sites, where the volumes of recyclable wastewater[223] generally exceed the volumes needed for toilet flushing, irrigation of generally small landscaped areas and car washing. Excess recycled water should be made available to other developments surrounding the scheme (cascade effect), preferably subject to a supply contract and some cost recovery. This would require the selling of water to home owners outside the S&CT scheme that provided the water treatment facility, which, as pointed out in section 3.2, would require registration as a water service provider, at least in Queensland and NSW. Specialist water technology companies are in a much better position to maintain the necessary protocols and management regimes required for registration as a water service provider than a body corporate. The former will have to be contracted by a body corporate anyway, because no body corporate will be in a position to actually operate its wastewater treatment system. To ensure that such specialist water technology companies can provide their services at a competitive price, registration as a water service provider should be open to private companies, and it should enable the servicing of multiple sites. As human health risks associated with plant failures are likely to be high in densely populated urban areas, private entities should not be granted registration or a licence as a water service provider unless they can provide relevant assurance or a performance bond to cover any immediate expenses to fix any malfunctioning equipment.

The body corporate should retain ownership over the space where the wastewater treatment facility will be located and also the pre- and post-treatment holding tanks. Many modern treatment systems capable of servicing 25 to 100 or more lots can be designed as compact, scalable units. In case owners are dissatisfied with the infrastructure installed by the developer or the costs for the services provided by the owner of the treatment unit, the body corporate, as the owner of the land, can arrange for an exchange of these treatment units and water service providers as a last resort. [224]

Installing and operating a wastewater treatment system still requires considerable investment. To keep economic risks and operating costs low, such systems should be installed subject to a long-term contract. In the S&CT context, long-term contracts have been problematic, particularly in instances where developers acting on behalf of the body corporate enter into agreements with service contractors. Often due to the long-term nature of these arrangements, bodies corporate have been burdened by onerous and seemingly never-ending arrangements (Ardill et al. 2004).

[223] If only parts of the scheme are serviced by a wastewater treatment system to match supply and demand for internal use only, the remaining lots would need to be connected to sewer mains, which, as a result, would trigger the need for sewer upgrades and headworks charges.

[224] Provided that the wastewater treatment system is not fully encased by a building envelope.

Recent legislative amendments in some states and the noted case of Arrow Asset Management[225] have imposed duties (including fiduciary duties) on developers in these situations, requiring them to act in the best interests of the body corporate when entering into contractual arrangements. Therefore, a developer will need to weigh up the necessity for a long-term contract (in these instances) against both legislative restraints (in some states) and the burden such a contract may have on a body corporate years later.

Perhaps the ramifications for developers entering into long-term contracts may be too great and result in short-term agreements.

6.3 DWMSs for remote sites

Remote sites represent the opposite extreme to brownfield sites—they are far away from existing water service networks, or they are obstructed by geomorphologic features. This signifies that owners have to be self-reliant with respect to their water services. The configuration for a DWMS is therefore relatively straightforward: all available roofwater needs to be captured and supplied to all taps in the S&CT complex. Toilets, laundries, car washing facilities and all landscape irrigation should be connected to a reticulated recycled water distribution system or the roofwater supply system if plentiful. In areas with prolonged dry seasons (most parts of Australia), tankwater needs to be supplemented by bore water or other natural surface waters. All wastewater has to be treated and recycled on site, or on adjacent agricultural land. Many residential or tourism S&CT developments in remote areas are also isolated because of their scenic location or their adjacency to nature conservation areas. This often limits opportunities for the on-selling of recycled or excess water. In many resorts in such remote areas, the use of hardy native plants often leaves enough recycled water for irrigation and all other uses, which might render additional stormwater harvesting uneconomical.

The type of development just described would simplify many of the S&CT management issues discussed under section 6.2. Apart from rainwater tanks on individual lots, all decentralised water management infrastructure should be owned and managed by the body corporate. The high costs associated with leasing a decentralised sewage treatment plant from a specialist water technology company and leaving all maintenance and monitoring tasks to such offsite service providers would, in most cases, be prohibitive. A more realistic scenario, particularly for resorts offering short-term (tourist) accommodation, would be based on extending the services of a resident facilities manager.[226] This service could include responsibilities for routine monitoring and maintenance tasks of all communally owned components of a DWMS. In remote locations, water charges can be incorporated into body corporate fees where rainwater is sourced from rainwater tanks on individual lots. Only the supply of top-up from naturally occurring water (other than rainwater) needs to be closely monitored and charged for. Rainwater supplied from a communal rainwater tank should only be supplied subject to a consumption-based charge, possibly even a progressive rate.

The key challenges for such developments are logistical more than they are an S&CT management issue. As noted by S&CT stakeholders in Queensland, it is often arduous to

[225] The Arrow Asset Management case (Community Association DP No 270180 v Arrow Asset Management Pty Ltd Ors [2007] NSWSC 527 (30 May 2007) resulted in a developer having to pay to a community association the proceeds of sale of the management rights of the scheme. The rationale was that the developer was the 'promoter' of the association and the purchasers of units were in a similar position to 'investors'. As such the developer was a 'fiduciary' and obliged to make full disclosure to the association of its interest, which it did not do. The normal disclosure in the unit sale contracts of the creation and sale of the management rights was deemed insufficient. There is significant potential for this case to apply across all Australian jurisdictions and also to apply to a wide variety of transactions entered into by developers, apart from the sale of management rights. There is also the potential for building managers and others to suffer as a consequence of the decision.

[226] In Queensland and NSW (and to some extent in Victoria and Western Australia) such a person will hold management rights, which include a contract with the body corporate to maintain the common property and all its assets in good working order.

send water samples for water quality testing to NATA accredited laboratories, or to get wastewater treatment engineers or experts on site to fine tune the scheme's sewage treatment plant and to properly train staff onsite.

Equally challenging is the task of government regulators who need to control the daily operation and performance of a wastewater recycling system, especially where abundant natural surface water can be extracted to substitute for substandard recycled water that is simply being discharged into the environment. It is notable that the courts have assisted government regulators by rigorously enforcing maximum penalties for wilful pollution of water, including groundwater.[227]

6.4 DWMSs for greenfield sites

Greenfield sites fall between the two extremes of brownfield and remote areas. They contain the most diverse group of developments. This diversity applies to their overall sizes, themes, environmental constraints and access to town water and sewer systems. Where subdivided under S&CT, such low-density developments are more likely to come under a community title, rather than a strata title subdivision (section 2.4). The large open spaces commonly found as a part of such community title schemes provide much greater opportunities to hide wastewater treatment facilities from view and to beneficially reuse recycled water.

In Australia, the bulk of urban expansion is continuing to occur on greenfield sites around major conurbations. Most of these conurbations have easy access to seawater and therefore desalination opportunity, a technology that is totally independent of rainfall or groundwater and, therefore, climate change scenarios. For many greenfield developments, the question of whether to choose a decentralised solution should be based on a cost–benefit analysis of energy consumption, environmental and social costs for water services and the quality and reliability of water service provision. Outcomes of such cost–benefit analyses will be location specific; however, some general constraints will be ever present: desalination through reverse osmosis and the subsequent transportation of desalinated water across a central water supply network is always (a) capital and energy intensive, and (b) subject to potential environmental impacts associated with discharging concentrated brine. In case of prolonged droughts, DWMSs, on the other hand, require a willingness of end-users to accept potentially severe water restrictions. The latter two costs are difficult to gauge. The gauging of energy and cost efficiencies associated with a DWMS, on the other hand, can be relatively straightforward. The following discussion therefore focuses on energy efficiencies of different components of DWMSs for greenfield developments and the way such systems can be promoted for S&CT subdivisions.

6.4.1 Rainwater harvesting infrastructure

Lower residential densities translate to more dispersed dwelling units, mostly single detached houses, which can create economic challenges for collecting rainwater in communal systems, even though they could be designed to be much more energy efficient than a series of traditional rainwater tanks with at least one pump per dwelling. Development sites with a natural high point could provide the space for one large tank, instead of a series of small tanks, and a gravity-fed rainwater distribution system. Initial extra costs would be incurred for installing a rainwater collection system with a pipe network that is separated from other surface water runoff collection systems and a powerful pump to lift large volumes of water

[227] *EPA v Gardner*, Land and Environment Court NSW, 7.11.1997: the offending individual was ordered to pay a $250,000 fine (the maximum penalty for individuals) plus court costs of $240,000 after being found guilty of having polluted a river by setting up a system which discharged approximately 130,000 litres of sewage per week over 128 weeks. The offender was convicted for an offence under s. 5(1) *Environmental Offences and Penalties Act 1989* (NSW) (now s .115 (1) *Protection of the Environment Operations Act 1997* (NSW)), i.e. wilfully disposing of waste in a manner which was likely to harm the environment.

from the lowest to the highest points of the development site.[228] As energetically favourable as it might be, such a system could create a number of legal problems relating to the ownership and control over roof areas and the water running off them. However, S&CT schemes' by-laws and architectural design guidelines can overcome some of these problems by providing a body corporate with the necessary powers to retain control over the maintenance of roof areas, gutters and downpipes and prohibiting individual lot owners from disconnecting from the communal rainwater collection system and installing their own rainwater tanks.

The only remaining, but still quite contentious, issue relates to the need for monitoring water consumption and designing a charging system that would prevent exploitation of communal rainwater by inconsiderate lot owners. Such exploitation would largely be the result of behavioural differences (unusually long showers, frequent baths or excessive clothes-washing habits), as all homes would be fitted with similar water saving devices specified in recently updated building codes and architectural guidelines. A volumetric based tariff charged in monthly intervals would be the most straightforward mechanism to prevent inconsiderate use. A simple, and perhaps more cost effective, alternative to having to calculate and collect consumption-based water charges would be to use a two-part tariff with a fixed _service' rate incorporated into body corporate fees for a conservatively estimated volume of water per indoor tap per lot. Only water consumed beyond the amount allocated per lot would then be charged separately at a premium rate to lot occupants. Bodies corporate could also be empowered to shut off the water supply in the rare cases where recalcitrant tenants refuse to pay for excess water consumption. Finally, body corporate committees should be empowered to executively change the monthly or quarterly allowances for water consumption under a fixed service rate in response to declared drought conditions or when directed by a water authority or water commission.

6.4.2 Stormwater infrastructure

Managing stormwater to improve its quality through water sensitive design features (such as gross pollutant traps, permeable surfaces, swales) prior to release into natural drains or waterways has become an integral feature for most developments in greenfield sites (see section 2.2). Once rainwater has passed a series of water sensitive urban design features, it will carry considerably reduced pollutant concentrations, making it suitable for irrigation. Collection and treatment of stormwater uses gravity as the main driving force, and swales and other vegetation in artificial wetlands can act as carbon sinks. The major energy costs relate to pumps required to pressurise irrigation systems, but only when required. This could make stormwater a very energy-efficient alternative water source. Projects with high irrigation demands for large recreation facilities, such as golf courses, should consider this alternative water source.

Stormwater quality is very much dependent on its catchment—its geographical location, geomorphology and developments. Managing these variable stormwater qualities generally requires project-specific conditions for construction and operation (maintenance and monitoring), which have to be covered by conditions of approval. In an S&CT subdivision, these can be translated into body corporate by-laws and architectural guidelines. To further improve the situation of mostly unregulated stormwater harvesting schemes, planning authorities could consider introducing provisions for impact assessment of larger communal stormwater or rainwater holding systems (approximately more than 15 kilolitres holding capacity) to relevant planning legislation, e.g. the *Integrated Planning Act 1997* (Qld) or the *Environmental Planning and Assessment Act 1979* (NSW).

[228] Using a large tank instead of many small tanks would also provide considerable cost savings.

6.4.3 Infrastructure for water recycling

As for brownfield locations, developers and water authorities for greenfield sites have to choose between greywater or blackwater treatment systems. In most cases, the latter would be more cost effective as it negates the need for upgrades of centralised wastewater service infrastructure. It also negates the need for dual wastewater pipe networks and probably results in only slightly higher energy costs for treatment (mostly pumps and aeration) compared to greywater systems. As indicated above (section 6.4) disposal of excess recycled water is less likely to be a concern. Accordingly, on-selling water to parties external to a scheme would unlikely be of interest to the body corporate managing such a scheme. This, in turn, would place a body corporate in a strong position to retain full ownership over all assets of its effluent recycling system, including the local sewage treatment plant. Ultimately, the question of whether a body corporate should own a sewage treatment plant or lease it from a specialist water technology company depends on the overall system costs, which in turn are defined by the size, location, and DWMS-configuration of an S&CT scheme.

6.5 Staged development and multi-layered schemes

Most, if not all, large community title developments are developed over a number of years and in a number of stages. In order to effectively manage these developments, most schemes are layered, so each stage has at least one subsidiary body corporate, which, in Queensland, sits under the umbrella of the principal body corporate, or an equivalent S&CT structure in other jurisdictions.

The implementation of DWMSs is therefore also often staged. Ownership of the infrastructure and most of the components are usually held by the principal body corporate (either as a body corporate asset (if a chattel) or as common property (if affixed to the land)).

Difficulties can arise, however, when a developer wishes to either replace an existing DWMS or implement a system that differs from the originally proposed system. Advances in technology, building standards and regulations can result in significant changes to the original project layout over the development life of a staged project. This is particularly the case with water infrastructure and its rapid technological development. Technological advancements can result in a reduction in the size of a DWMS (especially treatment plants), improvements in energy efficiency, a reduction in operating cost, and improvements in the quality of recycled water.

Changes to building standards and regulations may restrict or relax certain requirements or conditions. Such changes can have an impact on staged developments by requiring the implementation of new or diverse water system alternatives during the development process. What may have been prohibited at the beginning of a development approval process may become a legal requirement near its end.

The key challenge to changing a DWMS concept during the course of an S&CT development project concerns striking an appropriate balance between the interests and powers of: (a) the developer (party that likely seeks to maximise profits by installing a less expensive system), (b) the lot owners (party that likely seeks to retain quality standards but reduce operating costs), and (c) society in general (party that will seek to keep environmental and human health risks and impacts at a minimum). The particular phase of a development tends to determine which of these decision-making groups is in a position of ascendancy. It is to be expected that the balance of power can evolve as more subsidiary schemes are established: the decision-making role, which rests primarily with the developer at the beginning of a staged

development, moves to the owners (represented by the body corporate) as the development nears completion. Further research is required to ascertain whether current S&CT management arrangements for large schemes result in an appropriate balance of power. Do they obstruct sensible changes and alterations, and do they create an opportunity for developers to generate undue profits at the expense of existing and future lot owners? Other issues associated with situations involving changes to DWMSs are outlined below.

In NSW, a development contract is required to be registered with the initial strata plan. The contract sets out the conditions that are warranted (development that must be completed by the developer) and authorised proposals (development that is authorised but need not be completed). If a developer warrants a DWMS to be implemented in a development, any variation will require an amendment to the development contract. Consent to vary the contract will depend on the reason for the variation. If the variation is required due to a change in the law or change in the requirements of the consenting authority, approval to vary will be required by the consenting authority (LGA) and notification must be given to interested parties (including the owners corporation, the lot owners, and mortgagees). If the variation is the result of a developer wishing to modify the system (for example, to implement technological advances), approval may be required from the consenting authority and the owners corporation (either by way of special or ordinary resolution).

In order for a staged development to have scope to implement technological or legal changes, some flexibility needs to be built into the legislative framework and development approvals. Such flexibility should appropriately recognise the rights of existing owners and protect the interests of off-the-plan property purchasers.

For off-the-plan contracts, changes to the scheme or budget, which materially adversely affect a lot purchaser‘s position, can give a purchaser the right to rescind. A prudent developer should ensure that disclosure statements are drafted in contemplation of such changes.

If not already developed, each state should devise specific planning and body corporate legislation for staged developments to ensure that the necessary flexibility is guaranteed for developers, whilst not impeding reasonable rights of owners. In Queensland, development of a large scheme module under the *Body Corporate and Community Management Act 1997* (Qld) should be further considered.

6.6 Consumer protection

As noted elsewhere in this report, lot owners (represented by a body corporate) must govern every aspect of a scheme once a developer has completed a development and moved out. The responsibilities and obligations that rest with a body corporate to govern a scheme, especially a complex scheme, can be onerous. By the time a lot owner purchases a property, there have been numerous contractual relationships entered into on behalf of the body corporate (by the developer) to enable or facilitate the operational aspects of the scheme.

Following a developer‘s departure, the body corporate becomes the ultimate decision-maker. Even so, the workings of the body corporate typically become heavily reliant on a number of contracted parties that include: S&CT managers, resident managers and maintenance contractors. For developments with DWMSs, the body corporate is particularly dependent on external contractors for the system‘s continuing operation, maintenance and repair.

In order to make decisions on behalf of lot owners, the members and committee of a body corporate must not only be willing, they also need to have, or be able to acquire, the necessary knowledge to govern.

Problems can be expected to arise where members of a body corporate are naïve or apathetic about their responsibilities and obligations to govern a scheme. Some manager interviewees felt that owners are not interested in filling committee positions and have little understanding of their role as a member of the body corporate. Managers commented that most owners buy into a scheme based on price and location considerations and that they only participate in minor body corporate issues that affect them individually (such as pets and car parking). Although further detailed research is required in this area, it is a concern that anecdotal observations suggest that many lot owners are not actively participating in the running of the body corporate, especially at the broader, management level.

These communities are proliferating throughout Australia, and it is important to question whether bodies corporate are being governed effectively, whether there are enough mechanisms (legal or otherwise) to safeguard a body corporate, and ultimately the lot owners, from fraudulent contractors and decisions made by developers that can affect the body corporate long after the development has been completed and the developer has withdrawn. Another noteworthy issue concerns whether a move towards professional body corporate committees is warranted (especially for large, complex schemes), in order to alleviate the burden placed on volunteer lot owners.

Further detailed research is required to assess, the issues posed here and also whether further regulatory reform is required to protect lot owners.

7. Conclusions and findings

Assuming the current foundations of our political and societal mindset continue with:

- a focus on traditional urban water service networks for transporting, treating and disposing of human wastes
- a widely acknowledged need to reduce pressure on traditional urban water resources (dam, surface and groundwater)
- concerns about climate change—demanding reductions in energy costs and greenhouse gas emissions,

then communal DWMSs should remain in contention as a vehicle for providing communal solutions at an intermediate stage to utilise alternative water sources (rainwater, stormwater, greywater and recycled water).[229] Furthermore, current urban consolidation concepts require planning solutions for new communities with residential densities higher than those achievable through common land subdivisions. Such higher densities are commonly realised through subdivision under S&CT. Its inherent statutory objective of combining the interest of individual lot owners makes S&CT subdivision an ideal vehicle for implementing communal DWMSs at the individual development project level. Further, S&CT subdivisions:

- can enable savings in operating (maintenance and monitoring) and development costs relative to detached houses because of their need for fewer separate equipment items (tanks, pumps, filters, monitoring points)
- can deliver more integrated water management solutions tailored to local situations and should therefore always be considered by developers and decision makers (LGAs in the first instance) when seeking solutions that go beyond compliance with minimum building standards, green star ratings or development codes
- are likely to play a major role in the (re-)development of brownfield locations where S&CT is the key to achieving higher residential densities, to increase yield and make re-development projects viable, and to improve environmental outcomes by preserving larger open spaces (which facilitate solutions to water sensitive urban design (stormwater management), habitat conservation and public recreation)
- provide a legal platform for a coherent residential community implementing the concepts of sustainable living in ecovillages and upmarket, remote _resort' locations.

This study has identified a number of issues that need to be addressed or considered to promote the use of S&CT subdivisions as an effective basis for accelerating the implementation of DWMSs. The following recommendations represent solutions designed to alleviate problems associated with regulatory and administrative frameworks, planning processes, education and knowledge, and practical management aspects of S&CT schemes.

7.1 Regulatory mechanisms

7.1.1 S&CT provisions

Without water meters for individual lots, inconsiderate lot owners or tenants can exploit water saving initiatives incorporated into DWMSs for private short-term gains without suffering economic penalties. Put simply, trying to achieve water savings through DWMSs is difficult, if

[229] DWMSs can fill the gap between large district systems (such as Rouse Hill, NSW, and the Pimpama-Coomera Water Futures Strategy, Queensland) and small systems for individual residential lots or households (septic tank and other small systems).

not impossible, to implement without measuring and charging water consumption to individual lots. So far, this has been officially recognised only in Queensland, where all new schemes created under the *Body Corporate and Community Management Act 1997* have to be fitted with water meters for individual lots.[230] Similar provisions should be introduced in other jurisdictions where governments are serious about reducing the pressure on urban water resources.

Widespread concern about the adequacy of public liability insurance, especially for large and complex developments, should be addressed by raising minimum levels of public liability insurance for schemes with a DWMS, notably those featuring waste water treatment systems. Such higher levels should be determined by multiplying the minimum limit by a factor reflecting the overall number of lots and perhaps the type of DWMS incorporated into a scheme.

A financial matter commented on by strata managers and other stakeholders concerns the current practice of maintaining funds for capital expenditure (sinking funds). Most jurisdictions in Australia require sinking fund forecasts to cover a period of 10 years only, instead of 15 to 20 years, which is closer to the life span of pipes and other DWMS fixtures. Concerns about bodies corporate reducing contributions to their sinking funds suggest a need for regular mandatory audits provided by accredited specialist auditors, especially for schemes that own a waste water treatment system. Audit reports should be forwarded to consumer protection authorities, thereby enabling them to compile a database and the development of algorithms that could help the identification of cases where funds for capital expenditures appear to be deficient.

One possibility to address concerns raised about guaranteed and immediate access to funds where malfunctioning equipment has to be repaired or exchanged by public authorities to avert imminent health risks would be to establish an emergency fund (similar to those maintained in the oil shipping industry) that draws from a small proportion of the interest earned on sinking fund deposits.

7.1.2 Water service provisions

Although minimum standard requirements are well documented in quality guidelines and service standards, water service and water industry provisions have been the subject of considerable attention in NSW and Queensland during the past two years. The recent introduction of new legislation in both states would still require further amendment to accommodate mechanisms for allowing registration or licensing of water service providers who wish to operate facilities on multiple sites. Other states and territories should consider introducing similar legislation to clarify the powers, roles and responsibilities of small water service providers and the rights of consumers, including bodies corporate, to apply for dispute resolution and, in the worst case, termination of a water service contract. Similar to the situation in Queensland, water services legislation should be quite explicit with regard to the circumstances that would exempt an S&CT scheme from having to register or apply for a licence as a water service provider. This also applies to requirements for owning and reading water meters for individual lots in S&CT schemes.

Another water service provision warranting attention concerns restrictions over DWMS development with a water recycling capacity in a declared water service area. Provided that such systems are fitted with sufficiently large holding tanks permitting the storage of all wastewater output for two or more days (depending on local parameters),[231] wastewater

[230] *Queensland Plumbing and Wastewater (QPW) Code*, Part 4. The Standard Plumbing and Drainage Regulation 2003 (Qld) provides that all plumbing and drainage work must comply with the QPW Code.

[231] To allow removal of wastewater by truck, or to release wastewater during off-peak times into local sewer networks, in case the waste water treatment plant has to be by-passed for maintenance or repair.

recycling systems are, in principle, little different to sewer-mining systems, which are already in use in urban areas. Accordingly, state and local government authorities should collaboratively review their current development approval systems to remove restrictions and undue administrative barriers that have so far prevented the development of wastewater recycling schemes in declared serviced areas. Again, a first step in this direction has been taken in Queensland with the promulgation of the *Water Act 2000,* the *Legislation Amendment Act 2007* and the intended amendment of the *Plumbing and Drainage Act 2002* to allow wastewater recycling systems for testing purposes in serviced areas.

7.1.3 Wastewater treatment licences and environmental management guidelines

As for other legislative and administrative procedures in Australia's different jurisdictions, the current lack of uniform licence requirements and the diversity of environmental management guidelines for small-to-medium effluent recycling schemes,[232] hinder the development of a few standardised and certified, yet still robust and scalable, technologies to be installed on a modular basis. This has left water authorities and other regulators concerned about the uncertainty associated with the many different systems evolving in the market and the workloads and costs associated with testing, registering and monitoring each new system.

Currently, the performance of wastewater treatment plants to meet the standards and guidelines is less well documented, and it can be expensive for technology providers to deliver certificates of performance. Effectively, this signifies a market entry impediment, and only those with the capacity and capability are able to be active in the supply of equipment. There may be a role for government to assist the development of new technology or new players in the field. Greater collaboration is required between different state government agencies, water technology providers and water service providers to select and assist test cases, monitor and exchange results and develop a more uniform approach to approving and managing these systems.

7.2 Financial mechanisms

Practically all stakeholders referred to the overall costs of a DWMS as one of the major impediments to developing such systems. This is particularly the case for developments in declared service areas. In these areas, individual lots still need connections to water and sewer mains, even though communal rainwater tanks and wastewater recycling systems can reduce flows to and from the centralised water service infrastructure to a small fraction of what can be expected in standard land subdivisions without DWMSs. This in turn would enable the installation of much smaller diameter pipe connections, lower costs for upgrading existing networks and therefore substantially reduced headworks charges. Most current headworks charging systems consider only the anticipated numbers of water users (expressed as equivalent tenants or equivalent persons) and the location of the development project in relation to a specific water supply and sewer catchment area. In many cases, headworks charges can be relaxed as a result of developer contributions such as payments for land acquisitions to comply with open space provisions. Although this may have been appropriate to deal with the first few projects, a more proactive approach is required over the long term to signal a readiness for the consideration of projects with DWMSs by basing headworks charges on a more rational basis than the system of equivalent tenements or equivalent persons.

[232] In regard to treatment capacity thresholds for pollution control licences, specifications of management and monitoring requirements and performance levels (such as reference to different bacterial indicator organisms (faecal coliform or *E. coli*) for achieving required water quality levels).

Current water service charges present another financial issue that is critical for the long-term viability of DWMSs in serviced areas. As indicated in section 3.2, many water service providers use fixed water service charges when billing individual lots. In most parts of Australia, these fixed service fees make up around 50 to 66 per cent of the overall ongoing water costs for a typical residential lot. Part of these service fees is intended to cover maintenance and repairs of the pipe networks that distribute or collect water from individual lots. In a large S&CT development with a DWMS, most of these costs are carried by the lot owners if the development's water service network is owned by the body corporate. As fee setting mechanisms for trade waste agreements are based on volumes and types of pollutants released into a sewer system, it appears likely that the cost of repairs and maintenance correlate with the type and amount of water transported and treated through a water service network. Accordingly, costs for network maintenance and repairs should be incorporated into consumption-based charges (including the estimated or actual amount of sewage produced). This would provide a much stronger incentive to conserve as much centralised water as possible. It would also deter S&CT lot owners from abandoning their DWMS and reconnecting to a nearby centralised water service network.

7.3 Practical planning and development mechanisms

Once a developer or a decision-making authority has determined that a subdivision will be pursued by S&CT, then a specialist consulting strata manager should join the development team as soon as possible. Projects designed with early input from an experienced strata manager have a better chance of minimising 'down the track' body corporate management challenges, which, if left unaddressed, can increase the chances of lot owners voting for their system to be shut down. There is no blueprint for schemes with a DWMS (schemes are too diverse), but input from a well-qualified strata manager at an early stage would help alleviate many of the most common problems. This would also enhance the chances of all technical details and contracts pertaining to a scheme's assets being passed on to a body corporate and its strata manager.

Early input by an experienced strata manager would also lessen the likelihood of conflict arising between individual owners and their body corporate in connection with differing perspectives on the allocation of a scheme's bundle of rights and responsibilities associated with ownership over the individual components comprising a scheme's DWMS. Based on interview feedback provided by strata managers, as well as ongoing discussions during the course of this project, the following recommendations are provided:

- Communal rainwater collection systems—the roof area, downpipes, communal rainwater tanks, water distribution pipes (including their internal space in a building) should be incorporated into (affixed to) the common property and therefore, owned by the body corporate and maintained as part of the principal service contract.
- Irrigation systems—where possible, irrigation water should be gravity-driven from a central storage system. All pumps, pipes, valves, filters, and sprinklers used for irrigation of common property or in communal car washing facilities should be owned by the body corporate. Ownership over irrigation systems on community title lots will depend on the theme of the development (for example, lot owners in high-end ecotourist resorts in remote areas may prefer not to maintain a private irrigation system).

- Water meters—in declared serviced areas (brownfield developments) and greenfield sites close to declared water service areas, meters should be owned by registered water service providers to avoid any dispute over a meter's accuracy. In remote areas, bodies corporate should own and maintain water meters for individual lots and the common property. Service models for reading and billing of water consumption should not be limited to existing water authorities, rather, deregulation similar to that which has occurred in the energy provision sector should be used as a strategy to reduce costs for such services.
- Wastewater treatment plants and associated tanks—for small to medium greenfield sites, all brownfield sites and some ecovillage or ecotourism projects, the wastewater treatment plant should be designed as a package plant and owned by a local water service provider in connection with a long-term lease over an area of common property reserved for this type of infrastructure; for large greenfield sites where installation of package plants is likely to be economically and technically inefficient, the wastewater treatment plant should be affixed to the common property and owned by the body corporate but leased as common property to a water service provider; in all cases, major holding tanks should be owned by the body corporate.

7.4 Knowledge, information and education

7.4.1 Research and development

As at the beginning of 2009, very few studies have been found that provide any insight into the long-term performance of DWMSs and their different components. It is therefore recommended that there be greater monitoring and exchange of data between existing schemes that incorporate a DWMS. This would support the development of more sophisticated planning, financial and economic tools, contract and lease formats and performance and service standards for the development and maintenance of centralised water service networks with interspersed DWMS schemes in declared service areas. Such tools should be further informed by a databank forming a central repository of all relevant information relating to decentralised systems. This includes information about development components, development history and constraints, DWMS solutions, design of titles, body corporate constitutions' and by-laws (where applicable), and monitoring data and reports from water authorities and other agencies (such as the EPA)that evaluating DWMSs and their separate components. A range of tools pertaining to DWMS development and management could be developed under the headings:

- financial tools
- economic tools
- contract and lease formats
- performance and service standards
- asset management.

More research is required to calculate greenhouse gas costs for different DWMS concepts relative to centralised solutions. This would shed light on the relative energy efficiency of the two systems; and also provide greater understanding of what are the most energy and water efficient combinations of centralised and decentralised options.

7.4.2 Training and education

S&CT subdivisions with DWMSs are widely considered to be more complex than standard S&CT schemes. Accordingly, only appropriately trained strata managers should be permitted to manage an S&CT scheme with a DWMS and provide consultancy services to developers for these schemes. Such additional qualifications should be offered through special training courses accredited by national industry bodies, such as the National Community Title Institute in close collaboration with the Planning Institute of Australia and the Australian Water Association.

Probably one of the greatest impediments to a wider application of DWMSs concerns the knowledge gaps amongst LGAs, and other decision makers, about developments with a DWMS, especially those established on an S&CT basis. It is therefore strongly recommended that a training program be developed and modular training workshops provided to this group of stakeholders. The modules should be developed with a view to encouraging attendance by all interested stakeholders.

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Appendix A—Questionnaire

Questionnaire distributed during the NCTI conference workshop in Darwin, August 2008

Project funded by: the National Water Commission, QDRI and NCTI.

Please tick appropriate box or circle appropriate answer:

What is the nature of your engagement with the strata/community title industry?

❑ Strata manager ❑ Resident manager ❑ Specialist accountant

❑ Consulting lawyer ❑ Financier

❑ Owner ❑ Other

Where is your current State/Territory of operation?

❑ ACT ❑ NT ❑ NSW ❑ QLD ❑ SA ❑ TAS ❑ VIC ❑ WA

What type(s) of buildings do you primarily deal with?

❑ Residential ❑ Commercial ❑ Mixed Use ❑ Other: _____

During the past year, how often has the issue of reducing water consumption been raised with you by bodies corporate (owners corporations)?

Infrequently			Occasionally			Frequently
1	2	3	4	5	6	7

To what extent have these enquiries increased over the past five years?

Not at all						To a great extent
1	2	3	4	5	6	7

With respect to each of the following five (5) water management systems, score how frequently you have heard of, or noticed them, installed in new strata and community title developments.

Rainwater (roof water) collection systems (tanks):

	Not heard of			Occasionally			Always
For outdoor use only	1	2	3	4	5	6	7
For outdoor and indoor	1	2	3	4	5	6	7

Stormwater (general surface runoff) harvesting:

	Not heard of			Occasionally			Always
For outdoor use only	1	2	3	4	5	6	7
For outdoor and indoor	1	2	3	4	5	6	7

Greywater (shower, sinks, laundry, etc.) treatment and re-use systems:

	Not heard of			Occasionally			Always
For outdoor use only	1	2	3	4	5	6	7
For outdoor and indoor	1	2	3	4	5	6	7

Sewage (all household water combined) recycling:

	Not heard of			Occasionally			Always
For outdoor use only	1	2	3	4	5	6	7
For outdoor and indoor	1	2	3	4	5	6	7

Sewer mining :

	Not heard of			Occasionally			Always
For outdoor use only	1	2	3	4	5	6	7
For outdoor and indoor	1	2	3	4	5	6	7

To what extent do you agree or disagree with the following statements:

In order to deal effectively with decentralised water management systems, strata managers will have to become more qualified or specialised in this area of management.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

Costs are the most determining factor for the decision of a body corporate whether or not to abandon a decentralised system and connect (revert) to a centralised water and sewerage system.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

Developers are still designing projects without much consultation or understanding of strata and community title management issues.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

When developers move out of a development (are no longer the first owner), all necessary information about a complex‘s service components is passed on to the body corporate and its strata manager.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

A strata manager, who has been instructed by the body corporate committee to obtain a set of quotes for maintaining, servicing or repairing a particular building component, will select and contact contractors and collate the quotes for the committee.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

There are no significant differences between lift or cooling tower management and the management of decentralised water systems.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

Bodies corporate generally respond swiftly (if necessary by raising additional funds) to arrange the repair or replacement of a major piece of equipment in the event that it malfunctions and may pose a risk to the occupants of a complex.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

In strata titled complexes where individual lots have water meters and the body corporate owns the water service infrastructure, a body corporate can charge the lot owner for his/her water use on a consumption basis.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

A Strata Manager could effectively facilitate the operation and maintenance of a DWMS in a strata titled complex.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

The prescribed minimum public liability insurance is sufficient to cover strata and community title developments that have implemented DWMSs.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

Most large bodies corporate established during the past 2 years maintain sinking funds adequate to fund replacement of major equipment items if they are out of warranty.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

In the event that a body corporate can charge the lot owner for his/her water use on a consumption basis, a strata manager would bill lot owners and collect charges for such water use.

Strongly Agree		Agree	Neutral	Disagree		Strongly Disagree
1	2	3	4	5	6	7

What do you regard as the main obstacle for implementing decentralised water management?

Thank-you for completing this questionnaire

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