

The role of local recycled water systems for sustainable urban water servicing

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Certificate of original authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

Signature of Student: _____ (Rachel Watson)

Date:

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List of publications

This thesis is a hybrid thesis which includes both traditional thesis chapters, as well as a mix of peer-reviewed journal papers, peer-reviewed conference papers, industry conference papers and papers under peer review presented as stand-alone chapters.

The thesis includes the following papers:

- I. **Watson, R.** (2011). 'Wastewater systems: Decentralised or distributed? A review of terms used in the water industry.' *AWA Water Journal* 38(8): 69-73.
- II. **Watson, R.,** C. Mitchell, S. Fane (2012). 'How sustainability assessments using multi-criteria analysis can bias against small systems.' *AWA Water Journal* 39(8): 69-73.
- III. **Watson, R.,** Fane, S., Mukheibir P, C. Mitchell (unpublished) Review and synthesis of the diverse impacts of local recycled water systems
- IV. **Watson, R.,** C. Mitchell, S. Fane (2013). Local recycled water decisions - ensuring continued private investment. *OzWater 2013*. AWA. Perth, Australian Water Association.
- V. **Watson, R.,** Mukheibir P, C. Mitchell (unpublished) Local recycled water investment in Sydney: who, when and why
- VI. **Watson, R.,** Mukheibir P, C. Mitchell (2016) Local recycled water investment in Sydney: a policy and regulatory tug-of-war, *Journal of Cleaner Production* 148: 583-594
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- X. **Watson, R.,** P. Mukheibir and C. Mitchell (2017). Recycled water investment in Sydney - what's happening and why. OzWater 17. AWA. Sydney, Australia, AWA.

Contributions to the papers

Rachel Watson was the lead author for all papers. She was responsible for developing the ideas, methods, data collection and analysis. Rachel wrote all the papers and completed revisions in response to peer reviewers' comments. The papers and their concepts were discussed with Cynthia Mitchell, Simon Fane and Pierre Mukheibir in their roles as supervisors. Sue Jenkins of Sydney Water customer research assisted with reviewing the research design of Paper IX.

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Abstract

Local recycled water systems are emerging as an option to meet many of the opportunities and challenges facing the urban water industry, and as a result they are being planned, delivered and operated. Although Sydney has seen an increase in the installation of these systems, their uptake is still limited and there is a lack of agreement about their overall value.

The insights revealed in this research, gained through a literature review, in-depth interviews, and analysis of an extensive database of existing recycled water sites, will:

- guide industry to make more robust investment decisions for local recycled water
- assist regulators and policy makers to revise institutional structures that have had unintended consequences, so that they encourage investment that will support a resilient and adaptable water industry into the future.

It does this by articulating the full range of impacts (costs and benefits) of local recycled water systems. The impacts identified are appropriate for inclusion in a wide range of decision-making frameworks. When compared to more conventional options, the variance in scale and distribution of impacts (as well as uncertainty regarding their measurement and timing) make the consideration of the full range of impacts challenging, contentious and potentially costly. Therefore, identifying, valuing and including impacts in the decision-making process is only one part of the puzzle.

By using Sydney as a case study, this thesis demonstrates that the interactions between impacts and the context (environment, social, regulatory and institutional setting) are critical components of explaining what investment occurs and what role local recycled water systems (or any alternative) can have in urban water servicing. It is critical to consider this complex interplay to assess whether current policies and regulatory and institutional settings are appropriately designed to drive investment that meets the broad objectives of the water industry for the future.

For local recycled water to become a mainstream strategy, a number of changes are likely to be required. An important first step is to clearly identify the objectives of the urban water industry, and then agree on how local recycled water contributes to these objectives. In addition, clearer and more equitable price signals, and simple and predictable benefit transfer mechanisms, are areas for change. To assist with developing more robust signals for efficient investment, broader dissemination of the current capacity of centralised infrastructure and investment triggers is required to provide an opportunity for the market to respond with solutions that meet market demands and assist with managing centralised system constraints.

Abbreviations

AWA	Australian Water Association
COAG	Council of Australian Governments
IPART	Independent Pricing and Regulatory Tribunal
kL	kilolitre (1,000 litres)
LRMC	long run marginal cost
LRW	local recycled water
ML	megalitre (1,000,000 litres)
MBR	membrane bioreactor
SEPP	State Environmental Planning Policy
STP	sewage treatment plant
SWARD	Sustainable Water Industry Asset Resource Decisions
NSW	New South Wales
WSAP	Water Savings Action Plan

Glossary

BASIX – a NSW Government initiative which sets sustainability targets for water and energy for new buildings.

Blackwater –wastewater that contains wastes from humans, animals or food, such as discharges from toilets.

Centralised urban water services – water services that are provided through a single (usually public) utility. This usually involves collecting water far outside the urban area, and transporting it through a large pipe network to where it is used. Used water (wastewater) is then transported out of the urban area before being treated and discharged.

Decentralised water services – localised collection, treatment and disposal/reuse of water and wastewater at an individual home, cluster of homes/ facilities, or an isolated community.

Distributed water services – decentralised or local water services (that is smaller than centralised services) that have a connection to the centralised network (i.e. they are not isolated or remote from the centralised system as decentralised services are).

Greater Sydney Region – the case study in this research covers the Greater Sydney Region. The study area matches Sydney Water’s area of operations, and covers nearly 13,000 km² and includes Sydney, the Blue Mountains and the Illawarra.

Grey water – the less contaminated parts of domestic wastewater, such as discharges from laundry, cooking and bathing.

Local recycled water – a colloquial term for local recycled water.

On-site treatment – wastewater treatment on a single site level, that is, a household, an industrial site or a multi-storey building.

Sewer mining – extracting sewage from the sewer (before or after a sewage treatment plant) for treatment and reuse as recycled water.

Stormwater – rainwater that has run off urban surfaces such as roads, pavements, car parks, gardens or vegetated open space.

Recycled water – sewage, grey water, stormwater or roof water that is treated to a standard appropriate for reuse.

Urban water services – a term that in this thesis covers the whole range urban water services, including water capture, treatment and distribution; wastewater conveyance, treatment and disposal; and stormwater capture and removal.

