WRC WASTEWATER MANAGEMENT REPORTS

WATER RESEARCH COMMISSION

SP 142/20

Obtainable from:
Water Research Commission
Private Bag X03
Gezina
0031

Disclaimer

The Water Research Commission (WRC) has approved this booklet for publication. Approval does not signify that the contents necessarily reflect the views and policies of the WRC, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

SP 142/20

Printed in the Republic of South Africa

The Water Research Commission (WRC) was established in terms of the Water Research Act (Act No 34 of 1971), following a period of serious water shortage. It was deemed to be of national importance to generate new knowledge and to promote the country's water research purposefully, owing to the view held that water would be one of South Africa's most limiting factors in the twenty-first century.

Now in its fifth decade of serving South Africa, the WRC is working with its government and non-government partners to contribute new water knowledge and solutions to South African, African and global water challenges by developing and harnessing the water research and development capability in the country.

The primary functions of the WRC are to fund and steer the water research agenda in South Africa, and to effectively disseminate and communicate research findings. Administrative activities are carried out to ensure compliance with regulatory requirements and to provide an enabling environment for research management. In recent years the WRC has been increasingly called upon to not only develop new knowledge in the water and sanitation science and technology domain, but also to support and further develop human capacity and skill as well as lead technology, product and industry development.

The Research and Development (R&D) branch offers new knowledge in water and sanitation through research and development projects. The knowledge generated results in new or refined technologies and innovations which the WRC provides to the water sector to address specific needs and challenges. The branch is actively involved in human and institutional capacity development using research and development projects, research products and services.

The R&D branch has three key strategic areas (or business units), which are Water Resources and Ecosystems, Water Utilisation in Agriculture and Water Use, Wastewater and Sanitation Futures. Sanitation, wastewater management and related services fall under the latter unit. The Water Use, Wastewater and Sanitation Futures unit focuses mainly on water usage and wastewater management in the domestic, industrial and mining sectors. It aims to proactively and effectively lead and support the advancement of technology, science, management, and policies relevant to water supply, waste and effluent management, for these sectors.

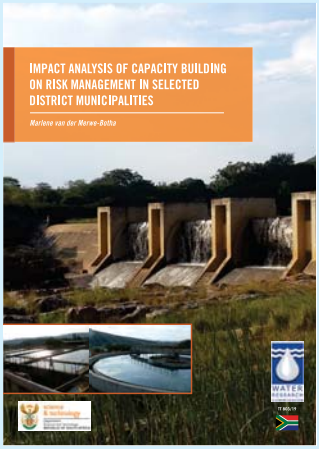
INTRODUCTION

The WRC wastewater management guidelines broadly focus on supporting sustainable management within wastewater services in support of improved wastewater service delivery. In this regard, the guidelines represent, ***inter alia***, operational and decision support tools whose themes can be generally classified as follows:

- Wastewater services risk management
- Operations and maintenance
- Appropriate technology selection criteria
- Asset management
- Frameworks for sustainable urban management
- Utilisation and disposal of wastewater sludge
- Water sector response to climate change

Generally, the uptake of some of these guidelines by municipalities has been significant, based on the institutional structure of municipalities falling under this category designed for better research uptake. Guidelines on the utilisation and disposal of wastewater sludge are currently used in authorisations by the authorities responsible for water and environmental affairs to stipulate the regulatory requirements for sludge management. Moreover, the existence of national programmes such as the Blue Drop (BD) and Green Drop (GD) Certification has encouraged municipalities to engage with some of the guidelines developed by the WRC, particularly the water and wastewater services risk management guidelines.

The current WRC guidelines have been developed using a generic approach designed to respond to the sector challenges holistically. A summary of some of the key guidelines is provided below.

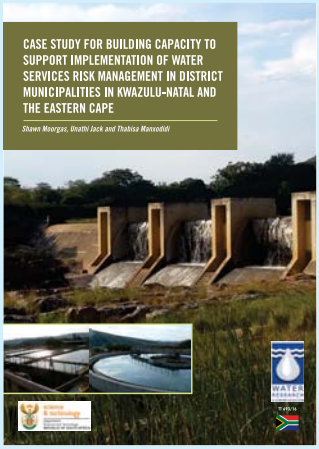


Impact analysis of capacity building on risk management in selected district municipalities

A capacity building support project was implemented during 2014-2016 which assisted selected District Municipalities in KwaZulu-Natal and Eastern Cape to prepare risk-based plans using existing tools and guidelines, whilst developing technical capacity through a learn-and-adapt approach. The municipalities experienced a number of water services and human resource challenges at the time, as identified from the Blue- and Green Drop results of 2013/14. The project methodology made provision to measure the impact of the capacity building project by comparing the Blue- and Green Drop results 'before' and 'after' the project. With the halt of the national Drop Certification programme, the impact could not be measured (**WRC Report no. TT 693/16**). Subsequently, the WRC commissioned a special study in 2018 with a two-fold purpose: 1) to determine the impact of the risk-based capacity building pilot project at the selected municipalities; and 2) to conceptualise a framework for the roll-out of risk-based capacity building on national scale, by considering the lessons learnt from the WRC capacity building pilot project, as well as other support studies.

WRC Report no. TT 803/19

To access the report, **click here**

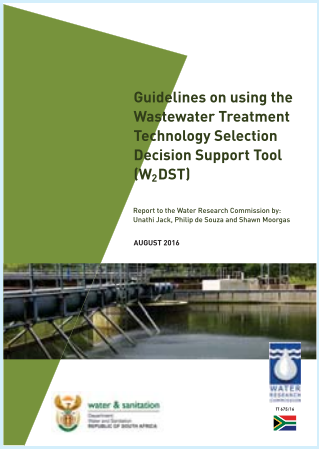


Case study for building capacity to support implementation of water services risk management in district municipalities in KwaZulu-Natal and the Eastern Cape

Although guided by the World Health Organisation and Department of Water and Sanitation, Water Safety Planning (WSP) and Wastewater Risk Abatement Planning (W_2RAP) approaches vary from institution to institution. It was imperative to understand these varying processes and build on what is already in place. The aim of this project was to use the existing Water Research Commission tools to engage with selected District Municipalities (DMs) within KwaZulu-Natal (KZN) and Eastern Cape (EC) and build capacity on risk-based planning for water and wastewater systems. The added advantage is that the project sought to mutually highlight where interventions are required in order to better comply with the criteria of the Blue and Green Drop Certification Programme. Where no risk management was observed, the project team undertook to complete a WSP and/or W_2RAP for one and/or two systems, walk through the process and advise the DM on its implementation plan and in so doing capacitate the DMs to conduct risk management that can be transferred to other systems.

WRC Report no. TT 693/16

To access the report, **click here**

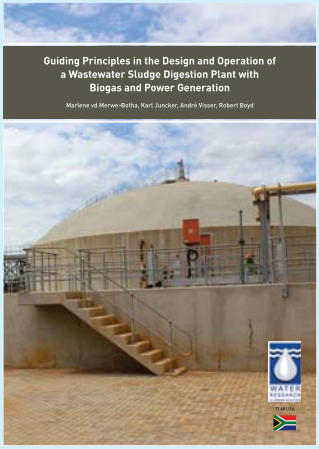


Guidelines on using the Wastewater Treatment Technology Selection Decision Support Tool (W_2DST)

The most commonly used wastewater treatment technologies in South Africa include activated sludge, bio/trickling filters, rotating biological reactors, wastewater ponds, membrane bioreactors, wetlands and aerobic granular activated sludge. There are various aspects to consider in selecting the appropriate wastewater treatment technology. The process of selection of a preferred technology should be guided by the particular circumstances, including design, operations, maintenance and institutional resources. The purpose of this study is to provide guidance to decision makers on selecting the most appropriate wastewater treatment technology for their particular circumstance. Among others, the guide provides a summary of wastewater treatment works status in South Africa, highlights key aspects to be considered when choosing an appropriate wastewater treatment technology, and provides step-by-step guidance on how to use the decision support tool for wastewater treatment technology selection, which is hosted on RiskQ (www.riskq.co.za).

WRC Report no. TT 675/16

To access the report, **click here**

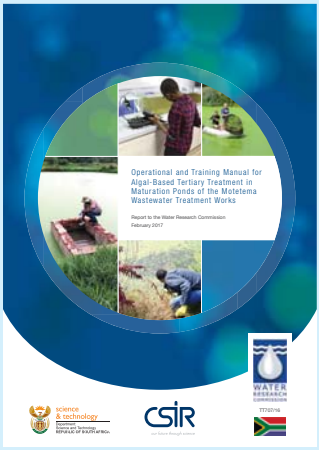


Guiding principles in the design and operation of a wastewater sludge digestion plant with biogas and power generation

The South African industry is widely acknowledged for its excellence in process design. However, some disconnect have been identified between the work of the design engineer, the process manager and the process controller. Opportunity presents itself to align the work of the Process Designer, who considers design criteria but often exclude operational optimisation of the system, and the Process Manager, who may lack design knowledge but are well conversed with operation of the plants. This study aims to not only align and optimise the process design and operation, but also to unlock the opportunities presented by integrated- and advanced sludge treatment methodologies. One of the value adds of sludge treatment is the generation of energy, which is gaining interest as the price of electricity increases and interrupted supply impact on the ability of treatment facilities to meet regulatory targets. Anaerobic digestion, coupled with Combined Heat and Power (CHP) generation is becoming an attractive technology. The study explores the case of the City of Johannesburg's full-scale CHP installation.

WRC Report no. TT 681/16

To access the report, **click here**



Operational and training manual for algal-based tertiary treatment in maturation ponds of the Motetema Wastewater Treatment Works

Pond systems are ideally suited for use in small rural communities, because they are simple and economical to operate and maintain. The algal-based tertiary treatment (phycoremediation) used in this project utilises a specific consortium of algal species to remove nutrients and create conditions for effective solar disinfection to reduce pathogens. The intention is to implement a self-sustaining system that is independent of electricity or expensive chemicals and that can be effectively operated within financial and capacity constraints. The purpose of this manual is to present operational guidelines and maintenance for phycoremediation treatment in rural wastewater treatment plants employing waste stabilisation ponds as tertiary treatment in the absence of electricity. The guideline is specifically set out for municipal plant operators and analytical services to manage an algal-based tertiary treatment system on a daily basis.

WRC Report no. TT 707/16

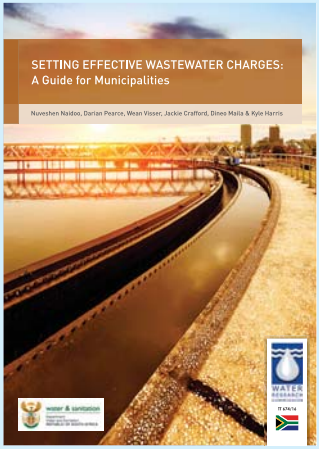
To access the report, **click here**

Implementation of effective wastewater charges by municipalities in South Africa: an investigation into the barriers and enablers

The approach for setting an effective wastewater treatment tariff is often challenging because it requires coordination of activities across multiple municipal departments and setting effective tariffs requires a genuine long term perspective. Fundamentally, a municipality needs to issue a tariff that covers all wastewater treatment costs and recover all these costs from the clients that it serves. The aims of this study were to assess the barriers slowing the development and implementation of suitable wastewater treatment charge structures at the municipal level; recommend corrective actions to remove these barriers; and develop training guidelines that will facilitate the development of human capacity to cope with the barriers identified. Barriers were identified through a comparative risk assessment methodology using an extensive information collection exercise that included a literature review, municipal revenue and expenditure, municipal statistics, Green Drop Data, expert interviews, selected case studies and workshops. Barriers included lack of cost accounting, ring-fencing, asset management, human resources and knowledge of the client base, with political will viewed as a necessary prerequisite. Based on the barriers identified, a national workshop was hosted that brought together key stakeholders from national and local government, academia and the private sector. During the workshop, some barriers identified through literature, interviews were validated, and recommendations on corrective actions to address these barriers were identified.

WRC Report no. TT 673/16

To access the report, **click here**



Setting effective wastewater charges: A Guide for municipalities

This study describes the barriers in implementation of effective wastewater charges in South Africa. The study provides a roadmap to the best available knowledge and solutions for addressing wastewater charge barriers. It offers the opportunity that can be used by decision makers and different personnel in the municipalities in their setting of charges for wastewater. It provides instruments to help municipalities identify needs, evaluate solution and plan, long term sustainable strategies for improved implementation of wastewater tariffs has been explored and provided for in the support. The study reports on the levels and trends of wastewater prices in South African and outlines the way in which the prices are determined. It seeks to evaluate whether the price of water to industry is reflective of the costs incurred in the wastewater treatment processes and whether the price setting process leads to optimal or at least reasonable outcomes. There is in-depth cost analysis and some relevant calculation on the determination of wastewater charges. This will enable municipalities to understand the relationship between the prices of services provided and the consumption of those services which are an essential component of setting charges and designing charge structures.

WRC Report no. TT 674/16

To access the report, **click here**

Wastewater treatment technologies – A basic guide

Wastewater treatment works (WWTW), more commonly referred to as sewage works, are just one of the many uses of water that are required when development takes place. In order to ensure that the development takes place in a manner that will be sustainable the WWTW chosen needs to be a technology type that will be suitable for a particular development and not necessarily the best available technology. The need for a basic guide to serve as a quick reference document has been highlighted. The purpose of the guide is therefore to graphically illustrate the journey of sewage from collection, conveyance, treatment and discharge to the environment. The guide would include both the liquid and sludge components. In this way its purpose is to enable those in decision-making positions, but who do not necessarily have a technical background, young engineers and inexperienced scientists who have just entered the field of wastewater treatment, to have a better understanding of the overall processes, terminology and reasons for wastewater treatment. In addition the tips in the guide around energy, legislative requirements and safety will help the reader ask relevant questions and make more informed decisions.

WRC Report no. TT 651/15

To access the report, **click here**

Other reports

Engaging a complex problem through a community of practice approach: Improvement of dysfunctional wastewater treatment works through a multistakeholder Green Drop support campaign (WRC Report no. KV 345/16)
This research project approached the problem of dysfunctional wastewater treatment works via a combination of political ecology, action research, social learning and complexity approaches, with the following research question: "Can dialogue, social learning in a community of practice formed from diverse stakeholders, practical co-operation and a better understanding of the position of wastewater treatment works frontline staff as well as the responsible municipalities, lead to improvement in Green Drop scores and performance?"

Wastewater risk abatement plan – A W_2RAP guidelines (WRC Report no. TT 489/11)
A Wastewater Risk Abatement Plan (W_2RAP) is a valuable primary risk management tool to enhance municipal wastewater service delivery. The W^2RAP encompasses all steps in the wastewater value chain, from production to discharge or reuse in a particular catchment. At the time of development, the W_2RAP was amongst the first world-wide initiatives that put in place a guideline to plan for, and apply a risk-based approach to improve and sustain wastewater service performance.

Drivers for wastewater technology selection – Assessment of the selection of wastewater technology by municipalities in relation to the management capability and legislative requirements (WRC Report no. TT 543/12)
This project provided, via a scientific selection of 15 municipal cases (sites) across the country, a high level assessment and initial comment on the appropriateness of the technological choices in relation to the current ability of the municipality to implement and administer such choices, and legislative environment within which these choices are overseen.

A guideline for integrating community-based procurement in the operation and maintenance of basic services (WRC Report no. TT 423/09)
While in South Africa there is general willingness to integrate pro-poor strategies and improve operation and maintenance (O&M) of basic services, the specific challenges obstructing implementation at a local level called for further research. Research was conducted in partnership with four municipalities, spanning across urban to rural case study settings and covering the range of basic services technologies provided, expressly to inform the development of a guideline for integrating community-based procurement in O&M systems.

A simple guide to the chemistry, selection and use of chemicals for water and wastewater treatment (WRC Report no. TT 405/09)
This guide aims to provide those decision-makers, and other users of water treatment chemicals, with specific and useful information about water treatment chemicals. It is a chemistry text book

aimed specifically at those people who have to make informed decisions but who have not had a formal education in chemistry or whose chemistry education has not been specific in detail relevant to water treatment chemicals.

Process design manual for small wastewater works (WRC Report no. TT 389/09)
This project was an update of the original 'A Guide to the Design of Sewage Purification Works' which was first published in 1973 by the then Southern African Branch of the Institute for Water Pollution Control (IWPC).

Guideline for the inspection of wastewater treatment works (WRC Report no. TT 375/08)
The guideline document deals with the requirements for undertaking an inspection at a Wastewater Treatment Works. The purpose of the guideline document is to assist the process controller to prepare for an inspection at the works, take corrective action where a problem is identified, assist the inspector to undertake an inspection at a works, and give guidance where a problem is identified.

www.wrc.org.za