

Wastewater Recycling Assessment and Treatment Option Analysis



**MURDOCH
UNIVERSITY**
PERTH, WESTERN AUSTRALIA



9th December 2011

A report submitted to the School of Engineering and Energy, Murdoch University in partial fulfilment of the requirements for the degree of Bachelor of Engineering

Academic Supervisor:

Dr. Martin Anda, Course Coordinator for Environmental Engineering

Business Supervisors:

Rino Trolio, Wastewater Treatment Process Expertise Manager

Rachael Miller, Recycled Water Strategy Advisor

Madhu Murali (30717262)

Executive Summary

Wastewater recycling for the purpose of public open space irrigation in regional Western Australia (WA) has become quite common. New Department of Health (DoH) guidelines governing water recycling in WA have recently been published. One of the main aims of this project is to help the Water Corporation's Wastewater Process Expertise Group (PEG) with the assessment of their recycling schemes. Eight schemes were assessed, for various parameters. A desktop assessment was initially conducted before a field visit and onsite assessment. The desktop assessment focused on Wastewater Treatment Plant (WWTP) effluent quality and the presence of past approvals and a recycled water supply agreement. The onsite assessment's main components were the storage areas, further treatment systems and the irrigation areas. The onsite assessment found that most schemes were generally non-compliant in a minor way, such as insufficient signage. However, serious irrigation management issues and inappropriate end-use sites were found in Northam. The desktop assessment found that two sites are currently operating without DoH approval, Northam and Wagin and also that there are issues with WWTP effluent quality in Kojonup and Mundaring. Suitable recommendations to overcome these issues were made.

Another main aim was in investigating alternatives for WWTP capital expansion to achieve wastewater treatment capacity increase or inflow reduction for selected sites. A Multi-Criteria Analysis (MCA) was performed to select the most suitable option from WWTP expansions works, residential greywater reuse and septic tanks. Water efficiency measures were also considered in the analysis but not considered further, as they were not seen as a suitable engineering measure. Residential greywater reuse was found to be the most preferred option and two systems were designed; an R20+ system for higher density town centre lots and a Rural Lifestyle system for larger plots. The R20+ system used a cluster-scale Nubian advanced greywater treatment system and the greywater can then be used indoors, for irrigation and stored over winter when not required. The Rural Lifestyle system used diversion devices for irrigation with untreated greywater. The R20+ system can successfully reduce inflows to a WWTP considerably and is also financially viable. However, the Rural Lifestyle system was found to achieve neither of these objectives. Recommendations were made for further study on the R20+ system and to integrate it into planning in the selected sites.

Acknowledgements

This project would not have been possible without the assistance of several parties. I would like to acknowledge Dr. Martin Anda, course coordinator of environmental engineering, for his mentoring, guidance and academic assistance and Gareth Lee, for his help with the internship contracts, presentation organisation and his guidance for the program.

I would like to show my utmost appreciation to Rino Trolio and Margaret Toohey from the Water Corporation, for providing me with this opportunity for field work and experience in the industry as well as for the financial remuneration, which supported me through the project. I would also like to show my sincere gratitude to Rachael Miller, for her attentive supervision and guidance and to Kate Meehan and Kendal Becu from the Recycling team for their patience, knowledge and company.

I am also deeply grateful to everyone who played a part in the project and the review of this report.

Table of Contents

List of Tables and Figures.....	v
Figures:	v
Tables:.....	vi
1 Introduction.....	1
1.1 Background.....	1
1.2 Main Aims	2
1.3 Water Recycling Scheme Assessments	3
1.4 Wastewater Treatment Analysis	7
2 Literature Review.....	10
2.1 Recycling Scheme Assessment.....	10
2.2 Wastewater Treatment Expansion	11
3 Methodology	12
3.1 Recycling Scheme Assessment.....	12
3.2 Wastewater Treatment Analysis	16
4 Recycling Scheme Assessments	19
4.1 Results.....	19
4.2 Analysis.....	28
5 Wastewater Treatment Analysis	32
5.1 Results.....	32
5.2 Final System Design	34
6 Conclusion	44
7 Recommendations.....	47
7.1 Recycling Scheme Assessment.....	47
7.2 Wastewater Treatment Analysis	47
8 References.....	49
9 Appendices.....	53
9.1 Recycling Scheme Assessment.....	53
9.2 Wastewater Treatment Analysis	53

List of Tables and Figures

Figures:

Figure 1: IWSS Schematic.....	1
Figure 2: 12-Element Risk Management Process.....	4
Figure 3: Recycling Scheme Flow Diagram.....	4
Figure 4: Assessment Focus of each Scheme Component.....	6
Figure 5: Septic Tank and Leach Drain System Schematic.....	9
Figure 6: Recycling Scheme Assessment Flowchart.....	12
Figure 7: Onsite Assessment Areas (Green and Red lines indicate Further Treatment and Storage and End Use Site Specifics	14
Figure 8: Standard Signage for Recycled Water Sites.....	15
Figure 9: Decision flowchart for Site Selection.....	16
Figure 10: Kojonup WWTP.....	20
Figure 11: Comparison of Inflows to treatment capacity over the year for Wagin	21
Figure 12: Wagin Recycling Scheme Tanks.....	23
Figure 13: Recycled water sign at McGillvray Oval, Subiaco	24
Figure 14: Recycled water sign at Football Oval in Wagin.....	24
Figure 15: Northam Non-Compliant Irrigation Areas (Marked in Green); SoN is the Shire of Northam (make text bigger if you have time).....	25
Figure 16: New Recycled Water Scheme Register Screenshot	27
Figure 17: Shire of Wongan Hills Storage Dam.....	30
Figure 18: Site Selection Conceptual Flowchart (Change if you get time).....	32
Figure 19: R20+ Cluster Scale Greywater Reuse Schematic Diagram (Purple and black arrows represent grey and black water respectively)	38
Figure 21: Rural Lifestyle Lot Scale Schematic Diagram (Purple, blue and black arrows represent grey, scheme and black water respectively).....	42
Figure 22: Mundaring Recycling Scheme Schematic.....	53
Figure 23: York Recycling Scheme Schematic	54
Figure 24: Wongan Hills Recycling Scheme Schematic	55
Figure 25: Northam Recycling Scheme Schematic	56
Figure 26: Wundowie Recycling Scheme Schematic.....	57
Figure 27: Subiaco Recycling Scheme Schematic.....	58
Figure 28: Kojonup Recycling Scheme Schematic	59
Figure 29: Wagin Recycling Scheme Schematic.....	60

Tables:

Table 1: WWTP designs and site visit dates.....	3
Table 2: Site population, growth and comments	7
Table 3: Stakeholders for Option analysis	17
Table 4: Selected Social, Environmental and Economic Criteria.....	17
Table 5: Scheme Agreement and Approval status	19
Table 6: Effluent Quality Summary.....	19
Table 7: DoH Verification and Operational monitoring Guideline values for “Low” risk schemes	20
Table 8: WWTP License Capacities and Average Daily Inflows from 2009-2010	21
Table 9: Further Treatment at Various Sites.....	22
Table 10: Storage Area Assessment at Various Sites	22
Table 11: Irrigation Site Assessment	23
Table 12: Recycling Scheme Assessment Summary	28
Table 13: Final Criteria Weightings	33
Table 14: Greywater Reuse Final Rating.....	34
Table 15: Final MCA Ratings Summary	34
Table 16: Approximate Water Use Breakdown in Northam and York	35
Table 17: Greywater Reuse Cost analysis	36
Table 18:R20+ System Summary	41
Table 19: Rural Lifestyle System Summary	43
Table 20: Weighted Social Criteria.....	61
Table 21: Weighted Environmental Criteria.....	61
Table 22: Weighted Economic Criteria	61
Table 23: Water Efficiency Measures Final Rating.....	62
Table 24: WWTP Capacity Expansion Final Rating	63
Table 25: Septic Tank Final Rating	64
Table 26: Greywater Reuse Final Rating.....	65