A CASE STUDY RESEARCH INTO URBAN WATER REUSE

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A dissertation submitted to the University of Technology, Sydney in fulfilment of the requirements for the degree of Doctor of Philosophy (Engineering).

June 2012

Certificate of Authorship/Originality

I certify that the work in this thesis has not been previously been submitted for a degree, nor has it been submitted as part of the 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 preparation of the thesis itself has been acknowledged. In addition, I certify that any information sources and literature used indicated in the thesis.

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Acknowledgement

Education is not the filling of a vessel, but the kindling of a flame.
Socrates

First and foremost, I would like to thank my parents for kindling the flame for education. This thesis is a symbol of my lifelong learning journey that my parents and my elder siblings inspired me to follow, right from my childhood.

In the Indian culture the role of a teacher is described to be akin to God. I have been fortunate to have really great teachers who guided me through this research. Prof Vigid Vigneswaran always encouraged me to capture my point of view in academic papers for high profile journals, his guidance in structuring and conduct of this research was greatly appreciated. I am also grateful to A/Prof Jaya Kandasamy, who over the last four years has played the vital roles of a mentor, good friend and a constant encourager.

I am particularly thankful to my wife Vinita, who has very capably shouldered all the responsibilities on the domestic front, allowing me to dedicate my weekends to work on this research. Her help in lifting me out of every performance trough over the last four years and finally in editing this thesis is also greatly appreciated.

I am also indebted to Dr Bruce Simmons for his guidance in structuring this thesis, as well as valuable words of encouragement over the duration of this research.

In compiling this thesis there are many other friends and colleagues who assisted me, and whose help I have greatly appreciated. I would particularly like to mention my best friend and long-term study partner Qasim Malik,

whose company and support on Saturdays at the UTS helped me to stay focussed. I am thankful to economist extraordinaire Daniel Masters for his assistance with the IO modelling work. I would also like to acknowledge the support of Gurmeet Singh, Isabelle Ghetti, Paul Woods and other staff from Kogarah City Council.

Last but not least, I would like to thank Eisha and Rohan for allowing their dad to be absent from weekend sports, while working on this research.

Contents

List of Figures

List of Tables

List of Pictures

List of Acronyms

BOD	Bio-chemical oxygen demand
CSIRO	Commonwealth Scientific and Industrial Research Organisation
HRT	Hydraulic retention time
IO	Input Output
IWCM	Integrated water cycle management
LGA	Local government area
LQ	Location quotient
MBR	Membrane bioreactor
ML	Megalitres (1,000,000 Litres)
MLD	Megalitres per day
SS	Suspended solids
TSS	Total suspended solids
TWCM	Total water cycle management
UV	Ultra violet
WSAA	Water Services Association of Australia

List of Publications

1. Chanan, A.P., Kandasamy, J.K., and Sharma, D., (2008). A Role for Input-Output Analysis in Urban Water Policy Decisions in Australia, In *Proc. of The IIOA Input - Output & Environment Conference,* (ed.) Prof. Dr. Thijs ten Raa, Saville, Spain, July 2008, pp. 1-18.
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3. Vigneswaran S., Davis C., Kandasamy J., and Chanan A., (2009), Urban Wastewater Treatment: Past, Present and Future, in *Water and Wastewater Treatment Technologies,* [Ed. Saravanamuthu (Vigi) Vigneswaran], Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, Eolss Publishers, Oxford, United Kingdom.
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13. Chanan, A., Vigneswaran, V., Kandasamy, J., and Singh, G., **(Submitted – under review)**. Beverley park water mining plant: getting the salt just right, *Desalination and Water Treatment*.

Abstract

Climate change could lead to longer and more frequent droughts for Australia. The option of water reuse, being independent of rainfall variations, provides a major source of water supply security for our growing cities. A *'soft path'* for water management is widely acknowledged to be the sustainable future of water management. Decentralised wastewater reuse schemes form an important supply option in this *'soft path'* approach.

Discussion on water reuse and its role in sustainable water resource management in Australia has been on the agenda for the last three decades. Despite its long presence on the agendas of policy makers and scientific community, promulgation of water reuse in Australia has been a rather slow process. The research efforts to date have focussed on the technological aspects of water reuse, leaving behind a gap in the area of policy and implementation aspects. This knowledge gap is even more severe when considering decentralised urban water reuse. Australian literature on decentralised reuse schemes owned and operated by entities other than the major water utilities is virtually non-existent.

This research assists in bridging the knowledge gap identified above, by investigating the decentralised water reuse technique of 'water mining' in detail. The concept of water mining is defined and range of technologies available for water mining are described, along with discussion on planning and risk management aspects of such schemes. A comprehensive literature review is also provided on urban water reuse, examining centralised and decentralised water reuse in Australia.

As opposed to traditional engineering line of enquiry, this research is of interdisciplinary nature, looking at socio-economic, environmental management, pricing policy, as well as technical aspects of a decentralised water reuse project. Using Beverley Park Water Reclamation Project (Sydney's first water mining scheme) as a case study, this research analyses design, planning, and implementation phases of this project. Operational risks to human as well as environmental health are also reviewed in context of the case study site.

A regional economic Input Output (IO) Model for the St George – Sutherland Statistical Region is developed to analyse the economic impacts of the case study project on the local economy. In addition to the IO method, other benefit estimation methods such as Hedonic pricing and sports fields Usage Hours are also discussed in context of the case study site.

On policy front, pricing of recycled water is further explored and lessons from solid waste recycling applied. The community's reluctance to accept potable reuse indicates that recycled water is not yet considered a direct substitute for virgin water. A sound water pricing regime that reflects the true costs of water and a competitive water industry is discussed as a critical policy platform for viable water recycling industry.

With 21st century water management transforming into a multi-dimensional challenge of water security, a holistic multi-dimensional approach is essential. By applying different aspects of the case study inquiry lens, this research adopted a multi-dimensional approach in exploring social, economic and technical characteristics of a single water mining case study.