

CATALOGUE OF AVAILABLE TT REPORTS

A gap analysis of water testing laboratories in South Africa

Faye Balfour, Hanlie Badenhorst and Debbie Trollip

There are a limited number of laboratories that undertake water quality testing in South Africa. More significantly, many of these laboratories have capacity limitations. These laboratories are a critical link in the value chain that ensures safe drinking water for consumers and unpolluted water in our water resources. Until recently there has been little focus on the quality control of the laboratories utilized in the testing of water. This has resulted in municipalities and the Department of Water Affairs (DWA) using both centres of excellence and those with little evidence of being able to produce reliable results. However, the most startling issue is that although the problem was acknowledged within the sector, it could not be quantified. How many laboratories are there? Where are they? What quality control measures do they have in place? Do they have suitably qualified staff? This WRC project has begun the process of quantifying these gaps in the sector. This project developed a database of existing laboratories that undertake water quality testing and, through a survey, obtained information on their capability and credibility. Nearly 200 laboratories were identified and 50% of these completed the survey.

TT 488/11
ISBN: 9781431201051
Overseas Price: \$30.00

Cleaner Production: A Guidance Document for the Mining Industry in South Africa Sustainable Use of Greywater – Guidance Report

Susan Barclay, Graham Trusler, Harro von Blottnitz, Christopher Andrew Buckley, Bas Kothuis & Claire Janisch

This project introduced Cleaner Production (CP) technologies to the mining industry by using a number of CP tools. A scoping study identified distinct differences in how big and small companies improve their practices and consider environmental impacts. Company policy and the practices of their competitors drive awareness within larger companies, while legislation drives awareness in smaller companies. The fact that several existing water-related threats by and to the mining industry can be alleviated by CP technologies, presents opportunities to facilitate the introduction of CP approaches. Cleaner Production Forums were formed where coal and gold miners could share

ideas, fight common battles and share success stories. Life Cycle Analysis studies were carried out to determine priority areas and acquaint industry with the technique. Throughout the project term a campaign was maintained to raise awareness of the benefits and need for adopting CP approaches. A CP guide was developed to assist mining companies with implementing CP programmes.

TT 485/11
ISBN: 978431200979
Overseas Price: \$35.00

Nicola Rodda, Kirsty Carden and Neil Armitage

This project was undertaken to provide guidance regarding the conditions under which greywater use should be allowed or propagated and to provide guidance to users about its sustainable use in small-scale agriculture and gardens. Two main products were produced, viz a user friendly Guidance Document and a supporting Technical Background Document which captures the technical information on which the Guidance Document is based and describes the extensive process that was followed to develop the Guidance Document. The Guidance Document is aimed at Municipalities, NGOs and informed members of the public who wish to implement greywater irrigation. The focus of the Guidance Document is to minimise the risks of:

- illness in handlers of greywater and greywater-irrigated produce, or consumers of greywater-irrigated produce.
- reduction in growth or yield of plants/crops irrigated with greywater.
- environmental degradation, especially reduction in the ability of soil irrigated with greywater to support plant growth.

TT 469/11
ISBN: 9781431200917
Overseas Price: 30.00

Agricultural water use in homestead gardening systems

Christiaan Matthys Stimie, Marna de Lange, Charles Terrence Crosby and Erna Kruger

The overall objective of this project was to improve food security through homestead gardening, by developing and evaluating the appropriateness and acceptability of training material for agricultural water use, training of household members in selected areas. Particular attention was given to the development of the 800 page resource

material for facilitators and food gardeners on "Agricultural use in Agricultural water use in homestead gardening systems

TT 431/10

ISBN: 9781770059184

Overseas Price: \$60.00

Christiaan Matthys Stimie, Marna de Lange, Charles Terrence Crosby and Erna Kruger

The overall objective of this project was to improve food security through homestead gardening, by developing and evaluating the appropriateness and acceptability of training material for agricultural water use, training the trainers and training of household members in selected areas. Particular attention was given to the development of the 800 page resource material for facilitators and food gardeners on "Agricultural Water Use in Homestead Gardening Systems". The development of the resource material followed a participatory approach and was field tested and refined with the assistance of food secure and insecure households in rural villages. The resource material succeeded in drawing widely from local and international materials and experience. Its usefulness in practice has been substantiated by facilitators who were not part of its development. It is anticipated that a variety of stakeholders will draw on this resource material to develop course material for their own purposes. A significant demand for the material exists from universities and agricultural colleges that are aware of the material. Best management practices for smallholder farming on two irrigation schemes.

TT 430/09

ISBN: 9781770059177

Overseas Price: 40.00

Manual for rural freshwater aquaculture

Qurban Rouhani, Niall, Nicholas James and John Case

In 2004, the Rural Fisheries Programme of the Department of Ichthyology and Fisheries Science, Rhodes University completed a project on behalf of the Water Research Commission (WRC) to assess the contributions of rural aquaculture to livelihoods. It became apparent that although the current contributions were low, the potential was significant. To exploit this potential, Project K5/1580//4 was targeted solicited by the WRC in 2005 and is co-funded by the Department of Agriculture, Forestry and Fisheries (DAFF). This project was formulated to address a number of issues, such as developing provincial aquaculture strategic plans, revitalizing state hatcheries, training of extension officers and the development of a manual to complement the training. An inclusive process to develop an aquaculture

training manual for extension officers was followed. The provincial Departments of Agriculture made inputs on the content and structure of the manual and drafts were then sent to DAFF and other stakeholders for review and comments. It is envisaged that this manual will continue to be modified and reviewed as aquaculture in South Africa grows in order to reflect the needs of the extension officers over time. The manual is not only intended for the training of extension officers, but is also resource material to be used in the field when interacting with farmers.

The manual consists of 13 chapters with information and supportive illustrations on introduction to aquaculture; fish biology; aquaculture species; types of fish-farm: ponds, cages and tank systems; water quality; production and shipping; feeds and feeding; harvesting; fish health and diseases; fish husbandry; cage culture; increasing production; and business and financial planning.

TT 463/P/10

ISBN: 9781770059924

Overseas price: \$28.00

Pearson Nyari Stephano Mnkeni; Cornelius Chiduzo; Albert Thembinkosi Modi; Joseph Benjamin Stevens; Nomakaya Monde; Isobel van der Stoep and Richard Dladla

The project was a collaborative undertaking by five organisations namely: the Universities of Fort Hare, KwaZulu-Natal, Zululand (which withdrew in 2006), and Pretoria, as well as Zakhe Agricultural Training Institute. It was conducted in the form of two case studies based in Zanyokwe Irrigation Scheme (ZIS) which uses sprinkler irrigation and Tugela Ferry Irrigation Scheme (TFIS) which uses a short-furrow irrigation system. Its main objective was to carry out research in Zanyokwe and Tugela Ferry irrigation schemes with a view to develop and implement technologies and knowledge useful for farmers in order to improve their livelihoods and those of surrounding communities. Participatory research methodologies were employed where the smallholder farmers and other stakeholders were involved in project activities. Important agronomic and socio-economic (including organisational and institutional arrangements) constraints to crop production on the two schemes were identified and action was taken together with the farmers to address the problem. The need for training of extension staff in irrigation management in order to better support farmers was highlighted.

TT 478/10

ISBN: 9781431200498

Overseas Price: \$40.00

Estuaries, Economics and Freshwater: An introduction

Duncan Hay, Stephen Hosking and Margaret Mckenzie

People are attracted to and value estuaries. They are much more than important ecosystems. They are also important social and economic systems – they play an important part in the lives of thousands of people living along our coast and inland.

TT 470/10
ISBN: 9781431200023
Overseas price: \$15.00

Guidelines for improved efficiency of irrigation water use Volume 3

Felix Britz Reinders

The activities undertaken during the course of the project have contributed to local knowledge on issues regarding irrigation water use efficiency. The outcomes have created new knowledge in that:

- Efficiency refers to the state of a water balance for a defined spatial and temporal area rather than to the value of a performance indicator; and
- Improved efficiency is achieved through a process of assessment and targeted actions, rather than general practices.

TT 467/10
ISBN: 9781431200245
Overseas price: \$40.00

Guidelines for improved efficiency of irrigation water use Volume 2 of 3

Felix Britz Reinders

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- Efficiency refers to the state of a water balance for a defined spatial and temporal area rather than to the value of a performance indicator; and
- Improved efficiency is achieved through a process of assessment and targeted actions, rather than general practices.

TT 466/10
ISBN: 9781431200238
Overseas Price: \$40.00

Guidelines for improved efficiency of irrigation water use Volume 1 of 3

Felix Britz Reinders

The activities undertaken during the course of the project have contributed to local knowledge on issues regarding irrigation water use efficiency. The outcomes have created new knowledge in that:

- Efficiency refers to the state of a water balance for a defined spatial and temporal area rather than to the value of a performance indicator; and
- Improved efficiency is achieved through a process of assessment and targeted actions, rather than general practices.

The resulting approach that has been documented in the final report therefore still complies with the original proposed improvement process of “measure; assess; improve; evaluate”. It promotes an investigative approach to improving efficiency, rather than relying only on water accounting.

TT 465/10
ISBN: 9781770050221
Overseas Price: \$30.00

Process design manual for small wastewater works

David Joseph Nozaic and Susan Delia Freese

‘A Guide to the Design of Sewage Purification Works’ was first published in 1973 by the then Southern African Branch of the Institute for Water Pollution Control (IWPC) and over the years this useful reference document has become known as the ‘Black Book’. This guide was revised and republished in 1987 and was intended to be less of a guide to design, and more of a manual to assist firstly designers, and secondly engineers and/or chemists who may be required to approve the designs for smaller domestic sewage works treating up to 5 Ml/d. Since publication of the revised edition of the Manual for Design of Small Sewage Treatment Works in 1987, no further revision has been carried out, despite that fact that since then there have been a number of new technologies introduced into wastewater.

TT 489/09
ISBN: 9781770058262
Overseas Price: \$35.00

Guide for management of waste stabilisation pond systems in South Africa

Philip de Souza & Unathi Jack

The waste stabilisation ponds of the Free State have generally performed well for many years, effectively preventing environmental pollution and associated health impacts. Nevertheless, concerns were raised as to the current operational state of waste-stabilisation ponds of the Free State and their impact on both the natural environment and human health. Considering the above, a preliminary study of waste stabilisation ponds was initiated by the Free State DWAF office. Based on these findings, the Water Research Commission (WRC) decided to extend the study by conducting an in-depth study of selected waste stabilisation ponds systems in the Eastern Cape and Free State.

TT 471/10
ISBN: 9781431200344
Overseas Price: \$25.00

Guide for operations and maintenance of a waste stabilisation pond system

Philip de Souza & Unathi Jack

The waste stabilisation ponds of the Free State have generally performed well for many years, effectively preventing environmental pollution and associated health impacts. Nevertheless, concerns were raised as to the current operational state of waste-stabilisation ponds of the Free State and their impact on both the natural environment and human health. Considering the above, a preliminary study of waste stabilisation ponds was initiated by the Free State DWAF office. Based on these findings, the Water Research Commission (WRC) decided to extend the study by conducting an in-depth study of selected waste stabilisation ponds systems in the Eastern Cape and Free State. The Free State and Eastern Cape systems assessed are within the Upper Orange Vaal catchment area. There are a few other systems assessed in the Eastern Cape that do not fall under this catchment area.

TT 472/10
ISBN: 9781431200351
Overseas Price: \$25.00

Manual for using electronic water quality management system (eWQMS) and waste stabilisation ponds assessment tool

Philip de Souza & Unathi Jack

The waste stabilisation ponds of the Free State have generally performed well for many years, effectively preventing

environmental pollution and associated health impacts. Nevertheless, concerns were raised as to the current operational state of waste-stabilisation ponds of the Free State and their impact on both the natural environment and human health. Considering the above, a preliminary study of waste stabilisation ponds was initiated by the Free State DWAF office. Based on these findings, the Water Research Commission (WRC) decided to extend the study by conducting an in-depth study of selected waste stabilisation ponds systems in the Eastern Cape and Free State. The Free State and Eastern Cape systems assessed are within the Upper Orange Vaal catchment area. There are a few other systems assessed in the Eastern Cape that do not fall under this catchment area.

TT 473/10
ISBN: 9781431200368
Overseas Price: \$25.00

Water related microbial disease guidelines

Ian Bailey

Many studies on the effects of water development on human health over the past fifty years have been criticized as to their validity and usefulness. Lack of adequate control, poor project design, many confounding variables, cultural bias, health indicator recall, health indicator definition and failure to analyse by age have been cited as rendering study results meaningless. Eminent researchers in the field, such as Cairncross and Birley, are equally skeptical. While instinctively it is accepted that water and sanitation do improve health, there are many opinions as to how and why.

TT 429/10
ISBN: 9781770055216
Overseas Price: \$30.00

Domestic water quality research impact assessment

Sostina Shiri & David Winter

The WRC provides leadership for water-related research and development through the support of knowledge creation, transfer and application. The WRC engages stakeholders and partners in solving a wide variety of water related problems, which are critical to South Africa's sustainable development and economic growth.

TT 416/09
ISBN: 9781770058828
Overseas Price: \$20.00

Development of a model for determining affordable and sustainable sanitation demand in dense settlements of South Africa

Richard Martin

The level and quality of the services that communities are to receive must be discussed with and accepted by the community members. Quite important are also the economic considerations of these principles, namely that services must be provided economically and efficiently in order to give citizens the maximum value for money. Experts have long noted the importance of determining the “effective demand” for services such as sanitation as expressed by the willingness of users to pay for these services. Too often the solutions proposed are inappropriate in terms of what the people want. As a result sanitary facilities are misused, badly maintained or even vandalized. If they are too expensive, the bills will not be paid which may give rise to the discontinuation of services and consequently to riots and/or violence. If the solutions do not meet the social norms, they will not be used. Finding the right solution is therefore fundamental in our quest for sustainability.

TT379/08

ISBN: 9781770058040

Overseas Price: \$25.00

Towards standards for municipal invoices in SA

Sarah Slabbert

The domestic water accounts (or consolidated accounts) that municipalities send out to consumers on a monthly basis are a key interface between local government and citizens. A municipal account is a unique one-on-one communication event between the municipality and the individual consumer (or customer) to whom the account is addressed. As such, municipal accounts offer a unique opportunity for municipalities to inform, educate and influence their customers and to establish their communication as clear, accurate and customer friendly. The research assessed current South African and international regulation, guidelines and research relating to accounts/invoices/bills, with special reference to domestic water accounts. This was supported by a survey of current municipal account practices, as well as a critical analysis of a representative sample of domestic water (or consolidated) accounts.

TT 458/10

ISBN: 9781770059832

Overseas Price: 25.00

Guidelines on domestic water accounts –towards a consistent approach in the RSA

Sarah Slabbert, Carmel Joseph, Annerie Allers

The domestic water accounts (or consolidated accounts) that municipalities send out to consumers on a monthly basis are a key interface between local government and citizens. A municipal account is a unique one-on-one communication event between the municipality and the individual consumer (or customer) to whom the account is addressed. As such, municipal accounts offer a unique opportunity for municipalities to inform, educate and influence their customers and to establish their communication as clear, accurate and customer friendly.

TT 457/10

ISBN: 9781770059825

Overseas Price: \$30.00

“Going with the franchising flow”: An exploration of partnerships for the operation and maintenance of water services infrastructure

Kevin Wall & Oliver Ive

The rapid rate of construction and commissioning of new water services infrastructure is severely challenging the public sector institutions in South Africa responsible for operating and managing this infrastructure. Innovative approaches are required. But even if all the existing water services institutions were coping with the responsibility, there would be good reason to investigate alternative institutional models, on the grounds that it needs to be found out if alternatives could be more cost-effective, and/or could offer a range of other advantages (including greater local economic development).

TT 432/10

ISBN: 9781770059627

Overseas: \$25.00

Guidelines for facilitating Cooperative and Adaptive Management of Freshwater Ecosystems

Dirk Johannes Roux, Kevin Murray, Liesl Hill

Water resources management is characterised by complex problems, considerable uncertainties, limited predictability, the need for integration across disciplines, and the need for coordination and cooperation between agencies with overlapping mandates. There are multiple stakeholders and their expectations can be diverse and guided by different mental models based on different knowledge forms.

TT 404/10
ISBN: 9781770059788
Overseas price: \$15.00

Seaman MT, Avenant MF, Watson M, King J, Armour J, Barker CH, Dollar E, du Preez PH, Hughes DA, Rossouw L

The South African National Water Act, Act 36 of 1998, requires that the environmental reserve be determined for each significant water body before water-use licences may be issued. Methods currently available for the determination of environmental water requirements in South African rivers are based on perennial rivers and are seen to be needing verification for use on non-perennial rivers. This research programme began by identifying which existing methods, i.e. those being used on perennial rivers, might initially seem to be suitable for use and where further work needs to be done (see Rossouw et al., 2005). It then took this research a step further with an overarching objective to develop a prototype methodology for determining the environmental water requirements for non-perennial rivers. This would be based on field-based knowledge acquired during comprehensive research on a range of non-perennial system.

TT 459/10
ISBN: 9781431200115
Overseas Price: \$40.00

The effects of stream flow manipulation on the invertebrate hosts of malaria, bilharzia and liver fluke disease

Leo Quale, Chris Appleton and Chris Dickens

This report details the results of a desktop investigation into the relationship between regulated river flow, flow manipulation and the invertebrate hosts of malaria, bilharzia and liver fluke disease in South Africa. Literature review yielded several international case studies which informed the study, and together with expert input, all information was gathered and documented in order to understand the relationship and suggest possible flow manipulation mechanisms which may be used to control transmission of these diseases through control of their invertebrate hosts. The possible effectiveness of these flow related control mechanisms has also been assessed and the number of 'people at risk' who may benefit from flow related control is estimated.

TT 456/10
ISBN: 9781770059801
Overseas Price: \$30.00

Framework and manual for the evaluation of aquatic ecosystems services for the resource directed measures

AE Ginsburg JG Crafford & KR Harris

The National Water Resource Strategy aims to strike a balance between the use of resources for livelihoods and conservation of the resource. This process invariably requires negotiation of trade-offs. These trade-offs are principally between the resource quality on the one hand and the beneficial use of water on the other. The framework developed through this project to achieve this is explicitly congruent with methods used by DWA in the determination of Resource Directed Measures and Source Directed Controls. Definition of the benefits yielded by an ecosystem have been based on the Millennium Ecosystems Assessment framework and comparative risk assessment methodology is used to develop the causal chains linking ecological production to the defined ecosystem services. Two case studies have been developed to illustrate the framework.

TT 462/10
ISBN: 9781770059979
Overseas Price: \$35.00

This Framework and Manual explores how these scenarios and their associated trade-offs should be evaluated.

Water Quality Overview and Literature Review of the Ecology of the Olifants River

Ralph Heath, Trevor Coleman, Johan Engelbrecht

In the light of the ongoing water quality problems in the Olifants River, Mpumalanga, a review of water quality studies done on the system was commissioned to provide this information for other studies on this system. An overview of the economic activities in the catchment provides the background for the water quality problems to which the system is exposed. Resource Quality Studies, Dept. of Water Affairs, started monitoring the catchment in 1983 and have monitored a number of parameters in their routine monitoring programme. The review also covers water quality results from specific studies in the catchment.

TT 452/ 10
ISBN: 9781770059894
Overseas Price: \$25.00

Public participation in the drafting of catchment management strategies made simple

Derick du Toit & Sharon Pollard

The focus of the document is to guide CMA personnel and others working on their behalf in the structuring of public engagement in the drafting and implementation of the CMS. The document is made up of simplified step by step guide. Each section is taken directly from the CMS guideline which is a national official document published by DWA in 2007 and each task is developed in terms of steps. The requisite level of public engagement is suggested on the left and the 'how' for each task is presented. There are 10 TASKS, each with step-by-step tables.

TT 455/10

ISBN: 9781770059795

Overseas price: \$35.00

Exclude postage

Guidelines for improved efficiency of irrigation water use Volume 2 of 3

Felix Britz Reinders

The activities undertaken during the course of the project have contributed to local knowledge on issues regarding irrigation water use efficiency. The outcomes have created new knowledge in that:

- Efficiency refers to the state of a water balance for a defined spatial and temporal area rather than to the value of a performance indicator; and
- Improved efficiency is achieved through a process of assessment and targeted actions, rather than general practices.

The resulting approach that has been documented in the final report therefore still complies with the original proposed improvement process of "measure; assess; improve; evaluate". It promotes an investigative approach to improving efficiency, rather than relying only on water accounting. The main output of the project was the compilation of guidelines for improved irrigation water management from dam wall release to root zone application. The guidelines are aimed at assisting both water users and authorities to achieve a better understanding of how irrigation water management can be improved, thereby building human capacity, allowing targeted investments to be made with fewer social and environmental costs. Using lessons learnt during the WRC project, best practices and technologies were introduced and illustrated.

TT446/10

ISBN: 9781431200238

Overseas price: \$35.00

Exclude postage

Integrated Management of Water Hyacinth in SA

Marcis Byrne, Martin Hill, Mark Robertson, Anthony King, Ashwini Jadhav, Naweji Katembo, John Wilson, Ryan Burdvig and Jolene Fisher

Water hyacinth, *Eichhornia crassipes* (Martius) Solms-Laubach (Pontederiaceae) is South Africa's most damaging floating aquatic weed. Despite notable successes with the biological control of other floating aquatic weeds, and a concerted biological control effort against water hyacinth, its populations continue to reach newsworthy proportions on major rivers and dams. Hill and Olckers (2001) ascribed the variable success of the biological control programme on water hyacinth in South Africa to variable climatic conditions, eutrophication of aquatic ecosystems, interference from integrated control operations, the hydrology of infested systems and techniques for establishing biological control agents. The research presented in this report addresses the effect of temperature and nutrients on the growth of water hyacinth and some of its biological control agents and investigates the interaction of herbicide application with biological control. This has been done in light of discovering a sublethal dose of herbicide which will retain water hyacinth plants in a system to maintain populations of the agents. In addition, a management plan has been developed to guide water managers as what action should be taken in terms of combining biological control with herbicidal control under different climatic and nutrient conditions.

TT 454/10

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Overseas price: \$35.00

Exclude postage

Ecohydraulics for South African Rivers: A Review and Guide

James C.S. and King J.M. (Editors)

This project was aimed at synthesizing existing knowledge on ecohydraulics in South Africa and then packaging it in the form of a Review and Guide document. The Guide provides theories and techniques related to ecohydraulics as well as the ecological context and perspective for the application of ecohydraulics. Thus building capacity amongst engineers and ecologists and contributing towards the effective management of our aquatic environment. The Guide will also provide an overview of the current state of ecohydraulics research in South Africa, serving as a useful point of reference for identifying and prioritising future research needs for ecohydraulics in South Africa. It is of importance to note that the techniques and theory presented in this document deal exclusively with ecology and ecohydraulics within a river context, with the intention

that environmental hydraulics in its broader sense, which typically include biological and chemical aspects in lakes, estuaries and wetlands, will be addressed in subsequent research projects. Furthermore, it is necessary to point out that the hydraulic theory that is presented in this document assumes that the user of this Guide will have a graduate level of understanding of river hydraulics. However, the content is presented in such a way as to ensure that water resource practitioners and managers as well as researchers across a wide spectrum of disciplines, should find the document informative and useful.

TT 453/10
 ISBN: 9781770059603
 Overseas price: \$35.00

Application of Ecological informatics Modelling Techniques for predicting harmful Algal Blooms

Carin Elizabeth van Ginkel, Sandra du Plessis, Johannes Jacobus Bezuidenhout

The study showed that eutrophication and the associated problems is a real threat to South African fresh water resources but that modelling methods can assist in managing the problem. The list of recommendations needs to be taken further by a number of stakeholders, e.g. the Department of Water Affairs, future CMA's, Universities and other researchers in order to:

- a) Determine the necessary variables and monitor these for future modelling exercises.
- b) Include total microcystin monitoring in impacted fresh water resources at least during the summer periods to enable resource managers to issue warnings to all potential impacted stateholders.
- c) Initiate and test available management options to minimise serious eutrophication levels in South Africa.
- d) Manage the risk imposed by the cyanobacterial blooms and the associated toxins produced in the water resources, on drinking water facilities and the health of recreational users.
- e) Develop short-term forecasting tools, for the algal blooms of Microcystis and Ceratium, with on-line water quality monitoring for early-warning and real-time forecasting for reservoir managers.
- f) Investigated the cause and effects for changing composition of the phytoplankton of these five reservoirs.
- g) Monitor at different depths to determine the best depth for abstraction for treatment purposes.

The successful use of the hybrid Evolutionary Algorithm Method to develop predictive tools for algal blooms indicated the necessity to develop capacity (both human and equipment) in South Africa to use the Hybrid Evolutionary Algorithm (HEA) RULE set development in all research

spheres, as the method is applicable to any type of numerical data and can be applied to any research field.

TT451/10
 ISBN: 9781770059535
 Overseas price: \$35.00
 Exclude postage

Integrated water quality management: A new mindset

Lee Ann Boyd; Robyn Lesley Tompkins; Ralph Gregory Melville Heath

The conceptual model is based on the premise that good water quality is in everyone's best interests. This "Change of Mindset" IWQM management approach "breaks down" the management of water quality into smaller management units. At the same time, both the horizontal and the vertical reporting framework is established. This structure is aimed at addressing the problem of implementation of quality standards across the country, and also improving enforcement by reducing the volume of reports that should highlight problem areas and allow for prioritisation of regulatory or remedial action. A further benefit of the IWQM management framework is that responsibility for water quality is based on significantly smaller geographical areas, and accountability to the adjoining areas (horizontal accountability) and to the next level of management (vertical accountability) is established with the creation of the management unit. This allows accountability for water quality to be focused on smaller management units, rather than diffused up ever higher levels of management. Finally, the IWQM approach allows water quality information to be packaged for a broader audience, as reporting is simplified to provide information on whether or not a management unit is within the specifications of its critical control points (CCPs) or not; rather than extensive technical reports to national level through the management chain.

TT 450/10
 ISBN: 9781770049529
 Overseas price: \$35.00
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Financial and economic feasibility of drainage

Robert Jack Armour and Machiel Frederick Viljoen

It was strongly suggested and agreed upon at a final Reference Group meeting for WRC project 1352, that the project team prepare a consultation proposal to meet with relevant stakeholders for technology transfer of the results produced in the project. This is due to the fact that this research successfully integrated and linked models and

results from different disciplines (soil science, hydrology and agronomy) with economic models at micro (per hectare, sub-WUA and WUA) level and social welfare models at the regional level. This enabled the researchers to determine the long term impact (cost and benefits) of different salinity management options and provided valuable information required for decision making at different levels.

In this regard the results show that for the different levels:

- Drainage installation and consequent leaching, is a better option financially, environmentally and socially than changing to more salt tolerant crops at farm, WUA and regional level;
- The project results clearly show that to reduce the risk of income loss due to irrigation salinity, drainage and leaching are necessary;
- At regional level the direct and indirect effects of modeled improved drainage (and subsequent investment in higher value crops) proved far greater than the costs of the drainage; produced the highest index for socio-economic welfare (ISEW); and an increase of employment in irrigation farming and related industries over the long term.

To reinforce the message of the technology transfer results to be presented, brochures will be handed out at the technology transfer meetings and a web-page will be introduced that will include links to the relevant WRC reports, the user friendly technology transfer report, and other updated and interesting salinity and drainage related information.

TT 448/09
ISBN: 9781770059511
Overseas price: \$35.00
Exclude postage

Impact assessment of the water administration system

David Winter

Since 1985 the Water Research Commission has been working closely with the DWAF together with NB Systems in developing water management systems that simplify the task of managing canal water for irrigation purposes. This has resulted in the production of a broad range of research reports that have been focused on the development of the Water Administration System (WAS).

The WAS program is designed to be a water management tool for irrigation schemes, Water User Associations (WUA's), Catchment Management Agencies (CMA's) and water management offices that need to manage their water usage, distribution and accounts. It is an integrated

database-driven system with many water management capabilities that include handling any number of farmers, abstraction points and measuring stations on canal networks, pipelines and rivers. The system involves simplified and controlled ways of managing water allocations, use, distribution and billing.

The main objective for developing the WAS program was to minimise water losses for irrigation schemes that work on the demand system and that distribute water through canal systems. The program consists of seven modules that are integrated into a single program that can be used on a single PC or multi-user environment. These seven modules can be implemented partially or as a whole, depending on the requirements of a specific scheme or office.

TT 447/09
ISBN: 9781770059504
Overseas price: \$25.00
Exclude postage

Assessing the impact of in-field rainwater harvesting and conservation research

James Nelson Blignaut and Xolani Rudolf Sibande

The Water Research Commission (WRC) has been supporting the Agricultural Research Council (ARC) at Glen near Bloemfontein and various other organisations over the past 15 years to conduct research and development for in-field rainwater harvesting (IFRWH) techniques and the dissemination of knowledge among the members of 42 villages surrounding Thaba Nchu. The WRC approached ASSET Research to conduct an investigation, using the McMaster University's research impact assessment tool, as to the uptake and impact of IFRWH in those villages.

TT 444/08
ISBN: 9781770059436
Overseas price: \$25.00
Exclude postage

Wetland valuation volume IV: A protocol for the quantification and valuation of wetland ecosystem services

JK Turpie and M Kleynhans

VOLUME 11: WRC REPORT TT443/09
WETLAND VALUATION VOLUME IV: A PROTOCOL FOR THE QUANTIFICATION AND VALUATION OF WETLAND ECOSYSTEM SERVICES

This study builds on three earlier volumes on wetland valuation and includes a review of current understanding of wetland ecosystem services to provide a protocol for

the quantification and valuation of wetland ecosystem services. The report is written for planners and decision-makers wishing to understand the purpose and potential for use of wetland valuation in a variety of decision-making contexts, and to guide them in the setting of terms of reference for specialist studies. In addition, the report aims to guide student and professional resource economists in their understanding of the purpose of and trade-offs in valuation studies, the choice of their detailed methodological approach and the role of biophysical specialists in wetland valuation. Although the report provides advice on how to achieve relatively rapid estimates of wetland values, it does not offer a shortcut tool for rapid valuation by non-professionals.

TT 443/09
ISBN: 9781770059351
Overseas price: \$30.00
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WETLAND VALUATION VOLUME III: ASSESSMENT OF THE LIVELIHOOD VALUE OF WETLANDS

JK Turpie

VOLUME 10: WRC REPORT TT 442/09
WETLAND VALUATION VOLUME III: A TOOL FOR THE ASSESSMENT OF THE LIVELIHOOD VALUE OF WETLANDS

Millions of South Africans are directly dependent to some extent on natural systems to sustain their livelihoods, and wetlands are considered particularly valuable in terms of the variety and abundance of services they provide. Understanding the degree to which wetlands contribute to people's livelihoods may be vital in steering decisions that minimize negative impacts or enhance the benefits that wetlands have for communities, such as their contribution to household income. This study developed a simple index for the assessment of a wetland's importance to people's livelihoods through understanding the level of dependence of surrounding communities on a wetland. The tool outlines the way in which the index parameters are estimated at a rapid, intermediate, or comprehensive level, depending on the budgetary constraints or the level of confidence required. Since the index produces a result which is in comparable units, the results can be used to assess the relative importance of a wetland compared to others in the catchment or even nationally, and to rank, or prioritize, different wetlands in terms of management priorities.

TT 442/09
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WETLAND VALUATION VOLUME II: CASE STUDIES

JK Turpie

VOLUME 9: WRC REPORT TT441/09
WETLAND VALUATION VOLUME II: WETLAND VALUATION CASE STUDIES

This report, one of the outputs of the Wetland Health and Importance (WHI) research programme and one of four on the value of wetland ecosystems, documents five case studies selected to fill some important gaps in wetland valuation in South Africa, as well as to provide examples of studies carried out at different levels.

TT441/09
ISBN: 9781770059337
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WETLAND VALUATION VOLUME I: SERVICES & THEIR VALUATION

JK Turpie, K Lannas, N Scovronick and A Louw

VOLUME 8: WRC REPORT TT440/09
WETLAND VALUATION VOLUME I: Wetland ecosystem services and their valuation: a review of current understanding and practice

This report, one of the outputs of the Wetland Health and Importance (WHI) research programme and one of four on the value of wetland ecosystems, reviews the wetland valuation literature to ascertain how wetland valuation has been approached internationally, and how international and local experience can guide best practice for approaching wetland valuation in South Africa. Wetlands are recognised as being valuable ecosystems which provide water, food and raw materials, services such as flood attenuation and water purification, and intangible values such as cultural and religious value. Despite this, and legislation to protect them, they are increasingly threatened, with more than half the world's wetlands having been lost already. Wetlands may be degraded due to market failure (where markets do not reflect true values or costs) and government failure (perverse incentives, lack of well-defined property rights leading to open access and ignorance of decision makers as to the value of wetlands). Economic valuation helps to compare the real costs and benefits of ecosystem use and degradation, and allows more balanced decision-making regarding the protection and restoration versus degradation of wetlands.

TT 440/09
ISBN: 9781770059320
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Assessment of two wetlands in the Kamiesberg uplands

Donovan Charles Kotze, Heather Louise Malan, William Nolan Ellery, I Samuels and L Saul

VOLUME 7: WRC REPORT TT439/09
ASSESSMENT OF THE ENVIRONMENTAL CONDITION, ECOSYSTEM SERVICE PROVISION AND SUSTAINABILITY OF USE OF TWO WETLANDS IN THE KAMIESBERG UPLANDS
There is a long history of use of the wetlands in the Kamiesberg area. Even for the present generation they represent an important resource to a community that is relatively poor.

This study, a joint initiative between the WRC-funded Wetland Health and Importance Research group and the Agricultural Research Council (ARC): Range and Forage Unit, reports on an investigation of the geomorphology, vegetation and utilisation by humans, of two wetlands (Langvlei and the Ramkamp) which are situated just outside of Leliefontein in the Kamiesberg area of the Northern Cape. The historical settlement patterns and land-use in the area are described, and the information collected was used to establish the environmental condition of the wetlands, the ecosystem services they are likely to deliver and how sustainable the use of those systems is likely to be. Sustainability was assessed both from a sociological, and an ecological, point of view.

TT 439/09
ISBN: 9781770059313
Overseas price: \$30.00
Exclude postage

Assessing the sustainability of wetland use

Donovan Charles Kotze

VOLUME 6: WRC REPORT TT438/09
WET-SUSTAINABLE USE:
A system for assessing the sustainability of wetland use

WET-SustainableUse has been developed to assess the ecological sustainability of wetland use, focusing on grazing of wetlands by livestock, cultivation of wetlands and harvesting of wetland plants for, for instance, crafts and thatching. WET-Sustainable Use asks to what extent the use of the wetland has altered the following five components of the wetland's environmental condition: (1) the distribution and retention of water, (2) the erosion of sediment, (3) the accumulation of soil organic matter (SOM), (4) the retention of nutrients and (5) the natural species composition of the vegetation in the wetland. WET-SustainableUse assists the user in answering these questions by providing a set of indicators for each of the five compo-

nents, and a structured way of scoring these indicators and deriving an overall score for each component.

TT 438/09
ISBN: 9781770059306
Overseas price: \$30.00
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Assessing cumulative impacts on wetlands at catchment scale

WN Ellery, S Grenfell, M Grenfell, C Jaganath, HL Malan and DC Kotze

VOLUME 5: WRC REPORT TT437/09
A method for assessing cumulative impacts on wetland functions at the catchment or landscape scale

This volume, part of the series on Wetland Health and Importance, describes methods which enable the assessment of the effects on wetland functionality of the cumulative impacts of human activities at a landscape scale. It uses two metrics - the land cover change impact metric and the loss of function metric to produce a functional effectiveness score that is translated to functional hectare equivalents. The land cover change is based on the recognition that wetland structure and function are fundamentally affected by the hydrological regime. The loss of function metric describes the relationship between the magnitude of impact and wetland functionality for a total of 6 ecosystem services: A) flood attenuation, B) stream flow regulation, C) sediment trapping, D) nitrogen removal, E) phosphate removal or F) toxicant removal. These metrics are based on limited field testing and need verification.

TT 437/09
ISBN: 9781770059290
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Aquatic invertebrates - indicators of human impacts in SA wetlands assessment of temporary wetlands

M Bird

VOLUME 3: WRC REPORT TT435/09
aquatic invertebrates as indicators of human impacts in South African wetlands

The recent emphasis on wetland protection and management has created an urgent need to develop assessment tools to establish and monitor human impacts in wetland ecosystems so as to prioritise wetlands for conservation and rehabilitation actions and to monitor the effects of these actions. Biological assessment or "bioassessment" is

one of the means of investigating wetland condition and involves the evaluation of a wetland's ability to support and maintain a balanced, adaptive community of organisms having a species composition, diversity and functional organisation comparable with that of minimally disturbed wetlands within a region. Potential indicator groups for bioassessment purposes include macrophytes, algae and diatoms, aquatic invertebrates, birds and fish.

This volume describes the use of macro-invertebrates for the assessment of the condition of a wetland.

E Day, JA Day, V Ross-Gillespie and A Ketley

TT 435/10

ISBN: 9781770059276

Overseas price: \$30.00

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VOLUME 2: WRC REPORT TT434/09 THE ASSESSMENT OF TEMPORARY WETLANDS DURING DRY CONDITIONS

This volume, part of the series on Wetland Health and Importance, describes methods which enable the user to assess the condition of temporary wetlands when they are dry. In extreme cases, a seasonal wetland may not be obvious, and methods are provided to aid in the recognition of wetlands in such cases. The soils underlying most wetlands exhibit characteristic colouration and this is described. Certain invertebrates, in particular Branchiopod crustaceans, characteristically inhabit this type of wetland and methods for the determination of the presence of these are described. In addition, certain plants are characteristic of this type of situation, and these are also described. However, no single indicator provides adequate information about wetland presence, type, hydroperiod, biodiversity, function and principle ecological and hydrological drivers. In extreme cases the most cryptic of wetlands may show none of the indicators.

TT 434/09

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Overseas price: \$30.00

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VOL 1: HANDBOOK TO THE WETLAND HEALTH & IMPORTANCE RESEARCH PROGRAMME

E Day and HL Malan

VOLUME 1: WRC REPORT TT 433/09

TOOLS AND METRICS FOR ASSESSMENT OF WETLAND ENVIRONMENTAL CONDITION AND SOCIO-ECONOMIC IMPORTANCE: HANDBOOK TO THE WHI RESEARCH PROGRAMME

Volume 1 of this series, one of the outputs of the Wetland Health and Importance (WHI) research programme, distils the major findings of the different components of the project and their implications for future work in the management or assessment of wetland environmental condition and socio-economic importance in South Africa. This series of 11 volumes addresses the assessment of wetland environmental condition using aquatic invertebrates and macrophytes as well as the assessment of temporary wetlands during dry conditions. There is a metric for the broad-scale assessment of impacts and ecosystem services and methods and case studies on the assessment of socio-economic and sustainability studies. (Volume 4 publication expected late 2010.)

TT 433/09

ISBN: 9781770059252

Overseas price: \$30.00

Exclude postage

Towards The Realization of Free Basic Sanitation: Evaluation, Review and Recommendation

Nozibele Mjoli, Gillian Sykes and Tracy Jooste

Access to a basic sanitation service as a right is enshrined in the Constitution of South Africa (Act 108 of 1996). In terms of Section 24(a), 'everyone has a right to an environment that is not harmful to their health or well-being.' This clause has been interpreted as a right to basic sanitation for all. Municipalities have a constitutional mandate of ensuring access to water and sanitation services for all including the poorest households. Despite the drafting of a Free Basic Sanitation (FBSan) strategy by the Department of Water Affairs & Forestry (DWAF) in mid-2004, the process of approval for this strategy has been slow due to the realization by government that provision of free basic sanitation service was more complex than free basic water. Municipalities are faced with a challenge of balancing financial resource allocation to the eradication of basic sanitation infrastructure backlog by 2010 and provision of free basic sanitation services to the poor. Therefore, there is a need to identify successful and cost effective approaches of implementing subsidies for basic sanitation infrastructure and provision of free basic sanitation services. Financial models and innovative strategies are required to assist the municipalities to provide sustainable free basic sanitation services to poor households and to finance ongoing O&M for these services. Good practice must be identified and scaled-up where possible. The aim of this study was to assess the experience of municipalities in the implementation of FBSan services and to develop economic and financial models for sustainable FBSan service. Based on the findings of the study recommendations were made for improving the delivery of FBSan services to poor.

TT 420/09
ISBN: 9781770059009
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The basement Aquifers of Southern Africa

Titus RA, Beekman HE, Adams, S and Strachan L

The report consists of several reviewed papers. The papers were sourced from various researchers that have worked on basement aquifers in southern Africa. The resulting synthesis document will be used by the hydrogeological community as a basic reference to basement aquifers. The paper titles and authors are:

- Basement aquifers of southern Africa: Overview and Research Needs - Shafick Adams
- A tectonic and geomorphic framework for the development of basement aquifers in Namaqualand: a review - Rian Titus, Andreas Friese, Shafick Adams
- Groundwater exploration and development - Karim Sami
- Groundwater exploration and development of basement aquifers in Botswana - Flenner Linn
- Groundwater chemistry of basement aquifers: A case study of Malawi - James Chimphamba, Cosmo Ngon-gondo, Prince Mleta
- A methodological approach to recharge estimation of semi-arid basement aquifers – the central Namaqualand case - Shafick Adams, Rian Titus, Yongxin Xu
- Basement aquifer Groundwater recharge, storage and flow - Jürgen Kirchner
- Factors that control sustainable yields in the Archean basement rock aquifers of the Limpopo province - Martin Holland, Kai Witthüser
- Hydrogeochemistry of fluoride and salinization mechanism of groundwater in the Singida region, central Tanzania - Hudson H. Nkotagu
- Hydrogeochemical processes that influence the groundwater chemistry of basement aquifer systems, Namaqualand - Rian Titus, Shafick Adams, Kai Witthüser, and Yongxin Xu
- Towards sustainable utilization of basement aquifers in southern Africa - Eberhard Braune, Shoni Mutheiwana
- Current practices and future needs for managing basement aquifers in Zimbabwe - Sam Sunguro, Hans Beekman
- Challenges of basement aquifers in southern Africa - Christopher J. Lovell
- Groundwater management in southern Africa - Mutsa Masiyandima
- Aspects of groundwater management that is pertinent to basement aquifers in the southern African development community (SADC) - Kevin Pietersen

TT 428/09
ISBN: 978 1 77005 8989
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Enabling effective learning in catchment management agencies: A philosophy and strategy

D Roux, K Murray E van Wyk

It is the responsibility of catchment management agencies (CMAs) to manage water resources in their respective water management areas. The nature of the functions they have to perform and the complicating and complex internal and external realities within which they operate create very demanding circumstances. It is therefore imperative that CMAs are effective learning organisations. This means they should be adept at acquiring knowledge, creating knowledge, transferring knowledge and, importantly, adapting when necessary.

This document provides some historical background to the knowledge movement and describes different types of knowledge. It also provides an encyclopedia of terms that define various commonly-used terms and concepts in this field.

TT 421/09
ISBN: 978 1 77005 8958
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A Planning Framework to Position Rural Water Treatment in South Africa for the Future

Chris Swartz

A number of recent WRC Projects (738, 1531, 1599) showed that serious problems exist with the treatment of drinking water for non-metropolitan areas. These problems are acute in rural areas, and include lack of capacity, poor operation and maintenance, lack of management involvement, commitment and resources, as well as a general lack of knowledge and understanding of the importance of effective drinking water treatment.

TT 419/09
ISBN: 978 1 77005 8897
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Review of Regulatory Aspects of Water Services Sector

Daniel Malzbender, Anton Earle, Hameda Deedat*, Brian Hollingworth*, Palesa Mokorosi

The purpose of regulation is to ensure that the service providers or operators of water services deliver in accordance with the law and the policy of the government. This research examined the international literature and case studies where the concept of a “regulator” is more understood as referring to an entity that is separated from the line departments of government. Whether the institutional form is government as regulator or an independent entity as regulator conceptually makes no difference to its objectives or its basic task. The international focus on independent regulators relates largely to effectiveness. The limited survey conducted as part of this research suggests that within South Africa, stakeholders, outside of national government, appear to favour an independent regulator because, it is said, that DWAF will be unable to fulfill simultaneously the three roles it defines for itself as regulator, supporter and enabler. The unfavorable side of an independent regulator is the cost and the requirement for skills that are in short supply. The research found that the legislation, regulations and policy that a regulator would have to apply are already well defined. Further, it was found that there are a number of core skills such as finance, economics and engineering that are required irrespective of the range of aspects that will be regulated. Depending on the functions and mandate, regulation will require between 48 and 80 direct staff and cost between R40 and R67million per annum. A similar estimate for an independent regulator suggests staff of between 65 and 112 and annual costs of between R63 and R99million per annum.

TT 417/09
ISBN: 978 1 77005 8866
Overseas price: \$20.00
Excl postage

Effective Groundwater Management in Namaqualand: Sustaining Supplies

Kevin Pietersen, Rian Titus and Jude Cobbing

The purpose of this guide is translate the scientific and technical knowledge gained through research on the hydrogeology of basement aquifers into a user-friendly format for the Department of Water Affairs and Forestry (DWAF), local authorities and the end-users. The guide is not intended for operators of water supply schemes, but rather for water resource planners. The guide has two overarching sections that deal with the issues of groundwater exploration and exploitation in a systematic manner.

It is subdivided as follows:

1. What is groundwater?
2. The importance of groundwater in Namaqualand
3. Namaqualand aquifer systems
4. Locating groundwater resources in Namaqualand
5. Selecting drilling targets
6. Borehole design
7. The drilling process and the importance of data collection
8. Determining the sustainable yields
9. Understanding the water balance
10. Managing the water resource
11. Water quality considerations

TT 418/09
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Manual for Index of Habitat Integrity (Section 2, Model Photo Guide) Module G Volume 2

Mark Graham; Marina Delana Louw

The manual consists of the following modules:
Module A: Ecoclassification and Ecostatus models
Module B: Geomorphological driver assessment index (GAI)
Module C: Physio-Chemical Driver Assessment index (PAI)
Module D: Fish response assessment index (FRAI) Volume 1 & 2
Module E: Macro-Invertebrate response Assessment Index (MIRAI) (Volume 1)
Module F: Riparian vegetation response assessment Index (VEGRAI)
Module G: Index of Habitat integrity.

TT 378/09
ISBN: 978 1 77005 8019
Overseas price: \$20.00
Excl postage

BASIC SANITATION SERVICES IN SOUTH AFRICA Learning from the past, planning for the future

David Still, Nick Walker and Derek Hazelton

The purpose of this study has been to investigate whether the improvements made are working, and whether they are financially sustainable. In its coverage the study is biased towards rural sanitation, as the overwhelming majority of South Africans without proper sanitation live in rural areas. The study finds that with few exceptions the practice since 1994 has been to provide funds for the initial capital costs of sanitation projects and not for operation

and maintenance. The reason for this is that funding for new infrastructure is typically provided to municipalities by central government as grant funding, while the funding for operation and maintenance is required to come from the municipal coffers. Strictly speaking the funding for operation and maintenance is covered by the Equitable Share grant, in terms of which most poor municipalities receive an operations subsidy of between R20 and R60 per month for sanitation for every poor family in their area. However the equitable share is an unconditional grant and in practice this is not seen by local government as funding that has to be spent on operation and maintenance of services. Research indicates that the funding is typically used to finance the municipal overhead costs, as well as to finance other infrastructure projects not covered by the MIG grant. This practice, of building sanitation infrastructure while not allowing for adequate maintenance in the future, whether it is basic VIP sanitation or full waterborne sanitation, is shortsighted and will result in South Africa facing a sanitation crisis in the medium term.

TT 414/09
ISBN: 978 1 77005 8804
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Development of a toolkit for strategic asset management

Peter Dunn, Ronnie McKenzie, Caryn Seago

A key element for ensuring greater understanding of strategic asset Management and its needs is a toolbox of advocacy and awareness materials targeting customers, officials and policy makers. This element has been identified as a priority action which received little attention in many international initiatives, and that which has as a result led to poor uptake. It is therefore key that the linkages of SAM are made to the daily operations of water services, maintenance, planning and strategic decision making.

TT 413/09
ISBN: 978 1 77005 8750
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PRODUCTIVE USE OF DOMESTIC PIPED WATER FOR SUSTAINING LIVELIHOODS IN POOR HOUSEHOLDS

NICKY NAIDOO, CIARAN CHIDLEY, GENE MAIN & MICHELE VRDOLJAK

The major question raised by the research is whether water for productive use should be subsidised. This research report has demonstrated that water is being used for

productive use and the various uses to which this water is being put. The research report also highlights that poor households using water for productive use 122% more than poor households that do not. The levels of water debts are high and that 40% of the households surveyed indicate that they pay for water, when possible, demonstrates both that water affordability can be low amongst the poor and that the provision of more water to households for beneficial use may experience financial sustainability challenges. This research indicated that the majority of water users surveyed have stated that they would use water if it were available. It is suggested that wanting to use water in such a manner and actually using the water are not the same thing. This research also indicates that households with higher levels of service use more water for productive use than those with lower service level standards.

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Excl postage

Nitrate in groundwater

Gideon Tredoux, JFP Engelbrecht & Sumaya Israel

Groundwater constitutes the main water resource in the rural areas and on farms. Surveys show that nitrate in groundwater is common in arid and semi-arid regions of southern Africa often exceeding drinking water specifications. High nitrate levels is the most frequent reason for groundwater sources to be declared unfit for drinking, i.e. exceeding 10 mg/L as N (Marais, 1999). Hence, a large percentage of newly drilled boreholes are rejected for human consumption due to excessive nitrate but communities in many rural areas still consume water with nitrate N exceeding the World Health Organization limit of 10 mg/L. Such non-potable groundwater gives rise to a health threat. Based on the latest information, groundwater in South Africa has high nitrate values, often exceeding 50 mg/L (as N), mostly in a band 100 to 250 km wide, stretching from east to west along the northern boundary of the country, across the four northernmost provinces. Anthropogenic inputs constitute the major source of high groundwater nitrate but research has shown that in certain cases nitrate also originates from the natural soil organic nitrogen pool. The indications, also from our neighboring countries, are that the present situation is unsustainable and anthropogenic nitrogen inputs need to be managed and reduced. Managing anthropogenic nitrogen inputs presents a great challenge for the sustainable use of groundwater.

Report No: TT410/09
ISBN: 978 1 77005 8736
Overseas price: \$15.00 Excl postage

Water Resources of SA: 2005 Study: Executive Summary

Middleton B.J. Bailey A.K.

The knowledge and processes involved in accounting for water resource availability continues to benefit from new insights, knowledge and data. The Water research Commission has been very instrumental in providing support and a platform for water practitioners to take part in regular research to develop water resource assessment techniques, collate the data and assess the nation's available water resources at varying intervals since the late 1970s. The last water resource assessment research project was carried out in 1990. This old study addressed surface water availability assessments and used time series data which ended in 1989. To date the outputs of this 1990 project are at the centre of national and regional water resource planning. This research project, which is commonly referred to as WR2005 is the best attempt to capture the latest available water assessment techniques, improved hydrological simulations, integrate water resource data which included data on groundwater, surface water, wetlands, water quality, soils, land use, improved catchment delineation, population, return flows, and several other variables that have a bearing on the quantification and assessment of the available water resources.

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Enabling effective learning in catchment management agencies: A philosophy and strategy

D Roux, K Murray E van Wyk

It is the responsibility of catchment management agencies (CMAs) to manage water resources in their respective water management areas. The nature of the functions they have to perform and the complicating and complex internal and external realities within which they operate create very demanding circumstances. It is therefore imperative that CMAs are effective learning organisations. This means they should adept at acquiring knowledge, creating knowledge, transferring knowledge and, importantly, adapting when necessary.

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TT 421/09
ISBN: 978 1 77005 8958
Overseas price: \$20.00
Excl postage

Civil Society Dialogue in Water Resources Management: Lesson from four local-level experiences of river systems

Ernita van Wyk, Tamsyn Sherwill, Charles M. Breen and A.B. Nkhata

Increasingly civil society is expected to participate in and even lead processes that direct behaviors' in relation to the sustainable use of natural resources. Within this context, civil society groups and organizations are encouraged to enter into dialogue with others to expose issues constructively and to promote shared understanding and learning. The ability of such groups to use dialogue to reflect and learn and to apply the learning to subsequent actions becomes an important way of coping with change and uncertainty. Civil society groups have a particular opportunity in that, even though they may be structured informally, formal and even statutory, they are able to operate as communities of practice and to conduct their business with a degree of flexibility and innovation.

The rules that guide natural resource allocation and use follow a common property regime. This means that the resource and its users are co-dependent in complex ways so that the rules for resource protection and use have to be continually reinforced or renegotiated over time. Within such a regime, civil society groups who act to influence the resource or society in relation to the resource, do so within the context of shared rules defined by the values that society attaches to the resource and the services that emanate from the resource. Thus in order for civil society groups to sustain their operations in ways that are seen as legitimate, such groups, their rules and actions, must be sanctioned by society.

TT 383/09
ISBN: 978 1 77005 8224
Overseas price: \$25.00
Excl postage

Guidelines for the Utilisation and disposal of wastewater sludge, Volume 4, Requirements for the beneficial use of sludge at high loading rates

Jacoba Elizabeth Herselman, Lucian Willem Burger and Priya Moodley

Seeking innovative solutions for the handling of wastewater sludge requires a paradigm shift in our perception and understanding of wastewater sludge as a resource and

not a waste product. Such a shift creates an opportunity for local authorities to generate a range of economic and social spin-offs to the benefit of their local communities. The Water Research Commission (WRC), and the Department of Water Affairs and Forestry (DWAF) developed this guideline series to support sustainable wastewater sludge management in South Africa. The aim of the project was to develop a series of guidelines to encourage the beneficial use of wastewater sludge but also provide solutions in cases where beneficial use is not feasible. Rather than develop a single guideline to address the range of sludge management options (beneficial and non-beneficial uses), 5 separate Guideline Volumes were developed. Volume 1 and 2 were published in 2006 as part of project K5/1453 while Volume 3, 4 and 5 were completed through a follow-up project K5/1622.

TT 350/09
ISBN: 9781770057104
Overseas price: \$25.00

WET-Origins

William Ellery, Michael Grenfell, Suzanne Grenfell, Donovan Kotze, Terence McCarthy, Stephen Tooth, Piet-Louis Grundling, Heinz Meckedahl, David le Maitre, Lisa Ramsay

Three main branches of research into wetlands were identified during a workshop held in early 2002, wetland rehabilitation, wetland health and integrity and wise use of wetlands.

The wetland rehabilitation was prioritised for two reasons. Firstly, it is estimated that South Africa has lost approximately 50% of its wetlands, and wetlands are increasingly being recognised as providing valuable services. And secondly, there has been substantial government expenditure on wetland rehabilitation through the Working for Wetlands project, which is linked to the Expanded Public Works Programme. This project was co-funded by Working for Wetlands to 50% of the budget.

The main objectives were: The project leader must help to make these objectives meaningful.

- Prioritisation of wetland areas for conservation and rehabilitation
- System rehabilitation
- Methodologies for rehabilitation (what about them???)
Improve or develop???
- Synergy with other programmes (establish??)
- Institutional arrangements (establish or strengthen??)
- Performance auditing

WET-Management Review

Donovan Kotze, Charles Breen, Innocent Nxele, John Kareko

1. TT 321/09 WET-RoadMap: A Guide to the Wetland Management Series
2. TT334/09 WET-Origins: Controls on the Distribution and Dynamics of Wetlands in South Africa
3. TT335/09 WET-Management Review: The Impact of Natural Resource Management Programmes on Wetlands in South Africa
4. TT336/09 WET-RehabPlan: Guidelines for planning Wetland Rehabilitation in South Africa
5. TT337/09 WET-Prioritise: Guidelines for prioritizing Wetlands at National, Regional and Local Scales
6. TT338/09 WET-Legal: Wetland Rehabilitation and the Law in South Africa
7. TT339/09 WET-EcoServices: A Technique for Rapidly Assessing Ecosystem Services Supplied by Wetlands
8. TT340/09 WET-Health: A Technique for Rapidly Assessing WET-Health
9. TT341/09 WET-RehabMethods: National Guidelines and Methods for Wetland Rehabilitation
10. TT342/09 WET-RehabEvaluate: A Manual for the Performance Evaluation of Wetland Rehabilitation Projects

This series of documents provides all the information that is needed for the rehabilitation of wetlands, consultants or for private land. Owners who wish to monitor the state of, and / or rehabilitate, wetlands on their property, or for use by programmes such as Working for Wetlands.

TT 335/09
ISBN: 978177005 6343
Overseas price: \$30 00
Excl postage

WET-RehabPlan

Donovan Kotze, William Ellery, Mark Rountree, Michael Grenfell, Gary Marneweck, Innocent Nxele, Charles Breen, John Dini, Allan Bachelor, Erwing Sieben

This project was co-funded by Working for Wetlands to 50% of the budget.

1. TT 321/07 WET-RoadMap: A Guide to the Wetland Management Series
2. TT334/09 WET-Origins: Controls on the Distribution and Dynamics of Wetlands in
3. TT335/09 WET-Management Review: The Impact of Natural Resource Management Programmes on Wetlands in South Africa
4. TT336/09 WET-RehabPlan: Guidelines for planning Wetland Rehabilitation in South Africa
5. TT337/09 WET-Prioritise: Guidelines for prioritizing Wetlands at National, Regional and Local Scales

6. TT338/09 WET-Legal: Wetland Rehabilitation and the Law in South Africa
7. TT339/09 WET-EcoServices: A Technique for Rapidly Assessing Ecosystem Services Supplied by wetlands
8. TT340/09 WET-Health: A Technique for Rapidly Assessing WET-Health
9. TT341/09 WET-RehabMethods: National Guidelines and Methods for Wetland Rehabilitation
10. TT342/09 WET-RehabEvaluate: A Manual for the Performance Evaluation of Wetland Rehabilitation projects

TT 336/09
 ISBN: 978 1 77005 6350
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 Excl postage

River ecoclassification manual for ecostatus determination (version 2): Module G: Index of habitat integrity section 1: TECHNICAL MANUAL

Kleynhans CJ, MD Louw & M Graham

The habitat integrity of a river refers to the maintenance of a balance of a balanced composition of Physico-chemical and habitat characteristics on a temporal and special scale that there are comparable

Protocol for the Assessment of the Status of Sustainable Utilization and Management of Groundwater Resources with special reference to Southern Africa

E Braune, B Hollingworth, Y Xu, M Nel, G Mahed & H Solomon

The development role for groundwater in Africa and Southern Africa is still poorly understood, resulting in under utilisation and poor management of the important resource. The international experience is that turning around this situation will require strategic action across sector and international boundaries. The study confirmed that SADC has made excellent progress to address groundwater in its comprehensive regional water resources policies and strategies. Groundwater is explicitly referred to in the SADC Protocol on Shared Watercourses. It is also featuring in the SADC Regional Strategic Action Plan for Integrated Water Resource Management and the Regional Water Policy and it has its own Groundwater Management Programme for the roll-out of this plan. When it comes to implementation in individual countries, the performance in groundwater resources management in SADC must still be generally rated as "below expectation", compared to relevant international best practice. The importance of groundwater in this region, the cooperative regional IWRM structures and

institutions that already exist and the understanding there is already for groundwater at the highest decision-making levels, offers a major opportunity to initiate a systematic, region-wide, and ultimately continent-wide, programme and approach, as foreseen by AMCOW, for building the capacity required to ensure that groundwater resources are utilized and managed sustainably in the SADC region. It is felt that the South African capacity for IWRM and, in particular for groundwater resources management, can make a much greater contribution than at present to developments in southern Africa and that the Water Research Commission should strategically position itself for such a role.

Report No: TT318/08
 ISBN: 978 1 77005 712 8
 Overseas price : \$20 00
 excl postage

An introduction to dense NON-AQUEOUS phase liquids (DNAPLs) in South Africa: A community guide

Usher BH; Pretorius JA; Gebrekristos RA

This document is aimed specifically at the lay person, to make them aware of DNAPLs and its occurrences, sources and behavior. This document forms part of a series of documents, produced by Water Research Commission project K5/1501 "Field investigations to study the fate and transport of dense non-aqueous phase liquids (DNAPLs) in groundwater". The documents in this series include:

- Executive Summary of the Project (only available on CD accompanying all reports listed below)
- Manual for Site Assessment at DNAPL Contaminated Sites in South Africa (WRC Report 1501/2/08)
- Groundwater monitoring guidelines for DNAPLs in South African Aquifers (WRC Report 1501/3/08)
- Guidelines for the acceptance of Monitored Natural Attenuation processes in South Africa (WRC Report 1501/4/08)
- Handbook for DNAPL Contaminated Sites in South Africa (TT 326/08)
- An Introduction to DNAPLs in South Africa: A Community Guide (WRC Report TT 326/08)
- Field and laboratory investigations to study the fate and transport of DNAPLs in groundwater (1501/5/08)

Report No: TT 325/08
 ISBN: 978 1 77005 658 9
 Overseas price: \$25 00
 Excl postage

Handbook for DNAPL contaminated sites in South Africa

Usher BH; Pretorius JA; Gebrekristos RA

Report No: TT 326/08
ISBN: 978 1 77005 659 6
Overseas price: \$30 00
Excl postage

A guide to catchment-scale eutrophication assessments for rivers, reservoirs and lacustrine wetlands

J N Rossouw, W R Harding, O S Fatoki

A study commissioned in 2000 by the WRC found that South Africa's policy and approach to eutrophication control has been inadequate over the previous 20 years. A strong need was identified to remobilise and redevelop our capacity to manage eutrophication. A workshop followed in 2001 to discuss research and capacity building within the field of eutrophication where assessment of the eutrophication problem was identified as the highest priority research area. This project produced a Guide to assess eutrophication related water quality using the same protocol as the DWAF Guide to catchment scale water quality assessment studies. The Guide is structured around six management questions that are designed to establish the eutrophication status and management options at catchment scale. The best eutrophication assessment practice was, furthermore, captured in a Web-based nutrient enrichment assessment protocol (NEAP). Course material making use of these two products was developed to fast track capacity building concerning eutrophication assessment. The primary target audience of the short course material is water resource practitioners, water resource managers and freshwater scientists

Report No: TT 352/08
ISBN: 978 1 77005 715 9
Overseas price: \$30 00
Excl postage

Technical instruments to support water quality use allocation

JN Rossouw, W Kamish and AHM Gorgens

The National Water Act prescribes the minimum components of a catchment management strategy. Prime amongst these are the formulation of water allocation principles and a Water Allocation Plan for each Water Management Area. This project focused on a very particular part of the allocation challenge, namely the allocation of "Water Quality Use". It aimed to develop a conceptual

framework for water quality use allocation procedures, and to develop and disseminate Technical Guidelines for water quality use allocation procedures. The project employed a process of "learning-by-doing" by applying the framework in a stressed catchment with water quality concerns. The ACRU Salinity model was applied to the Berg River catchment because it also offered a ready-made water quality information system (WQIS) previously developed under WRC Project No 951.

Report No: TT 363/08
ISBN: 978 1 77005 653 4
Overseas price: \$20 00
Excl postage

Towards a socio-ecological systems view of the Sand River catchment, South Africa: An exploratory resilience analysis

S R Pollard, H C Biggs, D Robert

South Africa is in the process of implementing IWRM, which by definition is a process based on managing the behavior of people and their response to a finite resource. In addition, wetland systems are under increasing pressure to support subsistence livelihoods, and their sustainability is being compromised. New thinking and understanding on the functioning of complex socio-ecological systems (SES) and how these contribute to the resilience of these systems could give managers a tool for improved management of these systems. This consultancy investigated how this new thinking may be employed in this situation.

Report No: TT 364/08
ISBN: 978 1 77005 747 0
Overseas price: \$20 00
Excl postage

Fire management in the Cape Peninsula: lessons for catchment management agencies from the Ukuvuka Campaign

Fowkes SM

The Ukuvuka initiative was a short term collaborative campaign designed to inject finance, skills, innovation and passion to address a core issue of common concern to the partners - changing fire-related behaviour. Ukuvuka ran from 2000 to 2004 and was supported by the three spheres of government, business (a short-term insurance company, a bank, an oil company and a daily newspaper) and NGOs. The trigger for the initiative was the immediate crisis of fires in the mountains of Cape Town's Cape Peninsula. The purpose of this report is to make a contribution to the policy implementation challenge by sharing some practical insights and experiences from that crisis initiative.

The report focuses particularly on applying the lessons to the water sector, specifically the formation of Catchment Management Agencies (CMAs.)

Report No: TT324/07
 ISBN: 978 1 77005 656 5
 Overseas price: \$10 00
 Excl postage

High-yielding groundwater areas around the Nelson Mandela Bay Municipality

Murray R; Goedhart M; Baron J

Prime groundwater development areas were identified and grouped into five hydrogeological domains. Within each of the domains specific groundwater exploration target areas were identified and prioritised. No ground-truthing was done to verify the target areas. It is likely that some of the areas may be unsuitable for groundwater development for a variety of reasons, and it is equally likely that there are a number of other areas that could be developed for large-scale groundwater supply.

The total groundwater potential for each domain was estimated using the GRA II data sets and by assuming the number of high-yielding boreholes that could be obtained in each domain. This latter approach is based largely on estimates of the number of prime drilling targets that can be located. It was not based on a remote sensing analysis and the identification and weighting of individual drilling targets. Thus in some areas there may be fewer prime drilling targets, and in other areas, more. The purpose of this exercise was to provide a first-order estimate of the groundwater potential, and thus it will not be correct, but it should serve as a good starting point. A summary of the groundwater potential of all five domains is presented:

- Groundwater Exploitation Potential (normal years) = 48 Mm³/a
- Groundwater Exploitation Potential (dry years) = 32 Mm³/a
- Borehole yield without artificial recharge and continuous abstraction = 28 Mm³/a
- Borehole yield with artificial recharge and 6-month/ a abstraction = 41 Mm³/a
- Existing use = 9 Mm³/a

Report No: TT 327/08
 ISBN: 978 1 77005 671 8
 Overseas price: \$20 00
 Excl postage

National Microbial Monitoring Programme for Groundwater: Implementation Manual

Murray K, du Preez M; Meyer R; van Wyk E; Parsons R; Flanagan L; Taylor M

The general purpose of this manual is to describe how the national microbial monitoring programme (NMMP) for groundwater should be implemented on a national scale. This national monitoring programme for groundwater supplements the National Microbial Monitoring Programme for surface waters. However, it should not be regarded as an extension of it. Monitoring groundwater is fundamentally different from monitoring surface water and accordingly has a completely different design.

This manual gives guidelines, procedures and methods for microbial monitoring of groundwater as well as how and when such data can be reported.

Accordingly, this manual is aimed at a variety of people and organisations. It is initially aimed primarily at DWAF officials who will have the primary responsibility to implement national water-related monitoring programmes. However, it is also aimed at Catchment Management Agencies (CMAs) and water management institutions to which monitoring responsibilities may be delegated.

Report No: TT 312/07
 ISBN: 978 1 77005 594 0
 Overseas price: \$20 00
 Excl postage

Integrated water resource management plan guidelines for local authorities: (IWRMP)

Burke J

The principle of integrated water resource management is endorsed by the National Water Act, Act 36 of 1998 and the National Water Resource Strategy (2004). Simply put, integrated water resource management in Local Authorities is about striking the right balance between a Local Authority's developmental role and the need to maintain environmental integrity in fulfilling the Constitutional obligations of sustainable development, socioeconomic development and a safe and healthy environment. Striking this balance is a challenge and requires cooperation between all tiers of government as well as between government and the private sector, but there are no hard and fast rules as the environment is a dynamic system, continually adapting itself to a new balance, following the effects of both human and natural influences on it. Implementation of the Local Authority Integrated Water Resource Management Plan will be a positive step forward in ensuring that Local Authorities achieve sustainable integrated water resource

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management in line with the catchment vision set by the Catchment Management Agency.

Report No: TT 304/07
ISBN: 978 1 77005 548 3
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A task oriented approach to participation:
PLEASE DOWNLOAD FROM
<http://www.wrc.org.za/>

Burt JC; du Toit DR; Neves DT

The NWA puts emphasis on the decentralization of water resource management to the catchment level. This necessitates an adoption of participatory management approaches that can support a multi-stakeholder dialogue of diverse interest groups such as water user associations (WUAs), community based organisations, NGOs, water resource managers, policy-makers and planners.

Therefore, there is a need for appropriate tools that can be used to support meaningful participation of the public at different levels of decision-making. This project answers the following questions:

- What is the appropriate CMA level of organisation that will be effective in ensuring that voices of marginalized groups are also taken into consideration in the governance of CMAs?
- How can civil society be best organized to play a meaningful role in the management of water resources at a catchment and sub catchment level?

Report No: TT 289/06
ISBN: 1 77005 502 9
Overseas price: \$15 00
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Water as a human right, made easy!
Workbook 1: PLEASE DOWNLOAD FROM
<http://www.wrc.org.za/>

Dericj du Toit, Teresa Sguazzin

Report No: TT 269/07
ISBN: 978 1 77005 435 6
Overseas price: \$15 00
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Human Rights project WORKBOOK 2: PLEASE
DOWNLOAD FROM <http://www.wrc.org.za/>

Dericj du Toit, Teresa Sguazzin

A key concept evident in the South African Constitution

is that National Government is committed to providing adequate food and water '... to meet basic human needs'. Arguably the most crucial resource, in terms of human need, is water. This commitment in providing water for basic human needs is captured by the National Water Act (1998) in the concept of the 'Basic Human Needs Reserve' (BHNR). The notion of the BHNR essentially elevates the status of water for basic human needs to that of a human right. Although an orientation that accepts access to water as a human right is enshrined in South African law, it represents a very new concept in water management in South Africa (and the world). One of the major obstacles hampering implementation is a lack of familiarity and understanding of the notion of the BHNR by the very people tasked with the responsibility for ensuring that it is honoured, i.e. local government. An informal, preliminary survey conducted by AWARD indicates that most members of local government have not heard about the BHNR.

Report No: TT 296/07
ISBN: 978 1 77005 513 1
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Guide for local government cooperation with
catchment management agencies

Mazibuko G; Pegram GC

The recent demarcation process and the on-going specification of the powers and functions between the district, local and metro councils have further clarified the roles and functions of local government. Local government is constitutionally responsible for the implementation and control of a range of activities that affect water resources. This research will amongst others provide recommendations on the requirements for co-operative governance and the most appropriate approaches and mechanisms to foster co-operative governance between CMAs and local government, to achieve a range of objectives under differing circumstances.

Report No: TT 270/06
ISBN: 1 77005 460 X
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Artificial Groundwater Recharge:
Wise water management for towns and cities

Rickey Murray

Report No: TT 219/03
ISBN: 1 77005 092 2
Overseas price: \$15 00
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Surface water: Groundwater interaction in a South African context: A Geohydrological Perspective

Parsons Roger

In response to a greater awareness of the role of groundwater in sustaining the environment and recognition of a unitary and interdependent hydrological system, surface-groundwater interaction has emerged as an issue requiring greater attention. This publication aims to establish the correct and consistent use of hydrological terms which is key for developing a better understanding of surface water-groundwater interaction

Report No: TT 218/03
 ISBN: 1 77005 084
 Overseas price: \$25 00
 Excl postage

An explanation of a set of national groundwater, plus 2 Hydrogeological maps (SA Price: R114.00)

Vegter JR

Advances in hydrogeology over the past years, and the increasing demand on groundwater resources, have given rise to the need to portray hydrogeological information in such a manner that planners and various groundwater users can make decisions by means of a quick and accurate overview of the most up-to-date information. Hydrogeological maps are seen as a powerful tool to meet this objective.

Report No: TT 74/95
 ISBN: 1 86845 183 6
 Overseas price: \$70 00
 Excl postage

Explanation of the 1:500 000 hydrogeological map 2326 Pietersburg (SA Price: R50.00)

Water Systems Management & DWAF

This is a high quality hydrogeological map of the Pietersburg map sheet at a scale of 1:500 000 and a set of explanatory notes which provide guidelines as to the need for detailed groundwater investigations and what hydrogeological conditions are expected to occur.

Report No: TT 75/95
 ISBN: 1 86845 188 7
 Overseas price: \$35 00
 Excl postage

Dealing with reservoir sedimentation (SA Price: R171.00)

Basson GR & Rooseboom A

Dam siltation has always been and still is a serious problem in South Africa. This report presents different techniques for controlling and managing dam siltation in South Africa.

Report No: TT 91/97
 ISBN: 1 86845 255 7D
 Overseas price: \$70 00
 Excl postage

Sluicing flumes: A new structure for discharge measurement in sediment laden rivers

Rossouw J, Loubser C, Rooseboom A & Bester A

This report confirms the flumes' good characteristics with respect to handling heavy sediment loads.

Report No: TT 103/98
 ISBN: 1 86845 368 5
 Overseas price: \$35 00
 Excl postage

Dealing with reservoir sedimentation Dredging (SA Price R200.00)

G R Basson A & Rooseboom

In this report the reservoir sedimentation theory and dam dredging techniques from around the world are evaluated. A criterion for selecting dredging techniques which emphasise on cost cutting measures is presented.

Report No: TT 110/99
 ISBN: 1 86845 493 2
 Overseas price: \$60 00
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A Global Overview of Inter Basin Water Transfer Schemes, Socio Economic and Socio Political Implications, and Recommendations for their Management

Snaddon CD, Davies BR & Wishart MJ

This report combines two source documents. The first is the report on the research done during the project and the second is a worldwide synthesis of information on inter basin transfer (IBTs) with contributions from scientists in the USA and Australia.

Report No: TT 120/00
ISBN: 1 8645 583 1
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Groundwater Development in South Africa and an introduction to the Hydrogeology of Groundwater Regions

Vegter J R

This report presents a historical overview from the introduction of the first drill in 1880 a manually powered diamond rig up to the present. The following topics are covered:

- Groundwater exploration and exploitation
- Investigation and research; and
- The evaluation of groundwater legislation

Report No: TT134/00
ISBN: 1 86845 642 0
Overseas price: \$25 00
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Hydrogeology of Groundwater: Region 1 Makoppa Dome

JR Vegter

Report No: TT135/00
ISBN: 1 86845 643 9
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Hydrogeology of Groundwater: Region 3 – Limpopo Granulite-Gneiss belt

JR Vegter

Report No: TT136/00
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Hydrological information and techniques to support the determination of the water quality component of the ecological reserve for rivers

Hughes DA; Munster F

Report No: TT 137/00
ISBN: 1 86845 646 3
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Hydrogeology of Groundwater: Region 7 – Polokwane/Pietersburg Plateau

JR Vegter

Report No: TT 209/03
ISBN: 1 86845 027 2
Overseas price: \$20 00
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Hydrogeology of Groundwater: Region 19 – Lowveld

JR Vegter

Report No: TT 208/03
ISBN: 1 86845 026 4
Overseas price: \$20 00
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Hydrogeology of the main Karoo basin: Current knowledge and future research needs

AC Woodford and L Chevallier

This document is aimed primarily at the groundwater practitioners working in Karoo fractured-rock aquifers, especially those involved on rural water supply projects and WRC-funded research projects. The level of information presented is also useful to other professionals with only limited groundwater knowledge

Report No: TT 179/02
ISBN: 1 86845 851 2
Overseas price: \$40-00
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Evaluation of the role of water user associations in water management in South

Pegram G; Mazibuko G

The new institutional reforms in water resource management prescribed in the National Water Act of 1998, delegate many water resource management functions (particularly resource protection and allocation) to organisations within Water Management Areas (WMA), namely Catchment Management Agencies (CMAs) and Water User Associations (WUAs). WUAs are statutory bodies intended to operate at a restricted localised level aimed at facilitating co-operative associations of individual water users, who wish to undertake water-related activities for their mutual benefit. This study is aimed at clarifying the roles of WUAs, evaluating the functioning of a number of established WUAs against this framework and the particular needs of the local conditions, and formulating guidelines

for the institutional and management arrangements.

Report No: TT 204/03
ISBN: 1 8645 982 9
Overseas price: \$25 00
Excl postage

Guidelines for integrating the protection, conservation and management of wetlands into catchment management planning

Dickens C; Kotze D; Mashigo S; MacKay H; Graham M

The South African legal environment provides for the sustainable use of the country's water resources. Yet, all is not well with the wetland resources of this country. Already suffering from years of abuse and over-utilisation, wetlands remain under threat as part of the water resource. These guidelines provide management agencies with much needed information for the management of wetlands. The impact of these guidelines is expected to be significant, especially for professional staff and interested members of society working at ground level

Report No: TT 220/03
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Overseas price: \$30 00
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An assessment of the water policy process in South Africa (1994 to 2003)

de Coning C; Sherwill T

The political changes which have taken place in South Africa during the last decade have had profound impacts on the development of new water policy, and have opened the way for significant shifts in policy and legislation generally, in relation to sustainable management of natural resources. The implementation context will strongly influence the future development and strategic direction of water policy in South Africa, but there is still limited understanding of the inter-relationships between policy development and implementation, with the added shaping forces of politics, economics and social factors.

This project aims to provide, through critical review and analysis, an understanding of where we have come from and where we are going to in terms of water policy, in order to support ongoing development and implementation throughout this and future policy cycles.

Report No: TT 232/04
ISBN: 1 77005 180 5
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Sediment control at river abstraction works in South Africa: Vol 1

Brink CJ; Basson GR; Denys F

This report presents a review of the international and South African state of the technologies available for controlling sediments at river abstraction works. Optimum abstraction locations, flushing channel designs and suitable pumping designs. Guidance for planning and design of river abstraction works is one of the main highlights of this report.

Report No: TT 259/06
ISBN: 1 77005 410 3
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Excl postage

Considerations for the design of river abstraction works in South Africa: Vol 11

Basson GR

Report No: TT 260/06
ISBN: 1 77005 411 1
Overseas price: \$40 00
Excl postage

Guide for local government cooperation with catchment management agencies

Mazibuko G; Pegram GC

The recent demarcation process and the on-going specification of the powers and functions between the district, local and metro councils have further clarified the roles and functions of local government. Local government is constitutionally responsible for the implementation and control of a range of activities that affect water resources. This report provides recommendations on the requirements for co-operative governance and the most appropriate approaches and mechanisms to foster co-operative governance between CMAs and local government, to achieve a range of objectives under differing circumstances. The guide is a user friendly document for all levels of local government.

Report No: TT 270/06
ISBN: 1 77005 460 8
Overseas price: \$15 00
Excl postage

Guide for catchment management agency cooperation with local government

This is a working guide for Catchment Management Agencies to cooperate with local governments in their areas of operation to achieve common objectives in the management of water resources and hence the development of their respective areas.

Report No: TT 271/06
ISBN: 1 77005 439 1
Overseas price: \$15 00
Excl postage

A synthesis of the hydrogeology of the Table Mountain Group - Formation of a research strategy

Pietersen K; Parsons R

A project was initiated during 2000 to synthesize the current knowledge about the Table Mountain Group (TMG) aquifer systems. This resulted in a document on the "Synthesis of the Hydrogeology of TMG – Formation of a Research Strategy." The document is subdivided into technical papers and appropriate case studies. This exercise resulted in the understanding that to realize the potential, of this groundwater supply, many uncertainties and barriers need to be overcome, including: deficient understanding of the occurrence, attributes and dynamics of TMG aquifer systems; lack of understanding of environmental impacts of exploitation; and uncertainties about how best to manage the resource within a multi-objective environment. Research of a multi-disciplinary nature is thus needed to find appropriate answers to questions concerning the water resource potential and optimal management of TMG aquifers, in the interest of furthering integrated water resource management in the region.

Report No: TT 158/01
ISBN: 1 86845 804 0
Overseas price : \$40-00
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Learning about participation in IWRM: A SA review: Book 1 and 2

(also available in Venda, Sotho and Zulu)

Burt J; du Toit D; Pollard S

Report No: TT 293/06
ISBN: 1 77005 506 1
Overseas price: \$20-00
Excl postage

Research on Berg river water management: Summary of water quality information system and soil quality studies: (Integrated Catchment Management: ICM)

Gorgens AHM; de Clercq WP

This report describes the development of an integrated information system specifically for water quality (WQIS) for the Berg River that is both integrated and interactive. The WQIS has been developed in close cooperation with its intended technical users to provide water resource operational and planning decision support. The WQIS has a user-friendly GIS-based Graphical User Interface and incorporates interfaces with DUFLOW and CE-QUAL-W2. It was applied to the proposed Skuifraam Dam in the Upper-Berg to illustrate its utilisation to support decision-making for various in-dam water quality management scenarios.

Also reported are field-scale process studies and large-scale soils data interpretation, with a strong focus on salinisation processes. The main products are a soils map and a salinity hazard map that were compiled for the Berg River catchment.

Report No: TT 252/07
ISBN: 1 77005 367 0
Overseas price: \$30-00
Excl postage

Developing and trailing guidelines for participatory water resources management

Rowntree K; Motteux N;

South Africa's National Water Act of 1998 makes the management of any water resource a partnership between local water users, regional catchment managers, and DWAF. The Act encourages communities to become actively involved in developing and managing their water resources. The three sets of guidelines - Participatory Guidelines, Environmental Guidelines, Planning and Economic Guidelines – are aimed at IWRM practitioners who work with stakeholder communities. The guidelines help practitioners make participatory water resource management a reality.

Report No: TT 258/07
ISBN: 1 77005 064 7
Overseas price: \$20-00
Excl postage

A study of Roman water law, with specific reference to water allocations and prior appropriation

Burger A

In view of the common law of South Africa being Roman-Dutch and Roman law, the question was asked: Can the Roman law provide some guidance for water law and water allocations in South Africa in as much as the Roman law represents principles developed and successfully applied for almost a thousand years. The principles of Roman law were developed over a very long period in the vast Roman Empire, which covered a number of different countries with widely different climates. The final version of the Roman law is contained in the Corpus Juris Civilis compiled under the direction of the Emperor Justinian around 534 AD. The law of all European, and many other countries grew out of Roman law. It is, with Roman-Dutch, the common law of South Africa. That part of the Roman law constituting the principles of the water law is set out in this article. Before a law has withstood the test of years of practice, one cannot say whether it is a successful law or not. The Roman interdicts offer practical, tested guidance for resolving conflicts arising in water-stressed situations typical of arid and semi-arid areas. This makes the body of Roman water law worthy of attention and further study for application in South Africa, particularly as we approach full-scale implementation of the National Water Act.

Report No: TT 279/06
ISBN: 1 77005 469 3
Overseas price: \$20-00
Excl postage

Hydrogeology of groundwater region 26 Bushmanland

Vegter JR

This report forms part of a series on the hydrogeology of the various groundwater regions in South Africa. Region 26 (Bushmanland) is the fifth region that will be published; there are 64 Groundwater Regions. The Regions previously published are: 1 (Makoppa dome), 3 (Limpopo Granulite-Gneiss belt), 7 (Polokwane/Pietersburg Plateau) and 19 (Lowveld). The hydrogeology of the Bushmanland Region is described using available data and gives a good overview of the groundwater conditions in this region.

The main findings indicate that with decreasing rainfall and an increase in thickness of the superficial deposits there is a corresponding though not uniform deterioration in groundwater conditions from east to west. The report lists the conditions at which potential water strikes can be encountered. The data revealed that weathering enhances

secondary porosity only where the water levels are less than about 30 metres deep. Water is generally struck in fractured fresh rock below the weathered zone and not in the transition between weathered and fresh rock as is the case in the higher rainfall areas. Seventy-four percent of groundwater samples, out of 968 samples, tested were unsuitable for domestic use. The constituents of concern in the groundwater are, in order of frequency of occurrence: fluoride, nitrate, chloride, sodium and sulphate. In most instances if a borehole produces significant water then the poor quality of the water becomes a limiting factor for development.

Report No: TT 285/06
ISBN: 1 77005 495 2
Overseas price: \$40-00
Excl postage

Groundwater Research needs in the Eastern Karoo Basin of South Africa

Murray EC; Cobbing JE

The main aim of the report is to outline the current groundwater research needs in the densely populated, impoverished eastern regions of the Eastern Cape Province. Groundwater is the main source for community water supply in the rural areas. Little groundwater research has been done to date in the eastern regions of the Eastern Cape Province – an area that comprises the Eastern Karoo Basin (the geological term for this region). The focus area of this document is Water Management Area 12, incorporating most of the former Transkei and Ciskei 'homelands'. This document describes how new research will coincide with national and provincial development priorities. It takes into account past research, proposes broad research areas, and finally, it lists what are considered to be the most important geohydrological research projects completed to date. It was developed after widespread consultation that included officials from the Department of Water Affairs and Forestry (DWAF) in the Eastern Cape Province, and a number of locally-based groundwater and engineering consultants.

Report No: TT 286/06
ISBN: 1 77005 497 0
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Integrated water resource management plan guidelines for local authorities (IWRMP)

Burke J

From a groundwater perspective, Groundwater Resource Directed Measures (GRDM) is more important than the

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Reserve on its own. While the Reserve only addresses the role groundwater plays in meeting basic human needs and sustaining aquatic ecosystems such as rivers and wetlands, GRDM allows the use and protection of the entire groundwater resource to be addressed holistically. Four levels of GRDM assessments are recognised – desktop, rapid, intermediate and comprehensive – each providing an increased level of confidence.

The objectives of this project were:

- To review and implement methods developed to set RDM for groundwater through an appropriate case study;
- To refine and adapt methods as a result of lessons learnt during the pilot study; and
- Align methods with other components of RDM (e.g. estuaries, rivers and wetlands).

The E10 catchment containing the Olifants River was selected as the pilot study area. A Groundwater Resource Directed Measures assessment was undertaken. Additional data and information was collected, through a hydro census, for the study area where data was lacking. The research resulted in the development of the GRDM manual that can be used as a guide by both experienced and inexperienced geohydrologists to undertake and review GRDM assessments. Accompanying software was developed to assist with the assessments

Report No: TT 299/07
ISBN: 978 1 77005 510 0
Overseas price: \$30-00
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Groundwater Sampling: a comprehensive guide for sampling methods: Second edition

Weaver JMC; Cave L; Talma AS

This revised edition incorporates a number of additional sections, such as sampling for isotopes, down-hole logging, etc. Some chapters have been substantially revised to include advances in field instrumentation, such as pH meter technology and increased attention to organic compounds. A short chapter on the sampling of wetlands, springs and groundwater seeps has also been included. Other chapters have undergone only minor changes, since what was relevant in 1992 is today still relevant. Groundwater quality data collected according to these described techniques can then reliably be used to evaluate hydro geochemical conditions.

Report No: TT 303/07
ISBN: 978 1 77005 545 2
Overseas price: \$20-00 Excl postage

KSA 2:

River Ecoclassification Manual For Ecstatus Determination (Version 2) Module A: Ecoclassification And Ecstatus Determination

C J Kleynhans, M D Louw

Report No: TT 329/08
ISBN: 978 1 77005 677 0
Overseas price: \$20-00
Excl postage

River Ecoclassification Manual For Ecstatus Determination (Version 2) MODULE D: Volume 1: Fish Response Assessment Index (FRAI)

C J Kleynhans

Report No: TT 330/08
ISBN: 978-1-77005-678-7
Overseas price: \$30-00
Excl postage

River Ecoclassification Manual For Ecstatus Determination (Version 2) Module D vol 2: Reference frequency of occurrence of fish species in SA

C J Kleynhans, M D Louw, J Moolman

Report No: TT 331/08
ISBN: 978-1-77005-681 7
Overseas price: \$25-00
Excl postage

River Ecoclassification Manual For Ecstatus Determination (Version 2) MODULE E: Volume 1: Macroinvertebrate Response Assessment Index (MIRAI)

Thirion C

Report No: TT 332/08
ISBN: 978-1-77005-679-4
Overseas price: \$25-00
Excl postage

River Ecoclassification Manual For Ecstatus Determination (Version 2) MODULE F: Riparian Vegetation Response Assessment Index (VEGRAI)

Kleynhans CJ; MacKenzie JA; Louw MD

Report No: TT 333/08
 ISBN: 978-1-77005-680 0
 Overseas price: \$30-00
 Excl postage

Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual)

Kleynhans CJ

Report No: TT 377/09
 ISBN: 978-1-77005-800-2
 Overseas price: \$25-00
 Excl postage

Module G: EcoClassification and EcoStatus Determination in River EcoClassification: Manual for Index of Habitat Integrity (Section 2, Model Photo Guide)

M Graham; M D Louw

Report No: TT 378/09
 ISBN: 978-1-77005-801-9
 Overseas price: \$20-00
 Excl postage

Environmental flow assessments for rivers: Manual for the building block methodology - Updated version

J M King, R E Tharme and MS De Villiers

Environmental (or instream) flows are flows that are left in, or released into, a river system with the specific purpose of managing some aspect of its condition. As the condition of river systems deteriorates globally, environmental flows are increasingly appearing in legislation. The science of advising on environmental flows is relatively young (about 50 years), but more than 100 methodologies in existence. South Africa formally addressed the topic in the 1980s, and during the 1990s made considerable progress at a national level. Recognising that international approaches to environmental flow assessments did not meet South Africa's needs entirely, development of a local approach was initiated. Through a decade of extraordinary cooperation and willingness to contribute, the national body of aquatic scientists, water managers and engineers developed the BBM to the point where it is now one of only a few advanced environmental flow methodologies in the world with a formal manual. In addition, the BBM (Building Block Methodology) has advanced the field of environmental flow assessment in an entirely new direction, being a holistic methodology that addresses the health (structure and functioning) of all components of the riverine

ecosystem. The BBM is essentially a prescriptive approach, designed to construct a flow regime for maintaining a river in a predetermined condition. This manual describes its basic nature and main activities, and provides guidelines for its application.

Report No: TT 354/08
 ISBN: 978-1-77005-721-0
 Overseas price: \$40-00
 Excl postage

Assessing the Impact of Research Funded by the Water Research Commission in Support of the River Health Programme

D J Roux, L Hill and W Strydom

The River Health Programme is a multi-institutional national programme which has 3 custodians, the DWAF, the DEAT and the WRC. The WRC, with its mandate for research, was very closely involved during the developmental stages, and published the first few State of the Rivers reports (SoR). Once the programme was running the WRC withdrew support from the publication of the SoR, but has remained involved at the levels of national coordination and research as required.

The report covers the history and development of the River Health Programme (RHP) from the concept of using biological systems for monitoring environmental quality, which was new when the programme was first conceived, through the early growth phase to its becoming established as a national programme.

Report No: TT 360/08
 ISBN: 978-1-77005-742 5
 Overseas price: \$20-00
 Excl postage

Local institutions for water governance: the development of a water users association and catchment forum in the Kat River Valley, Eastern Cape

J Burt, A McMaster, K Rowntree & R Berold

This report describes the development of water resource management organisations (institutions) in the Kat River Valley from 1997 to 2006. The two organisations described here - the Kat River Valley Water User Association and the Kat River Catchment Forum - are given separate narratives for the sake of clarity, although they developed in close association. The developments described here were taking place at a time of great change in South Africa's political and institutional structures, both locally and nationally. The Kat River Valley was one of the first catchments in the

country to set up water management structures. At the time there was no clear direction from the Department of Water Affairs and Forestry about requirements for the water users association process, nor was there a clear policy in relation to catchment forums. Researchers, practitioners and the members of the various institutions had to learn as they went along.

This report offers a reflection on what worked and what did not. The authors hope that the story will be useful to others who are grappling with how to implement the National Water Act in a way that honours the Act's principles of equity, sustainability and efficiency.

Report No: TT 295/07
ISBN: 978 1 7005 586 5
Overseas price: \$20-00
Excl postage

Estuaries and Integrated Development Planning: A Managers' Guide

Hay D

Estuaries are valuable economic, social and ecological resources supplying a range of goods and services to society. As public resources their management requires active co-operative management. While local government has a key leadership role to play in their management, their Integrated Development Plans (in the Eastern Cape) indicate that in most instances they are not taken into account. A social and political process of engaging local government on estuary management is proposed. The approach focuses on the economic value of estuaries and how local government can optimise the benefits that accrue from estuaries for itself and for its residents. As part of this engagement an estuary management training course has been developed for municipalities and tested in three areas.

Report No: TT 294/07
ISBN: 978 1 77005 541 4
Overseas price: \$15-00
Excl postage

An introduction to Aquifer dependent Ecosystem in South Africa

Colvin C; Le Maitre D; Saayman; Hughes S

Aquifer Dependent Ecosystems (ADE) occurs throughout the South African landscape, but their identification is often difficult although this is relevant for water management and allocation. ADEs have been categorised by 8 principal aquifer types (based on lithology) and 7 habitat types. At a coarse national scale it is possible to identify

areas with a high probability of supporting terrestrial and aquatic ADEs and to assess their vulnerability to disturbance. High areas of risk are linked to shallow discharge zones where over abstraction is taking place and mining and irrigated agriculture dominate land-use. South Africa is moving towards IWRM and ADEs need to be considered in this context. The successful protection of ADEs requires cooperative governance of land, water and the environment.

Report No TT 301/07
ISBN:978-1-77005-532-2
Overseas price: \$ 25-00
Excl postage

Learning and teaching about water in our classrooms: A series of lesson plans for grades 8-12

Peddie C; Hibbert D; Conway-Physick C

In support of learning and teaching about water-related issues, the Water Research Commission of South Africa and Share-Net (a project of the Wildlife and Environment Society of South Africa) have developed a series of lesson plans on water. These lesson plan packs, from Grade 8 to 10, are linked to the South African National Curriculum.

All the lesson plan packs (Grade R-8) are available on www.envirolearn.org.za

Other useful websites are the Water Research Commission: www.wrc.org.za and the Wildlife and Environment Society of SA www.wessa.org.za

Report No: TT 346/08
ISBN: 978 1 77005 693 0
Overseas price: \$30 00
Excl postage

2. Learning and teaching about water in our classrooms: A series of lesson plans for grades R-7

Clare P; Hibbert D; Conway-Physick C

Report No: TT 345/08
ISBN: 978 1 77005 650 3
Overseas price: \$30 00
Excl postage

WET-Roadmap: A guide to the wetland management series

Dada R; Kotze D; Ellery W; Uys M

This programme, co-funded by Working for Wetlands, aims to establish national wetland rehabilitation procedures by establishing a framework within which wetlands requiring rehabilitation may be prioritised and continually assessed. It will develop a diagnostic framework for assessing the underlying causes of degradation and develop national guidelines for rehabilitation including a review of the methods available. It will also develop synergy with other research being done on wetlands, examine the institutional arrangements around wetland management, and develop a long-term monitoring system that will allow strategic adaptive management of wetlands.

Report No: TT 321/07
ISBN: 978 1 77005 632 9
Overseas price: \$10 00
Excl postage

Guidelines for the planning, design and operation of fishways in South Africa

Ralph Heath, Anton Bok, Pieter Kotze, Paul Fouche, Hylton Lewis, Jan Rossouw, Mathew Ross

The need to manage water has led to the construction of barriers in rivers, effectively fragmenting the habitat and curtailing the passage of migratory biota.

This project will develop protocols for assessing the extent of blockage to free passage, and so prioritizing river systems for remedial measures, for the assessment of sites for use in the EIA and the RDM process. Understanding of the biological/hydraulic requirements of the relevant biota will be developed and this, together with data from existing fishways, will be used to develop cost-effective designs for local biota.

Report No: TT 287/07
ISBN: 978 1 77005 577 3
Overseas price: \$30 00
Excl postage

Hydrology and water quality of the Mgeni catchment

Kienzle SW; Lorentz SA; Schulze RE

The ACRU hydrological model was configured for the Umgeni catchment upstream of Inanda Dam to simulate daily streamflow for 137 sub catchments for a 34-year period from 1 January 1960 to 31 January 1993.

Simulated streamflows were verified against observed data for a limited number of sub-catchments. All verifications gave a coefficient of determination above 78%. In all cases simulated streamflow was within 6% of the observed values. It was found that the simulated impact of present land uses compared with pristine conditions can be highly significant.

Report No: TT 87/97
ISBN: 1 86845 297 2
Overseas price: \$30 00
Excl postage

The biological and chemical database. User manual (SA Price: R28.50)

Dallas H & Janssens P

A Biological/Chemical Database was developed as part of this project, incorporating virtually all the ecological studies done on South African rivers which include both taxonomic and chemical data. Using SASS4 (South African Scoring System, version 4), several of the water quality variables in the DWAF guidelines for environmental water quality were tested for each of the four regions (mountain, foothills, transitional and low land rivers).

Report No: TT 100/98
ISBN: 1 86845 421 5
Overseas price: \$50 00
Excl postage

Guides to the freshwater Invertebrates of Southern Africa

The principle aim of the series of ten books is to synthesize much of the existing knowledge on the identification of freshwater invertebrates into a standard format that is accessible to users who wish to identify taxa beyond their field of expertise.

This series will include an introductory volume containing general information and a key to the families of invertebrates.

• **Volume 1:** In preparation

• **Volume 2: Guides to the freshwater Invertebrates of Southern Africa: Crustacea I (SA price: R50.00)**

Day JA, Stewart BA, De Moor IJ & Louw AE

Report No: TT 121/00
ISBN: 1 86845 581 5
Overseas price: \$25 00

CATALOGUE OF AVAILABLE TT REPORTS

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• **Volume 3: Guides to the freshwater Invertebrates of Southern Africa: Crustacea II (SA price: R50 00)**

Day JA, Stewart BA, De Moor IJ & Louw AE

Report No: TT 148/01
ISBN: 1 86845 703 6
Overseas price: \$25 00
Postage inclusive

• **Volume 4: Guides to the freshwater Invertebrates of Southern Africa: Crustacea III (SA price: R50 00)**

Day JA, Stewart BA, De Moor IJ & Louw AE

Report No: TT 141/01
ISBN: 1 86845 676 5
Overseas price: \$25 00
Postage inclusive

• **Volume 5: Guides to the freshwater invertebrates of Southern Africa: Non Arthropods (SA Price: R114-00)**

Day JA & IJ deMoor

Report No: TT 167/02
ISBN: 1 86845 827 X
Overseas price: \$50 00
Postage inclusive

• **Volume 6: Guides to the freshwater invertebrates of Southern Africa: Arachnida & Mollusca: Araneae, Water Mites & Mollusca (SA Price: R50-00)**

Day JA & IJ deMoor

Report No: TT 182/02
ISBN: 1 86845 875 X
Overseas price: \$50 00
Postage inclusive

• **Volume 7: Guides to the freshwater invertebrates of Southern Africa: Insecta; Ephemeroptera, Odonata & Plecoptera (SA Price: R114-00)**

IJ de Moor, JA Day & FC de Moor

Report No: TT 207/03
ISBN: 1 86845 875 X
Overseas price: \$50-00 Postage inclusive

• **Volume 8: Guides to the freshwater invertebrates of Southern Africa: (SA Price: R100-00)**

de Moor IJ; Day JA; de Moor FC

Report No: TT 214/03
ISBN: 1 77005 055 8
Overseas price: \$50-00
Postage inclusive

• **Volume 9: Guides to the freshwater invertebrates of Southern Africa: Diptera (SA Price: R100-00)**

JA de Moor, AD Harrison & IJ de Moor

Report No: TT 201/02
ISBN: 1 86845 900 4
Overseas price: \$50-00
Postage inclusive

• **Volume 10: Guides to the freshwater invertebrates of Southern Africa" (SA Price: R100-00)**

Stals R; De Moor IJ

Report No: TT 320/07
ISBN: 978 1 77005 629 9
Overseas price: \$50-00
Postage inclusive

The Kruger National Park Rivers research programme

C Breen, M Dent, J Jaganyi, B Madikizela, J Maganbehari, A Ndlovu, J O'Keeffe, K Rogers, M Uys & F Venter

The Kruger National Rivers research programme is a co-operative undertaking by resource-use managers, funding agencies and researchers. It addresses the water quality and water quantity requirements of the natural environments of rivers, particularly those flowing through the Kruger National Park.

Report No: TT 130/00
ISBN: 1 86845 622 6
Overseas price: \$35-00
Excl postage

State of the Rivers Report

DWAF, WRC, CSIR, Mpumalanga Parks Board & Dept of Environmental Affairs

Between 1996 and 1999, the River Health Programme

(RHP) conducted surveys on the three major river systems of Mpumalanga, the Crocodile, Sabie Sand and Olifants Rivers, including some of their tributaries. The RHP collected and assessed a substantial body of data on the ecological health of these rivers during the surveys.

The following reports are available:

- 1) State of the Rivers Report: Letaba and Luvuvhu River Systems 2001 (TT 165/01)
- 2) State of the Rivers Report (TT 147/00)
- 3) State of the rivers report: Umngeni River and neighbouring rivers and streams. (TT 200 /02)

Report No: TT 147/00
 ISBN: 1 86845 689 7
 Overseas price: \$20 00
 Excl postage

Ecological risk assessment guidelines (South African price: R50 00)

Claassen M, Strydom W F, Murray K & Jooste

Ecological risk assessment is a structured approach that describes, explains and organizes scientific facts, laws and relationships and provides a sound basis to determine sufficient protection measures and to develop utilization strategies. The risk assessment process has the potential to improve communication between scientists, managers and the public, thereby promoting mutual understanding and collaboration. Appropriate use of this guideline document will thus promote cooperative governance and sustainable development

Report No: TT 151/01
 ISBN: 1 86845 721 4
 Overseas price: \$25 00
 Excl postage

The Botanical importance rating of the Estuaries in former Ciskei/Transkei

Colloty BM, Adams JB & Bate GC

Botanical importance refers to the contribution of the plants to the conservation status of an estuary. In this study botanical importance is the sum of functional importance, species richness, community richness and community type rarity.

Report No: TT 160/01
 ISBN: 1 86845 790 7
 Overseas price: \$20 00
 Excl postage

Guidelines for Legionella levels in water: A code of practice

Pauline Coubrough

The guidelines are intended for use in South Africa, taking in account South African environmental conditions. International guideline documentation, results from outbreaks that have occurred throughout the world, and the National Legionella Action Group's research findings were used in the formulation of the guidelines.

Report No: TT 174/02
 ISBN: 1 86845 846 6
 Overseas price: \$15 00
 Excl postage

Predicting water quality and biotic response in ecological reserve determinations

Malan H; Day JA

The management of water quality in the environmental Reserve is more complex than that of water quantity. The principal aim of this project is to examine the relationship between water quality and water quantity with particular reference to instream flow requirement assessments, and to produce a framework for the assessment of water quality in IFR studies. Secondary aims are to investigate how the Biobase database may be used in the assessment of water quality guidelines.

Report No: TT 202/02
 ISBN: 1 86845 923 3
 Overseas price: \$30-00
 Excl postage

Prioritisation of South African estuaries based on their potential importance to estuarine- associated fish species

Maree RC; Whitfield AK; Quinn NW

This report presents a ranking of South African estuarine systems based on their importance to estuarine-associated fish species, and aims to facilitate the identification of South African estuaries with a high conservation priority, by placing all South African systems in a regional and national context.

Report No: TT 203/03
 ISBN: 1 86845 979 9
 Overseas price: \$10-00
 Excl postage

• Freshwater fish and human health: Overview guide

Heath R; du Preez H; Genthe B; Avenant-Oldewage A

This programme focuses on the development of a series of guidelines and protocols to promote and advocate the safe use of water with the aim to build awareness and to transfer technology to the public to minimise water-related health risks. This programme is intended to meet the needs of practitioners and will consider aspects of water use and health, hygiene, hazards and risks as well as epidemiological studies, communication protocols and education guidelines. These projects are concerned with translating scientific data into accessible formats.

Report No: TT 212/04
ISBN: 1 77005 046 9
Overseas price: \$20-00
Excl postage

• Freshwater fish and human health: Reference guide

Heath R; du Preez H; Genthe B; Avenant-Oldewage A

Report No: TT 213/04
ISBN: 1 77005 047 7
Overseas price: \$25-00
Excl postage

Environmental water quality in water resources management

Palmer T; Berold R; Muller N

The release of harmful and potentially harmful substances into the environment has caused water quality problems worldwide. Toxicology offers a cost-effective way of measuring the likely impact of an effluent on the environment, in that it will identify whether the effluent is toxic, including any synergistic and antagonistic effects. This will allow for both the determination of the suitability of the effluent for discharge to be determined for licensing purposes, and for specific industries to monitor their compliance with license conditions. Most toxicity tests measure acute effects and the chronic values are calculated empirically. The measurement of sub-lethal methods will, thus, provide accurate values on which to base decisions, so enhancing the capacity of managers to protect the water resource. During this project new methods will be developed for quantifying the chronic effects of toxic effluents at sub-lethal concentrations.

Report No: TT 217/04
ISBN: 1 77005 083 3

Overseas price: \$10-00
Excl postage

The effect of water quality variables on aquatic ecosystems review

Dallas HF; Day JA

Water is a scarce resource in South Africa, and increasing population pressure has meant that the resource is heavily exploited and carries an increasing pollution load. Aquatic ecosystems are able to remediate a certain amount of pollution, but once this level has been exceeded then the ecosystem, together with its ability to remediate pollution declines. Chapters 2 and 3 of the review provide a general introduction to the issue of water quality in relation to aquatic ecosystems. Chapters 4 to 12 synthesise what is known about the effects on aquatic ecosystems of specific physical attributes and chemical constituents. Specifically, these include temperature, turbidity, pH, total dissolved solids and dissolved oxygen. Organic enrichment, including bacterial contamination, as well as the effects of enrichment by specific nutrients are covered, as are biocides and trace metals. The last eight chapters examine the effect of different types of whole effluents or other specific disruptions resulting from human activities, including agriculture, aquaculture, engineering and construction with specific reference to river regulation, forestry, industrial effluents, mining and urban runoff.

Report No: TT 224/04
ISBN: 1 77005 131 7
Overseas price: \$30-00
Excl postage

Towards the conservation and sustainable use of Eastern Cape estuaries

Breen C; et al

The ACRU hydrological model was configured for the Umgeni catchment upstream of Inanda Dam to simulate daily streamflow for 137 sub catchments for a 34-year period from 1 January 1960 to 31 January 1993. Simulated streamflows were verified against observed data for a limited number of sub-catchments. All verifications gave a coefficient of determination above 78%. In all cases simulated streamflow was within 6% of the observed values. It was found that the simulated impact of present land uses compared with pristine conditions can be highly significant.

Report No: TT 237/04
ISBN: 1 77005 235 6
Overseas price: \$20-00
Excl postage

Spatsim, an integrated framework for ecological reserve determination and implementation

Hughes DA; Palmer CG

Water quality is currently trailing water quantity in the ecological Reserve methodology. Further development of the methods used is necessary to enable the water quality component to be considered adequately. The aims of this project are to develop acceptable time-series data for selected water quality variables, encapsulate the expert water quality knowledge in an organised way and encode these for inclusion into the DSS currently being developed as part of a parallel project, and co-ordinate this with other water quality projects working on the Reserve. This will ensure that decisions taken on water quality in the Reserve determination process are done in a standard way and in parallel with those on water quantity.

Report No: TT 245/04
 ISBN: 1 77005 296 8
 Overseas price: \$25-00
 Excl postage

Managing sedimentary processes in SA Estuaries: A guide

Hay D; Huizinga P; Mitchell S

Ingress of marine sediments into estuaries was the single most important issue in estuary management identified in the western part of the Eastern Cape during the early stages of the EC Management Programme. The local authority for the Port Alfred / Boesmans River area has committed funds to develop the predictions of the effect of interventions on the problem. If the predictions indicate that an intervention may be successful, then the EIA around the planned intervention will be undertaken within this project. Thereafter, the implementation of any technology will be for the expense of the local authority.

Report No: TT 241/05
 ISBN: 1 77005 272 0
 Overseas price: \$20-00
 Excl postage

The SA diatom collection:

1. An appraisal and overview of needs and opportunities

Harding WR; Archibald CGM; Taylor JC; Mundree S

The South African Diatom Collection (which extends beyond South Africa's borders) was established over the period 1950 to 1995 by a number of collectors and is

amongst the larger collections worldwide. A number of case studies were carried out which showed the relevance of the OMNIDIA software package (use of diatom-based water quality indices) for South African conditions. The general conclusion is that the data and information contained in this collection will add value to, and have a place in, the current suite of assessment tools currently being used for the management of the surface water resource in South and Southern Africa.

Report No: TT 242/04
 ISBN: 1 77005 275 5
 Overseas price: \$25-00
 Excl postage

2. Benthic diatoms in the rivers and estuaries of South Africa

Bate GC; Smailes PA; Adams JB

This follow-on project (from the project entitled Identification of diatoms and their use in the assessment of water quality) will address 3 aspects of the use of diatoms in monitoring for water quality. The determination of the relationship between dominant diatom assemblages and freshwater quality will continue. The same will be done for estuarine diatoms, where the relationship between water quality and dominant assemblages will be defined. Thirdly, a manual of South African diatoms will be produced. The product of this project will enable the use of diatoms, long recognised as being sensitive indicators, in water quality management at the technician level, not achieved elsewhere before.

Report No: TT 234/04
 ISBN: 1 77005 182
 Overseas price: \$35-00
 Excl postage

3. A methods manual for the collection, preparation and analysis of diatom samples

Taylor JC; Harding WR; Archibald CGM

Report No: TT 281/07
 ISBN: 1 77005 483 9
 Overseas price: \$20-00
 Excl postage

4. An illustrated guide to some common diatom species from South Africa

Taylor JC; Harding WR; Archibald CGM

Report No: TT 282/07
 ISBN: 1 77005 484 7

Overseas price: \$30-00
Excl postage

The state of Yellowfish report in South Africa: (SA price R50-00)

Wolhuter LE; Impson ND

Report No: TT 302/07
ISBN: 978 1 77005 543 8
Overseas price: \$30-00
Excl postage

Cross-sector policy objectives for conserving South Africa's inland water biodiversity

Roux D; Nel JL; MacKay HM; Ashton PJ

Report No: TT 276/06
ISBN: 1 77005 459 6
Overseas price: \$25-00
Excl postage

Conservation planning for river and estuarine biodiversity in the Fish to Tsitsikamma water management area

**Lindsay NJ, Smith-Adao L, Roux DJ, Adams J, Cambay
JA, de Moor FC, Kleynhans CJ, Kotze I, Maree G,
Moolman J, Schonegevel LY, Smith RJ, Thirion**

This study piloted the development of a planning framework for systematic conservation of inland water biodiversity in South Africa. The tool for river prioritization and selection was tested, refined and demonstrated in the Fish to Tsitsikamma Water Management Area, and provides a process for implementing biodiversity conservation in practice.

Report No: TT 280/06
ISBN: 1 77005 473 1
Overseas price: \$30-00
Excl postage

Estuaries and Integrated Development Planning: A Managers' Guide

Hay D

Estuaries are valuable economic, social and ecological resources supplying a range of goods and services to society. As public resources their management requires active co-operative management. While local government has a key leadership role to play in their management, their Integrated Development Plans (in the Eastern Cape) indicate that in most instances they are not taken into account.

A social and political process of engaging local government on estuary management is proposed. The approach focuses on the economic value of estuaries and how local government can optimise the benefits that accrue from estuaries for itself and for its residents. As part of this engagement an estuary management training course has been developed for municipalities and tested in three areas.

Report No: TT 294/07
ISBN: 978 1 77005 541 4
Overseas price: \$15-00
Excl postage

KSA 3:

Integrated algal ponding systems and the treatment of domestic and industrial waste- waters: part 4: Report 7

Rose PD; Hart OO; Dekker LG; Clark SJ

Inadequate sanitation is a leading cause of water pollution and consequently illness in many underdeveloped countries, including South Africa, for example the Eastern Cape Province, where cholera has reportedly become endemic. As modern wastewater treatment processes are often energy-intensive and expensive, they are not suitable for use in these areas. There is thus a need to develop more sustainable wastewater treatment technologies for application in smaller communities. The integrated algal ponding system (IAPS) was identified as a possible solution to this wastewater management problem and was investigated for adaptation to local conditions at the Rhodes University Environmental Experimental Field Station in Grahamstown.

The system was monitored over a period of nine years, with various configuration adjustments of the high rate algal pond (HRAP) unit operation investigated. Under standard operating conditions, the system was able to achieve levels of nutrient and organic removal comparable with conventional wastewater treatment works.

The mean nitrate level achieved in the effluent was below the 15mg.l-1 South African discharge standard, but nitrate removal in the IAPS was found to be inconsistent. Although the system was unable to sustain chemical oxygen demand (COD) removal to below the 75mg.l-1 South African discharge standard, an average COD removal rate of 87% was recorded, with the residual COD remaining largely in the form of suspended algal biomass.

Previous studies in the Eastern Cape Province have shown that few small wastewater treatment works produce effluent that meets the microbial count specification. Therefore,

in addition to the collation of IAPS data from the entire nine year monitoring period, this study also investigated the use of the HRAP as an independent unit operation for disinfection of effluent from small sewage plants. It was demonstrated that the independent high rate algal pond (IHRAP) as a free standing unit operation could consistently produce water with *Escherichia coli* counts of 0cfu.100ml⁻¹. The observed effect was related to a number of possible conditions prevailing in the system, including elevated pH, sunlight and dissolved oxygen.

It was also found that the IHRAP greatly enhanced the nutrient removal capabilities of the conventional IAPS, making it possible to reliably and consistently maintain phosphate and ammonium levels in the final effluent to below 5mg.l⁻¹ and 2mg.l⁻¹ respectively (corresponding South African discharge standards are respectively 10mg.l⁻¹ and 3mg.l⁻¹).

The quality of the final effluent produced by the optimisation of the IAPS would allow it to be used for irrigation, thereby providing an alternative water source in water-stressed areas. The system also proved to be exceptionally robust and data collected during periods of both high-intensity and low-intensity management regimes were broadly comparable.

In summary, the results of the nine-year study have demonstrated reliable performance of the IAPS and its use as an appropriate, sustainable wastewater treatment option for small communities. For producing a treated water suitable for irrigation, some significant strengths of IAPS compared to other wastewater treatment technologies are the relatively low capital and operating (e.g. energy) costs, stable performance and low management demands. The system should find ready application in the RSA.

Report No: TT 193/07
 ISBN: 978 1 77005 890 5
 Overseas price: \$35-00
 Excl postage

Part 4: Process Scale-up in the Treatment of Mine Drainage Wastewaters and the Disposal of Sewage Sludge

Neba A; Whittington-Jones KJ; Rose PD

Acidic wastewaters from mining operations (acid mine drainage, AMD) and various industrial and metal-refining processes often contain high levels of sulphates and heavy metals. WRC studies have shown that AMD volume flows may reach hundreds of megalitres per day for decades, with acute and long-term impacts on the public water resource system, the environment, and community health, and consequences thus for the economic and

social development of the water-scarce Gauteng region.

The development of suitable biological treatment processes has to date been constrained by reactor design appropriate to the large volume flows and the availability of cost effective carbon sources. Recent WRC projects have researched algal ponding technologies and applied these low-cost processes to the treatment of mining and tannery wastewaters. This has led to the development of the biological sulphate-reducing (biodesalination) BioSURE® process using sewage solids as the carbon source for sulphate reduction and algal activity for precipitating heavy metals and neutralising of acidic drainage streams. In early 1998 a pilot plant was constructed and commissioned at Grootvlei Mine in a collaborative research venture involving the WRC (Project No. 869), ERWAT and Grootvlei Mine. Detailed study of the basic process mechanisms was undertaken in WRC Project No.972. In project 1078 the outstanding components of the pilot plant were constructed to enable evaluation of the complete integrated process over an appropriate time period. In this one-year project 1291, the specific aim was to provide managerial inputs into operationalization and optimisation of the BioSURE® plant constructed at Ancor Sewage Works by ERWAT and Grootvlei Mine, and thus to assist in process decision-making relating to the full-scale engineering of the process and to provide specialist support to WRC research partners in their implementation of process scale-up for technology transfer.

The above aims were in general achieved and reported on during the course of the project. The operationalisation of the BioSURE® process in this project has contributed significantly to the development of the current situation, where a full-scale plant is being constructed at Ancor Sewage Works to treat AMD from Grootvlei Mine.

The final report on this project 1291, along with the final report on project 1169, is to be published as Report 12 in the series "Salinity, Sanitation and Sustainability" (ISBN series 1-86845-853-9, Volume 4, Part 4 "Treatment and Disposal of Sewage Sludges"). The report will include early results (to December 2004) from the full-scale plant currently being built and commissioned at ERWAT'S Ancor Sewage Works.

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 Excl postage

Management of water-related microbial diseases: Volume 2: What causes the problem? - A what to do for water suppliers following diarrhoea incidents?

M Steynberg; B Genthe; A van Middelkoop

Internationally there is growing concern about the general failure of authorities to understand the public health impact of waterborne and related infectious diseases.

The water supplier is responsible for protecting the health of the public by providing water that is considered to be safe. When cases of diarrhoea occur in the community, the public is also very quick to blame the water. Confidence in the quality of the water can then only be restored if the allegation has been investigated to the satisfaction of the public.

This handbook provides practical guidelines on how to conduct such an investigation. The methods and materials are not original, and can be found in many books and publications that abound in the fields of water management and epidemiology. No attempt is made in this handbook to discuss all the issues surrounding the recommended procedures-the relevant literature will provide far greater insight. What sets this book apart is the fact that it pulls together the relevant methodology from traditionally remote disciplines, the methodology that is required to find out whether cases of diarrhoea could be due to water consumption.

The water quality and water treatment data routinely collected by the water supplier form an important starting point in finding out whether the water could be responsible for cases of diarrhoea. This handbook shows how to record and interpret such routine data appropriately so that they facilitate the investigation.

The target audience for this handbook includes both the water supplier and the district health services, for example the water quality officer and the environmental health practitioner. The successful implementation of the recommended procedures depends on the involvement of both sectors. All water suppliers, however large or small, should take note of the guidelines provided in this handbook.

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Management of water-related microbial diseases: Volume 4: How dangerous is the problem?-Communicating the risk

B Genthe; M Knoetze

Water-related microbial disease such as cholera causes untold misery in communities across South Africa every year. As part of the effort to promote awareness and understanding of the conditions promoting infectious disease transmission, water service providers are increasingly required to have a risk communication programme in place.

Health risk communication is the exchange of information and opinions concerning risk and risk-related factors among risk assessors, risk managers, consumers and other interested parties.

It is not merely the dissemination of information. If well managed, it will ensure that the message is constructively formulated, transmitted and received and will result in meaningful actions.

This guideline document presents the fourth in a five-volume series aimed at addressing the question of how best South Africans can protect themselves from water-related microbial disease. It provides a framework of principles and guidelines for the communication of health risks, specifically for water service providers.

Communicating with the public is an essential element of health risk communication. Ineffective communication often results in conflict, which in turn leads to the erosion of public confidence, and inefficient use of water service providers' resources. The recognition that people are entitled to make decisions about issues that affect their lives can assist water service providers in forming a better understanding of, and formulating more appropriate reactions to, a particular risk. Appropriate risk communication not only promotes consistency and transparency in arriving at and implementing risk management decisions, it also fosters public trust and confidence in the safety of the water supply.

The document will provide guidelines and examples that will assist water service providers in communicating with the public when a water quality issue arises that has a potential impact on health.

It is hoped that this document will assist water service providers, government departments, water boards, municipalities and district councils in communicating with the public when a water quality issue arises that could have a potential impact on health. In this way, the guide will hopefully make a significant contribution to protecting

our most vulnerable communities against water-related microbial disease.

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Guidebook for the selection of small water treatment systems for potable water supply to small communities

C D Swart, I Goldie; G Mwiing, LM Daries; BA Delcarme; JD Seconna, JC Geldenhuys

Small water treatment plants are defined as water treatment systems that have to be installed in areas which are not adequately serviced and do not normally fall within the confines of urban areas. They are therefore mostly used in rural and peri-urban areas and include chlorination plants for water supplies from boreholes and springs, small treatment systems for rural communities, treatment plants of small municipalities and treatment plants for establishments such as rural hospitals, schools, clinics, forestry stations, etc. Most of these applications require small plants of less than 2.5 ML/d (although plants of up to 25 ML/d may sometimes also fall into this category).

The decision-maker selecting one of these small water treatment plants has a great number of local and international system designs to choose from. Especially in the case of novel and emerging systems, very little may be known of these systems in terms of cost, efficiency and the applicability to the intended application. Supplier information may be sketchy, or promising new technologies have not yet been fully evaluated under South African conditions. Socio-economic factors are also very important and should be taken into account in the selection of small water treatment systems in order to ensure sustainability.

Although some evaluation of a selected number of small water treatment plants has taken place under previous WRC projects (WRC Report No 450/1/97: Package water treatment plant selection, and WRC Report No 828/1/01: Field evaluation of alternative disinfection technologies for small water supply), a number of other small water treatment plants, available on the international market, have not yet been assessed in any way for possible (beneficial) application in South Africa. This guidebook is therefore seen as complementing existing guidelines in providing assistance in the selection and operation of specific small water treatment systems being marketed for the treatment of potable water for small communities.

A number of local and international studies have shown that the selection of the correct water treatment system is

but a first step in ensuring a sustainable supply of potable water to small communities. Following of the correct operational and maintenance procedures is of even greater importance for ensuring sustainability of water supply. Although most suppliers of small water treatment systems provide their clients with some operational and maintenance guidelines, these may not be exhaustive, or certain important generic aspects may not be covered. Information on operation and maintenance aspects will be of significant value to the owners and operators of such small water treatment systems.

The guidebook aims to provide guidelines for the identification and optimal selection of available and emerging new water treatment systems, which are currently being marketed for the supply of potable water to small communities in South Africa.

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Enabling water fluoridation on small drinking water treatment plants Part A: Guidelines for the implementation of fluoride dosing in small systems Part B

R Rajagopaul; PThompson; A Hariram

Regulations for the fluoridation of South African potable water supplies to an optimum concentration of (and not more than) 0.7 mg/l in order to limit the development of dental caries were published in the Government Gazette of 8 September, 2000. Water Services Providers (WSP's) had to register with the Department of Health (DOH) by 8 September 2001 for fluoridation of their water supplies to consumers – or apply for exemption. However, because of the larger safety risk foreseen for both plant operators and water users in smaller and rural water treatment plants, such plants supplying water to less than 60 000 people, currently receive, on application, temporary exemption from the Director-General: Health. This unfortunately excludes a large part of the population from receiving the benefits of fluoridation. By far the majority of water treatment plants fall within the category of supplying less than 60 000 people with potable water. In addition, most of the operators on these smaller plants are not at a skills level required by the regulations for the safe operation of a fluoride dosing facility. A need therefore existed to enable these smaller plants to administer fluoride safely through the correct choice and operation of instrumentation and equipment, as well as by innovative ways in which to make a plant fail-safe in terms of both technology and human shortcomings. The project aimed to enable fluoridation to be done safely on small water treatment plants by means

of the evaluation, selection and implementation of safe handling and dosing equipment and monitoring instrumentation.

Potentially suitable handling and dosing equipment and monitoring instrumentation were evaluated at an Umgeni Water treatment plant and the following products emanated from the study and evaluation: i) A full report was produced on the various fluoridation handling, dosing and monitoring equipment evaluated, including cost implications to the water treatment plant. ii) A comprehensive guideline document was compiled, outlining suitable fluoridation techniques, equipment available, correct installation and use of the equipment and general safety measures that (especially) small plant personnel need to adhere to. In the light of the fact that fluoridation will go ahead in the near future, this guideline is a very timely document, which will assist especially the small water treatment facilities – but also larger plants – in ensuring that their fluoridation requirements are met in an efficient and safe way.

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On-site mobile training of water treatment operators in small rural water supplies

MNB Momba, N Makala, M Dugeni

Many small rural water treatment plants in South Africa do not produce the quality or quantity of water that they were meant to. Both technical and human factors have been reported to be the major causes of the failure of small rural water treatment plants to provide potable water to their consumers. Inadequate water treatment systems are therefore placing rural communities at risk of diseases. It has been found that most of the operators who operate rural small water treatments lack the knowledge of plant operational processes. Even when an attempt has been made to offer training, the level of the material used is well beyond the educational level of the operators. Consequently there is a need for the training to be adapted to their capability as well as to be done on-site. This guide was meant to complement the cartoon guide “An illustrated Guide to Basic Water Purification Operations” by providing a practical, mobile course oriented training manual.

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Water Services Barometer Study

SM Martin

Community consultation in the provision of water services is both a legislative obligation and a critical success factor. Legislation and policy require government to engage with communities in the provision of Water Services. In order to inform/consult the public and obtain their participation and support, national departments such as DWAF and DPLG embarked on awareness campaigns and/or solicited public participation through meetings, leaflets and the mass media.

No single comprehensive study has been done which provides a barometer of the general public's knowledge and understanding of the water services messages as communicated, and their involvement in, and preferences for, consultative processes. To this end, this study into the level and status of community consultation on a range of water services issues was undertaken. The study gives a 'reading' of the current state of knowledge and awareness amongst the South African public regarding five key water services knowledge areas. The analysis of the data furthermore identifies areas of strength and weakness with the view to developing recommendations for improvement.

For the purpose of this study, the term 'community consultation' was broadly defined to include all types of communication aimed at the general public, ranging from information dissemination to community participation. The study limited itself to water services messages and it focuses on two major communication campaigns of the Department of Water Affairs and Forestry that have dealt specifically with Water Services, Free Basic Water and Water and Sanitation Hygiene (WASH).

In order to assess the results/ outcomes of these water services campaigns, a barometer instrument was constructed. The barometer quantifies, with a composite score out of a possible 10, the knowledge /awareness/ desired behaviour of adult South Africans regarding key messages of the campaigns.

Five key water services knowledge areas were identified from the literature review and the analysis of the e National Spatial Biodiversity Assessment (NSBA) established that 30% of grasslands in South Africa are irreversibly transformed and only 2.8% are formally conserved. The National Grasslands Biodiversity Programme (NGBP) aims to mainstream biodiversity in production landscapes involving the coal mining and agricultural sectors, and is investigating both regulatory and market based approaches to achieve this. Offsite mitigation and mitigation banking for wetlands have been identified as concepts with the potential to achieve the desired conservation of

aquatic biodiversity within the priority areas of the grass-land biome.

The concept of wetland mitigation banking developed in the United States to meet the country's policy of 'no-net loss' of wetlands. It is, however, a controversial concept, with the overriding argument against adopting the mechanism being that "it encourages a commodity approach to conservation wherein wetlands are traded for cash".

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Guidelines for the improved disinfection of small water treatment plants

MNB Momba, CL Obi and P Thompson

The efficacy of drinking water treatment by small water treatment plants – and particularly the disinfection aspects thereof, is fraught with several technical and management problems. This is corroborated by the extensive documentations on the supply of water of poor microbiological quality which is unsafe for human consumption in different provinces of South Africa. In order to unravel the intricacies around the operational and management parameters impinging upon the disinfection efficiency of small water treatment plants and to ensure sustainability of potable water supply to rural communities, this study was executed, involving 181 small water treatment plants across seven provinces of South Africa. The goal was to determine the nature and full extent of the disinfection problems experienced and to provide practical and user-friendly guidelines for intervention.

From extensive surveys at these plants and their disinfection systems, it was established that equipment, maintenance, operator education, operator training, operator working conditions and Management-operator interaction were normally inadequate. These aspects were quantified and graphically portrayed on the report. A detailed and user friendly guide document was further drawn up to assist in improving disinfection of final water at small water treatment plants and distribution systems. It includes practical steps and also installation and operating costs for the different disinfection systems and chemicals. This guide document is intended for use at operational and management levels by plant managers, supervisors, plant operators and plants owners, consultants and Municipal Water Local Authorities. The report and guide document will fulfill a long-standing need for more complete information on (both technical and social) aspects regarding improved final water quality produced from small water treatment systems in South Africa.

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Research into UD/VIDP (Urine diversion ventilated improved double pit) toilets: Prevalence and die-off of ascaris ova in urine diversion waste

CA Buckley, KM Foxon, DJ Hawksworth, C Archer, S Pillay, C Appleton

Urine Diversion (UD) systems have recently received a great deal of international attention in the context of "Ecological Sanitation" or "EcoSan". EcoSan refers to a cycle, or closed-loop system, which treats human excreta as a resource. In this system, excreta are processed on site until they are free of pathogenic (disease-causing) organisms. Thereafter the sanitized excreta are recycled by using them for agricultural purposes.

Despite the obvious benefits of the design, there are a number of unresolved scientific, technological, social and health-related questions about how the design works from a biological and mass transfer perspective, and what the real health and environmental risks are to the householder, community and any outsiders involved in the pit emptying process. The processes of drying and biological degradation which take place in UD vaults were investigated, with a view to understanding the characteristics of the UD waste at the time that the vault is to be emptied. The process of degradation in a UD vault was thought to be anaerobic biodegradation, with some aerobic degradation occurring at the air interface at the top surface of the waste; however it was found that the conditions in the heaps are not conducive to anaerobic digestion. Because of the way in which the faeces and sand are added to the vault, the mixture is very non-homogeneous. Further the analysis has also highlighted the importance of the air circulation rate for achieving good drying. The fact that the Durban system is to close off the vault during the standing phase is therefore an unsatisfactory feature of the system, since it means that very little drying will occur during the standing phase. The risk assessment showed that there was a 31% reduced risk of diarrhoea in the areas where the on-site sanitation program had been implemented to areas where it had not been implemented.

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Scientific support for the design and operation of ventilated improved pit latrines (VIPs) and the efficacy of pit latrine additives

Buckley CA; Foxon KM; Brouckaert CJ; Rodda N; Nwaneri C; Balboni E; Couderc A; Magagna D

This project proposed to undertake field and laboratory investigations of VIPs and their contents in and around the eThekweni Municipal area in order to understand the conditions found in the pits and to propose design and operating practice that will extend the life of pits. The standard VIP design was found to be effective for the accumulation and degradation of faecal sludge. However, it was observed that the ability of a VIP latrine to function as an improved sanitation system i.e. to provide hygienic separation of human waste from human contact, to limit the transport of pathogens from human waste by vectors such as rodents and insects, to reduce nuisance associated with flies and odour and to preserve the dignity of the user, was compromised in a number of respects due to poor construction, bad user habits, and during pit emptying operations. It was observed that poor construction or lack of maintenance often resulted in essential features of the VIP latrine design being missing or damaged, including vent-pipes, flyscreens, pedestal lids, doors and back plates. Under these conditions, there were usually problems with odours and flies. Bad user habits resulted in rapid accumulation of pit contents, particularly when poorly degradable anal cleansing material such as magazines, plastic bags or stones were used. In many cases pit latrines appeared to double as waste disposal sites, resulting rapid filling of the latrines.

During pit emptying operations, significant risk of infection of workers and community members with human pathogens originating from the pit contents is expected due to difficulties in removing pit latrine contents and separating faecal sludge from solid waste. Examination of face masks worn by workers engaged in emptying pit latrines and screening the exhumed contents indicated that viable ova of a number of helminth species including *Ascaris*, *Trichuris* and *Taenia* spp (roundworm, whipworm and tape worm) may be present in pit latrine contents and that these constitute a significant health risk to workers involved in handling pit latrine contents, and community members who have access to the area around the pit latrine during and after pit emptying operations.

Finally, commercial pit latrine additives were found to contain large concentrations of active micro-organisms with the ability to utilise organic substrates. However, neither the field trials, nor the laboratory trials provided evidence that the use of these products could result in a significant reduction in either mass or volume of pit latrine contents.

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The status and use of drinking water conservation and savings devices in the domestic and commercial environments in South Africa

D Still, S Erskine, N Walker and D Hazelton

This study included four different surveys in order to gauge the status and use of water efficient devices in South Africa. Firstly, commercial and institutional settings such as hotels and hostels were investigated; secondly the suppliers of plumbing fittings were studied; thirdly the architectural profession was surveyed; and finally the knowledge and attitude of 1428 home owners in 10 towns and cities in South Africa were tested. The findings indicate that in commercial and institutional settings, there is clear evidence that water efficient devices are becoming more common. The plumbing industry demonstrates an increasing market share of water efficient devices and this is apparent on the showroom floors of the major plumbing suppliers. This is almost in spite of the suppliers, who as a rule do not push water efficiency (as one said, it is not their job to preach to their customers, who buy mainly on functionality, style and cost). Of the 1 428 homeowners surveyed, 29% indicated that they had at least one water efficient device in the home. Typically only about 20% of the respondents in the average town believed they might possibly use too much water, but significantly more, 40% to 50%, have considered reducing their water consumption.

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The view from below: Citizen Voice and regulation in water services to the poor

D Hemson, R Shirley & C Munthre

Regulation in a democratic society cannot work independently of participation by citizens. Public agencies acting as regulators have to have the views of citizens to hand as it is their interests which are being protected. As the regulatory strategy in South Africa acknowledges, without this knowledge, regulation will have a limited impact. Internationally there is increasing interest in engaging poor communities and capturing citizen voice in scorecards as a step towards improving accountability between citizen and provider. Such participation should assist developing the regulatory framework in South Africa as communi-

ties understand the operation and standards of water services, voice their needs, and, as necessary, seek redress. The expression of voice is an integral aspect of a developed reflexive delivery system in which community voice operates as an important prod to municipalities acting as Water Service Authorities to respond to expressed need. Although greater attention to citizen voice is advocated, the challenge remains as to what method can be adopted to involve poor communities on the widest basis actively in people's regulation of water services?

The project has succeeded in providing a set of tools for community appraisal and engagement with the evolving regulatory system. New tools appropriate to the situation have been developed and existing community tools reshaped. These tools and community materials on water services are supported by an established training programme and strategy for spreading their use and techniques. The methods and materials have been developed in deprived and remote communities with the greatest challenges in water services and the tools have been shown to add data and value to community advocacy for better services.

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Guidelines for the implementation of sanitation and hygiene education programmes in informal settlements

N. Naidoo and C. Chidley

The need for this research study was largely informed by the outcomes of the Naidoo et al (2007) research study, 'The Effectiveness of Sanitation Education and Awareness Programmes in Informal Areas'. Rapid urbanisation in South Africa has resulted in the mushrooming of numerous informal settlements, however the provision of services especially sanitation services has not kept pace. According to the National Sanitation Task Team most water and sanitation projects carried out by local authorities have lacked significantly in the aspect of health and hygiene awareness. National and international experience has shown that the most successful sanitation initiatives have been those in which emphasis was placed on generating a high level of health and hygiene awareness rather than producing a large number of latrines. In addition, hygiene education programmes lay the foundation for an integrated approach to the provision of a wider set of environmental services. The benefits of effective and sustainable hygiene education programmes in informal settlements are numerous and include reduced infant mortality from diarrhoea, reduced environmental pollu-

tion, reduced health care costs, improved conditions of living, reduced operations and maintenance etc. Hygiene education programmes are among the most cost effective ways of lowering health costs especially in high density settlements where residents are at greater risks to poor sanitation related diseases. The study has determined that hygiene education programmes should be seen as an integral component of the functions provided by the Water Service Authority (WSA). As such, hygiene education can no longer be linked to only new sanitation infrastructure programmes. Instead, hygiene education should be a continuous function, like operations and maintenance, which is an ongoing function of local government. This approach will ensure that the message of good hygiene practice is continuously re-enforced and the approach is supported by existing policy and legislation.

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Membrane-related Water Research Impact Assessment

Frost & Sullivan

This study was commissioned as one of the impact studies contemplated to showcase research funded by the WRC in specific water research areas. The WRC has been instrumental in building the membrane industry in South Africa. The WRC has already funded a few projects on membrane research since its inception in 1971. However, most projects were funded after the establishment of a dedicated membrane programme in the early 90's. 66 membrane projects were funded since 1993. Research on membranes have resulted in significant economic, social, environmental and health benefits. The projects in this category have further helped to develop guidelines for best practices and are expected to be important within the water industry in South Africa for some time to come. Projects in this category have often led to the commercialisation of new products. They have further resulted in guidelines that have significantly impacted membrane project operational improvement, helped to decrease fouling and created methods to extend the life of membranes. Therefore, membrane research funded by the WRC was selected as a theme to perform an impact assessment on as showcase of the research funded by WRC and its impact on the South African and international society.

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Guidelines for the Utilisation and Disposal of Wastewater Sludge, Volume 1 – 5: Impact Assessment

Cornelis van der Waal

The release of the 2006 Sludge Guideline series aims to rectify previous sludge guideline shortcomings and provide an easy to use management tool for the handling of wastewater sludge. The aim of this project was to quantify the potential impact of the 2006 Sludge Guidelines on South African society by analysing current examples of wastewater sludge best practice that are aligned with the 2006 Sludge Guidelines.

Numerous examples of wastewater sludge handling best practice were reviewed. A variety of organisations benefit economically from the re-use of wastewater sludge and distinct social impacts that stem from these economic benefits were also identified. Environmental impacts have resulted largely from unsustainable sludge handling and mismanagement practices.

The examples identified during the completion of this project clearly reflect that wastewater sludge management practices that are aligned with the 2006 Sludge Guidelines are having a significant impact across economic, social and environmental areas of South African society.

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Excl postage

The impact of large consumer unit size on water and sanitation services in lower income urban areas in South Africa

Kim Lesley Walsh

The purpose of this research was to assess whether being a member of a large consumer unit, defined as more than eight people sharing a stand, results in inhibited access to water and sanitation services, and whether large consumer units find water and sanitation services to be unaffordable. This research suggests that large consumer units cannot be viewed simply as a homogenous group. Different types of consumer units, and different households making up those consumer units, face different challenges with respect to water and sanitation. Nuanced policy approaches will be necessary to help to alleviate these differing challenges. Such policy approaches might include considering programmes to upgrade backyard accommodation, and meter such accommodation separately; increases in the amount of Free Basic Water allocated to large consumer units; revisions to the rising block tariff structures, or

consideration of alternative tariff approaches; and education programmes around the wise use of water. Indigent policies should also be reviewed to take large consumer unit size into consideration.

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Excl postage

Development of a knowledge management system for operation of the algal integrated ponding system (AIPS)-A training and operations tool for small wastewater treatment plants

KJ Whittington-Jones, PD Rose, W Leukes, G Lok, Si Naidoo and D Lok

TSI had been approached by the Environmental Biotechnology Research Unit (Rhodes University) in 2001, with respect to providing a solution to the loss of valuable tacit knowledge at Sewage Processing Plants around the country due to high staff turnover. A knowledge management technique, developed by Gerrit Lok, was proposed as a possible solution and a demonstration site was recommended by the Water Research Commission and Rhodes University to evaluate the applicability of this tool. The Integrated Algal Ponding System (IAPS) project, co-ordinated by the University at the Grahamstown Sewage Works was used for the demonstration of this tool. As part of its contribution towards the country's RDP, in terms of provision of low-cost sanitation for low-income consumers, the Water Research Commission (WRC) had embarked upon the IAPS project in Grahamstown. IAPS had been designed as both a demonstration plant and a research facility with the objective of promoting acceptance and advancing knowledge in the operation of low-cost photosynthetic water treatment systems.

The primary objective of this initiative was to capture the expertise, skills and knowledge developed by an individual or a team of individuals, who have performed demanding tasks at the IAPS. A secondary objective was to develop the decision support system to allow for the simulation of fault conditions with appropriate remedial actions and reference to background support material. One of the main requirements of the diagnostic system was that it should not be another so-called "expert system" but would be a "non-robotic" system. In other words, when used for problem solving, it would actually enhance the learning of the user. A "hands-on" approach was used in this study to develop a totally comprehensive tool for the layman-operator. A Decision Support System was developed on an MS Access database using web page support for the decision tree and reasoning path. The final product was presented in the form of a CD to the client with installation and operational instructions.

Report No: TT372/08
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 Excl postage

Assessment of the occurrence and key causes of drinking-water quality failures within non-metropolitan water supply systems in South Africa, and guidelines for the practical management thereof

G Mackintosh and U Jack

This project identified the minimum requirements for effective and sustainable drinking-water service delivery within non-metropolitan water distribution networks to ensure acceptable drinking-water quality. Interviews with municipalities followed by site visits provided insight into current treatment plant and distribution network operation and maintenance procedures and the key factors that result in water quality failures in non-metropolitan networks. A web-enabled risk assessment tool was developed, as were practical guidelines aimed at different levels and/or users of the water service team, supported by two web-enabled tools available via the electronic Water Quality Management System (eWQMS). The management guides provide assistance in understanding planning, legislation, drinking water quality issues, staff training and reporting. The process controller's guide has been developed to assist operations and maintenance personnel in the operation and maintenance of drinking-water treatment plants and identifies issues that need urgent attention. The distribution system personnel guide assists operations and maintenance personnel in understanding and rectifying typical failures experienced in drinking-water distribution systems.

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 Excl postage

Technical and social acceptance evaluation of microfiltration and ultrafiltration membrane systems for potable water supply to rural communities

CD Swartz, MJ Philips, J Setlolela, B R Delcarme, JD Seconna

Conventional small rural plants have been shown to lack sustainability due to high technical abilities required to operate these plants successfully. As membranes are known to produce high quality water, require less operator attention and may be automated much easier, this project aimed at evaluating membrane technologies for treatment

of surface waters, including the determination of social acceptance factors for transferring the new technologies to the community. Both bench and pilot plant trials were run and two communities studied regarding social acceptance of membrane technology. It was found that membrane technology will be eminently suitable in treating surface waters to potable standards with minimal operator input. The social studies showed that community perceptions and preferences need to be taken into account before sighting of the plant. The project provided extensive insights into rural water supply with membrane based plants and the guideline will have a significant and positive impact on doing this correctly in order to ensure the sustainable supply of safe drinking water to rural communities.

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Guideline for the inspection of wastewater treatment works

Lee Ann Boyd and AM Mbelu

The Department of Water Affairs and Forestry (DWA) monitors Waste Water Treatment Works (WWTW) as mandated through the National Water Act, 1998 (Act 36 of 1998). This is done through regular inspections of the WWTW. For an inspector to undertake inspections thoroughly and give proper guidance on any problems encountered, it is important that he/she fully understands the complex nature of the various unit processes involved in the treatment of wastewater. Equally, Process Controllers must have insight with regards to the aspects that are monitored during the inspection. This Field Guide provides Inspectors and Process Controllers with a tool to conduct inspections on a WWTW. It provides guidance on how to identify possible problem areas and makes recommendations on how to solve common problems. The guideline and electronic checklists will assist the Inspector undertaking the inspection providing guidance where a problem is identified as well as assist Process Controllers to prepare for an inspection at their WWTW and take corrective action where problems are identified.

Report No: TT375/08
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 Overseas price: \$40-00
 Excl postage

Community-based governance of freshwater resources in Southern Africa

S Pollard, T Cousins

One result of the process of democratisation is legal pluralism in areas of communal tenure, in that the traditional locally-derived rules and norms for natural resource management run in parallel to statutory systems. In addition, South Africa is about to implement reforms in the statutory systems aimed at bringing about equity and sustainability. Within this complex social system, this project aimed to examine governance options for community based natural resource management in communal areas.

This project contributed to the growing discourse on legal pluralism in water management through examining local or customary, laws in practice, focusing on water resource management. The research reviewed the status of community governance of water resources in four SADC countries (South Africa, Mozambique, Zimbabwe and Zambia), and documented the complementarities and tensions between statutory and customary systems in these countries. One lesson from these countries is that where the implementation of national legislation is weak, people revert to the traditional governance structures.

The reality is that legal pluralism will be part of the South African Water governance landscape for some time to come, and internationally based research has warned that the 'neglect of customary laws may cause IWRM implementation to fail, or will have negative consequences for individuals and groups who were better served by customary-based systems – especially the poor'. The report concludes that we should not be constrained by a few idealized models of centrally managed water. Preferably let us seek innovative ways to integrate, or embed, common-property regimes with the formal, statutory system.

Report No: TT328/08
ISBN: 978 1 77005 674 9
Overseas price: \$20-00
Excl postage

Standard methods for the recovery and enumeration of Helminth Ova in wastewater, sludge, compost and urine-diversion waste in South Africa

Priya Moodley, Colleen Archer, David Hawksworth and Lizette Leibach

These Guidelines detail a new classification system according to the microbiological class, stability class and pollutant class and total viable Helminth Ova have been added

in the microbiology class. The Guidelines do not specify the analytical methods and as a result, different laboratories adopted different methods in South Africa. This project aims to validate a new EPA method for measuring Helminth Ova in wastewater and wastewater sludge. The method and related literature with sufficient visual material will be documented and used to build capacity in South African water and wastewater laboratories to measure all Helminth Ova in wastewater sludge and wastewater samples.

Report No: TT 322/08
ISBN: 978 1 77005 648 0
Overseas price: \$25-00
Excl postage

Condensed laboratory methods for monitoring phytoplankton, including cyanobacteria, in South African freshwaters

Swanepoel A; du Preez HH; Schoeman C; J van Vuuren S; Sundram A

The project will compile a comprehensive methods manual for the analysis of phytoplankton, cyanobacterial toxins, Geosmin and MIB for South African freshwaters. Current methods used for phytoplankton identification and enumeration, cyanobacterial toxin analysis, as well as for Geosmin and MIB analysis will be synthesized and a summarized reference document compiled.

Report No: TT 323/07
ISBN: 978 1 77005 684 8
Overseas price: \$25-00
Excl postage

Aqualite Water Balance Software – User Guide

Roland Scott McKenzie

The methodologies used in AquaLite draw strongly on recent recommendations of Task Forces of the International Water Association (IWA). It should be noted that the methodologies for quantifying water losses contained in the AquaLite model are not the only methods used worldwide. They are, however, well accepted and used extensively in many parts of the world and are rapidly being recognised as the most appropriate and pragmatic techniques for assessing the water balance components for potable water distribution systems. AquaLite also includes the calculation of the Unavoidable Annual Real Losses (UARL) as well as the use of the Infrastructure Leakage Index (ILI) as a key performance indicator. These two parameters are currently the subject of considerable attention and debate throughout the world and are being used in many countries. When used properly they can provide very useful infor-

mation on the performance of a water distribution system but must be used with care to ensure that the results are meaningful since there are situations where the estimates can be misleading.

Report No: TT 315/07
ISBN: 978 1 77005 599 5
Overseas price: \$10-00
Excl postage

Water Services and HIV / AIDS; Integrating health and hygiene education in the water and sanitation sector in the context of HIV/AIDS

(PLEASE DOWNLOAD FROM WEB: www.wrc.org.za)

Clacherty A; Potter A

This Water Research Commission study (Project K5/1634) arose from a growing realisation that, in relation to water and sanitation infrastructure development projects, there is little consistency or coherence of approach to health and hygiene education (H&HE). As a result, many interventions are ineffectual. Further, the linkages between HIV/AIDS and the improvement of water and sanitation facilities and related H&HE are poorly addressed in this country. The response involved considerable research over a period of time. It has identified factors which constrain and enable effective implementation of project-based H&HE in the context of HIV/AIDS. Based on that research and understandings of the context, it has developed and tested various institutional and financial arrangements and developed implementation models based on this work. The study places considerable emphasis on the linkages between water and sanitation, health and hygiene education and HIV/AIDS. The impact of HIV/AIDS on the lives of many South Africans is severe; it is imperative that the water services sector formulates and implements an appropriate response as a matter of urgency. It is critical that issues around HIV/AIDS are mainstreamed, both in terms of prevention as well as in reducing the impact on people living with AIDS. Caregivers, in particular, require not only knowledge of water and sanitation and related health and hygiene issues, but also access to adequate quantities of water of good quality.

Report No: TT 316/07
ISBN: 978 1 77005 602 2
Overseas price: \$20-00
Excl postage

Report No: TT 317/07
ISBN: 978 1 77005 603 9
Overseas price: \$20-00
Excl postage

The assessment of training programmes and capacity needs for the water sector: Executive summary

Mjoli N; Schoeman G

The South African Government has committed itself to an ambitious target of eliminating the water and sanitation services backlog by 2008 and 2010, respectively. However, the current skills shortage at the local government level poses a threat to the achievement of the water and sanitation delivery targets. The slow rate of delivery is largely due to inadequate technical skills in most municipalities. The problem is particularly acute within rural municipalities which have the lowest resource base and, at the same time, have the highest sanitation backlog figures.

The shortage of skills is not limited to the water services sector; the water resources management sector faces a similar problem. There is a growing concern among sector stakeholders that the current approaches to skills development are not producing the numbers of skilled people that are needed to improve the performance of municipalities. This situation calls for a review of the current practices in skills development and training provided by public and private providers in order to identify factors that are hampering accelerated skills development, despite the availability of large budgets from the skills development fund.

Report No: TT 306/07
ISBN: 978 1 77005 554 4
Overseas price: \$10-00
Excl postage

Standardisation of the use of particle counting for potable water treatment in SA

Ceronio AD; Haarhoff J; Pryor M

Turbidity is a gross measure of the quality of potable water. Particle counting and size analysis is fundamental to a deeper understanding of flocculation, settling and filtration processes. The primary objective of water treatment is the removal of particles. This project investigated the use of particle size analysis as a control parameter for the optimisation of water quality, and compared this to the control using zeta potential and streaming current. It studied the effects of pretreatment processes such as ozonation and coagulation on the clarity of the filtered water by measuring particle size; and considered the use of particle size analysis together with CFD for the optimisation of water treatment equipment. The report stresses the importance of standardisation of this technology and also includes a substantial amount of fundamental principles and practices useful to potential users considering the implementation of this technology.

CATALOGUE OF AVAILABLE TT REPORTS

Report No: TT 166/01
ISBN: 1 86845 801 6
Overseas price: \$20-00
Excl postage

An illustrated guide to basic water purification operations

Bouwer JL; Haylett

Lack of skills because of lack of training was identified as one of the most important hindrances to the supply of good quality potable water, especially in rural areas. Suitable training material is not available and current training material is inadequately targeted for rural operator training. A cartoon based operator manual for sewage plant operator training had previously been completed and proved to be a big success. Therefore, it was seen as appropriate to complete a similar guide for operator training on, especially, small to medium sized water treatment plants.

Report No: TT 247/05
ISBN: 1 77005 323 9
Overseas price: \$30-00
Excl postage

Corporatisation of municipal services providers

Development group; University of Western Cape

The restructuring of municipal water departments into stand-alone companies has been a long-standing subject of debate within the industry. This study aimed to further explore the concepts of corporatisation and its relevance to the South African water sector by, combining an international literature review with local case studies and policy reviews. The research concludes that corporatisation in itself does not guarantee performance. Whilst a shift in legal form from a municipal department to a stand-alone legal entity can make a difference, this is not the only or major determinant of performance. Various objective factors and broader governance factors are likely to have a greater impact than simply the legal form of the utility. Further corporatisation may be a suitable option for some municipalities. For capacity reasons corporatisation is only likely to be feasible within the large metro poles at this stage. As the experience base grows within South Africa, and transaction costs diminish, corporatisation may become feasible for smaller local authorities. This study highlights that before embarking on a corporatisation process municipalities should assess whether they have sufficient financial, managerial and political capacity to see the process through.

Report No: TT 199/02
ISBN: 1 86845 897 0

Overseas price: \$25-00
Excl postage

Management of water-related microbial diseases

DWAF; WRC

The purpose of this guideline series is to provide awareness building and management information on the nature and prevention of important water-related microbial diseases.

The purpose of volume one in the series, "Disease characteristics", is to introduce and describe the basic facts of some important water-related diseases. This guide is primarily an awareness building guide to educate the upcoming generation in the need for: (1) disinfected drinking water, (2) safe waste disposal, (3) good personal and kitchen hygiene, and (4) protection of water resources from faecal pollution.

Report No: TT 175/03
ISBN: 1 86845 849 0
Overseas price: \$25-00
Excl postage

1.Guidelines for the appropriate management of urban runoff in SA

Ashton PJ; Bhagwan JN

As the aim of this study was to establish general guidelines for the management of urban runoff water quality, especially focusing on dense settlements, urban runoff quality is a country-wide problem, the causes of which must be addressed. Past attempts to intercept urban storm water and channel it through a single storm water system to receiving water have failed. As storm water quality may be worse than treated sewage effluent and sometimes even raw sewage, treatment of storm water at some stage before discharge to the receiving waters has to be considered. Present engineering storm water management options do not cater for improving storm water quality. The impact of low-cost, high-density urban land use on the catchment warrants serious attention. Appropriate sanitation and waste disposal for peri-urban areas requires fundamentally new approaches. It is imperative therefore that applied research into these areas be conducted for the protection of South Africa's limited water resources.

Report No: TT 155/01
ISBN: 1 86845 764 8
Overseas price: \$15-00
Excl postage

2. Expert system for design of storm water management systems for urban runoff quality

Coleman TJ

Report No: TT 156/01
ISBN: 1 86845 768 0
Overseas price: \$15-00
Excl postage

PRESMAC: Development of a pragmatic approach to evaluate the potential savings from pressure management in potable water distribution systems in South Africa. (Presmac User Guide Version 1.1)

McKenzie R; Lambert A

This document incorporates the user guide to the South African Pressure Management and Control (PRESMAC) model which has been developed through the Water Research Commission (WRC) funded project titled "The Water Leakage: Pressure Management Model".

The PRESMAC model represents one of several models that are being developed through the WRC in order to assist water suppliers to manage and reduce their levels of unaccounted-for water. The models are supplied free-of-charge through the WRC for use within South Africa and further details can be obtained from the WRC web site on: <http://www.wrc.org.za>.

Report No: TT 152/01
ISBN: 1 86845 722 2
Overseas price: \$20-00
Excl postage

Financial planning for infrastructure services at district level: A user guide to the district services model. Version 1.1

Palmer Development Group

This manual outlines the philosophy behind the model, its aims, limitations and key assumptions. The structure and operation of the model is described in detail, covering the required data inputs and the meaning and presentation of the various outputs.

The District Services Model (DSM) has been designed to assist district municipalities to undertake financial analysis of infrastructure investment plans. The model performs this analysis at two levels:

Level 1: District-wide infrastructure planning, and
Level 2: Medium-term Council budgeting.

Report No: TT 143/01
ISBN: 1 86845 680 3
Overseas price: \$15-00
Excl postage

A guide to non-point source assessment to support water quality management quality of surface water resources in SA

Pegram GC; Gorgens AHM

The primary focus of this guide is to support water quality management of surface water resources, and particularly non-point sources management, through the provision of appropriate and cost-effective information for decision-making.

Report No: TT 142/01
ISBN: 1 86845 677 3
Overseas price: \$20-00
Excl postage

The Development of Effective Community Water Supply Systems using deep and Shallow Well Hand pumps

Hazelton DG

Deep- and shallow-well hand pumps are used extensively for rural community water supplies over large parts of South Africa. Very often, however, these installations fail to meet the requirements even though they are considered to be one of the simplest community water supply technologies.

It has, however, been demonstrated in other parts of the world that high failure rates are not inevitable and that these schemes can be transformed into reliable low-cost solutions through the adoption of the so-called village level operation and maintenance (VLOM)-concept, where appropriate design technologies and implementation policies are systematically included. The study indicated that 10% of the South African populations (2 million people) are dependent on the estimated 10 000 hand pumps which exist in this country. This can be equated to an investment of about R400 million, and the study estimates that between 40% and 50% of the hand pumps are not working at any one time.

Report No: TT 132/00
ISBN: 1 86845 629 3
Overseas price: \$25-00
Excl postage

Applicability of waste minimisation clubs in South Africa: Results from pilot studies

Barclay S; Buckley C

Industrial small-, medium- and micro-enterprises (ISMMEs) are a strategic growth sector in the RSA but cumulatively are significant sources of pollutants which detrimentally affect sewage treatment. The overall objective of the project was the development of regional waste minimization clubs, in which cleaner production practices can be cost-effectively established as a contribution to the sustainability in South Africa of ISSMEs that are both competitive and environmentally responsible.

Report No: TT 161/05
ISBN: 1 86845 831 8
Overseas price: \$30-00
Excl postage

Guidelines for the utilisation and disposal of wastewater sludge: Volume 1 of 5: Selection of management options

Snyman HG; Herselman JE; Kasselmann G; Steyn CE; Wilken JW

This work implements the major recommendation arising from the comprehensive multi-stakeholder WISA Sludge Management Group in the consultative process coordinated by the WRC to review and update the current published sludge management guidelines.

Report No: TT 261/05
ISBN: 1 77005 422 7
Overseas price: \$20-00
Excl postage

Guidelines for the utilisation and disposal of wastewater sludge: Volume 2 of 5: Requirements for the agricultural use of wastewater sludge

Snyman HG; Herselman JE; Kasselmann G; Steyn CE; Wilken JW

Report No: TT 262/05
ISBN: 1 77005 423 5
Overseas price: \$20-00
Excl postage

Water purification works design: (SA Price R150-00)

Van Duuren FA

This project was aimed at facilitating the optimal, most economical water purification and treatment works by providing a design guide based on water quality considerations, processes and operations. This guide indicates water quality requirements, control and management of procedures, and water demands in all sectors. It also categorises water purification and treatment processes and operations

Report No: TT 92/97
ISBN: 1 86845 345 6
Overseas price: \$50 00
Excl postage

Information transfer extraction management systems (ITEMS) (SA Price R114-00)

Howard MR; Perkins M

This project developed a computerised Information Transfer, Extraction and Management System (ITEMS) which enables users to gain access to local and international information on mine-water quality, management, treatment and research. The six modules incorporated in ITEMS, viz. literature, water quality guidelines, contaminant properties, research results, an impact assessment manual and a mine-water management manual, and the options available in each of the modules, renders ITEMS an extremely versatile information tool. The total computer file size of the databases is 87 Mbytes. ITEMS is available on CD-ROM

Report No: TT 94/98
ISBN: 1 86845 378 2
Overseas price: \$70 00
Excl postage

Solids-free sewer systems in South Africa: a community leader's guide

Du Pisani JE

This study evaluated the STED systems in South Africa. It showed that STED systems were used on over 16 000 erven in South Africa. The study showed that problems experienced with these systems were mainly due to poor operation and maintenance and some incidents of blockages were due to incorrect design and construction of the STED systems. The study concludes that with proper design, operation and maintenance, STED systems offer a cheaper alternative of meeting the sanitation needs of. The output of this research includes two guidelines, namely Operation

and Maintenance of Solids-free Sewer Systems in South Africa: Guidelines for Engineers; and Solids-free Sewer Systems in South Africa: A Community Leader's Guide.

Report No: TT 96/98
 ISBN: 1 86845 401 0
 Overseas price: \$20 00
 Excl postage

Handbook to guide communities in the choice of sanitation systems

Bernhardt Dunstan & Associates

The main aim of this study was to evaluate on-site sanitation systems from a socio-economic perspective with special reference to affordability, appropriateness and social acceptability. The study was undertaken in three case study areas, namely, Soshanguve TT, Ivory Park and Ga-Mmotla. The study concluded that in all three case study areas, communities were dissatisfied with their on-site sanitation systems. Women were unhappy about being excluded from decision-making on the selection of sanitation technologies, because as the main users, they are better qualified to select a sanitation system that could be operated and maintained by the users.

Report No: TT 104/98
 ISBN: 1 86845 425 8
 Overseas price: \$10 00
 Excl postage

Guidelines for the design and operation of sewage sludge drying beds

Ceronio AD; Van Vuuren LRJ; Warner APC

Current information and guidelines for the design and operation of sewage sludge drying beds in the RSA are very limited. The design data available are largely empirical and give almost no insight into the effect of climate, sludge concentration, loading rates, sludge volume index, filter media, etc. on the drying bed area required. Based on the research and support of experimental work done, as well as information obtained from literature, the study produced a guideline that is specific for South African conditions called Guidelines for the Design and Operation of Sewage Sludge Drying Beds (WRC Report No TT 107/99)

Report No: TT 107/99
 ISBN: 1 86845 491 6
 Overseas price: \$25 00
 Excl postage

Guidelines for the calibration of measuring flumes in sewers

Rooseboom A; Goodey GM

During 1992 a detailed investigation revealed that the majority of open channel flumes on South African sewer mains and at municipal wastewater treatment plants, do not comply with the generally accepted British Standards 3680. In this project tests were performed on different flumes in order to establish the impact of differences in shape and surface roughness on calibration coefficients. These guidelines are the product of a large number of practical tests, combined with existing standards for the measuring of fluids by flumes. The result is a set of methodologies and worked examples, which clarifies and simplifies measuring flume design to the point where plant personnel in the smaller plants will also be able to follow and utilise the guidelines to the full.

Report No: TT 111/99
 ISBN: 1 86845 501 7
 Overseas price: \$25-00
 Excl postage

Corrosion brochure for local authorities

Ramotlholo JS; Ringas C

The brochure highlights cost-effective ways in which external corrosion can be minimised. The brochure can also be useful to repair teams working in the field. The brochure contains colour photographs showing the different forms of corrosion in order to assist field teams to correctly identify the cause of the failure. Appropriate repairs can then be carried out. The brochure also describes how each local authority can build up its own database, thereby assisting in the long-term strategy of each local authority by ensuring that correct corrosion prevention strategies are used.

Report No: TT 112/99
 ISBN: 1 86845 510 6
 Overseas price: \$15-00
 Excl postage

DOMESTIC WATER SUPPLY: GUIDES

The provision of an adequate and safe water supply to all people is one of the goals of the South African Government. To ensure the safety of water supplies, a need for a user-friendly Guide to facilitate evaluation of the health-related quality of water supplies was identified as a priority by both the Departments of Health and Water Affairs and Forestry. This resulted in the production of a series of guides.

This Guide forms part of a series which is intended to provide water supply agencies, water resource managers, workers in health-related fields, as well as communities throughout South Africa, with the information they need to sample, analyse, assess and interpret the quality of domestic water supplies. The following documents from the series:

Quality of domestic water supplies

Vol I: Assessment Guide TT 101/98

Report No: TT 101/98
ISBN: 1 86845 416 9
Overseas price: \$25-00
Excl postage

Quality of domestic water supplies –

Vol II: Sampling Guide1 TT 117/99

Report No: TT 117/99
ISBN: 1 86845 543 2
Overseas price: \$15-00
Excl postage

Quality of domestic water supplies –

Vol III: Analysis Guide1 TT 129/00

Report No: TT 129/99
ISBN: 1 86845 620 X
Overseas price: \$20-00
Excl postage

Quality of domestic water supplies-

Vol 4: Treatment guide TT 181/02

Report No: TT 181/99
ISBN: 1 86845 873 3
Overseas price: \$30-00
Excl postage

Quality of domestic water supplies –

Volume 5: Management Guide TT 162/01

Report No: TT 162/99
ISBN: 1 86845 809 1

Overseas price: \$30-00
Excl postage

The management of urban impoundments in South Africa volume 2: Guideline manual

Freeman MJ; Howard MR; Wiechers HNS

This Urban Impoundment Management Guideline Manual is the product of a research project carried out for the Water Research Commission to investigate the water-quality problems most commonly experienced in South African urban impoundments, as well as the management techniques which can be used to address them.

The purpose of the Guideline Manual is to assist those responsible for, or with an interest in, the management of the water quality of urban impoundments. It is thus aimed predominantly at those persons in local authorities who must manage the water bodies in their areas.

Report No: TT 119/00
ISBN: 1 86845 553 X
Overseas price: \$25-00
Excl postage

The economic cost effects of salinity - integrated report

Urban-Econ Development Economists

As the salt content of water increases, the water becomes less suitable for most users, and additional costs are incurred. The study was undertaken because of uncertainties about some of the methodology and assumptions that were used in the desk study and the need for a versatile economic model that can be used to quantify the effect of salinity in monetary terms and to compare the cost-benefit ratios of alternative options. A generic methodology to determine the financial, economic and social impacts associated with an increase in salt concentration were first developed, and then applied by conducting a survey to determine the impacts of increased salt concentrations in the middle Vaal River.

Report No: TT 123/00
ISBN: 1 86845 590 4
Overseas price: \$20-00
Excl postage

Defluoridation, denitrification and desalination of water using ion - exchange and reverse osmosis

Schoeman JJ; Steyn A

This project concentrated on demonstrating the feasibility of using advanced adsorption, ion-exchange and membrane technologies to remove fluorides, nitrates and dissolved suspended solids from groundwater in order to produce potable water for rural communities which are remote from first-world infrastructure. Activated alumina, ion-exchange and reverse-osmosis systems were evaluated at a number of rural sites in terms of both technical and social acceptance factors. The results achieved in these demonstration studies show that activated alumina and ion-exchange processes and advanced water treatment processes such as membrane filtration can be employed successfully for the purification of adverse-quality groundwater to potable standards in the rural areas.

Report No: TT 124/00
ISBN: 1 86845 597 1
Overseas price: \$20-00
Excl postage

Land -based effluent disposal and use: Development guidelines and expert systems-based decision support

Murphy K O'H

Effluents and soils were identified as factors which help in the process of making decisions on the applicability of a specific effluent on a specific land. The identification of the effluent takes into account health-related aspects, the risk of pollution to the water source and the effects of it on plants. The identification of the soil relates to the ability of soils to attenuate the contaminants in the effluents.

The user guide takes one through the process in order to be able to determine whether the combination is acceptable or not and whether it conforms to health guidelines. If this is acceptable, it is indicative of restrictions or protective measures. ELADS Effluents to land - application decision-support software is the expert systems-based decision-support software developed. It could be used not only for sewage effluents, but also for organic effluents, to some extent for nitrogenous effluents and effluents containing potentially toxic trace elements. It could be modified to accommodate any site, soil or effluent-related limits specified by new regulations. (WRC Report No TT 125/00).

Report No: TT 125/00
ISBN: 1 86845 551 3
Overseas price: \$20-00 Excl postage

The level of communication between communities and engineers in the provision of engineering services

Pybus P; Schoeman G; Hart T

The purpose of this research was to test the hypothesis above and to establish how engineering information, for example, concerning the level of service, can best be given so that the community leaders can make a decision based on sound knowledge of the technicalities of the situation. In an analysis of the major factors that negatively affect communication between consultants (specifically engineering) and communities, it was found that the majority of factors stemmed from a lack of integrated and comprehensive project planning. The findings from this study are supported by an excellent set of guidelines, aimed at improving communication processes between practitioners and communities in water and sanitation development projects

Report No: TT 133/00
ISBN: 1 86845 630 7
Overseas price: \$20-00
Excl postage

• Waste minimisation guide for the textile industry: A step towards cleaner production: Vol I

Barclay S; Buckley C

The Waste Minimisation Guide for the Textile Industry has been found to be a useful tool for assisting the RSA textile industry to improve its environmental performance in the following areas of application:

- The textile industry can use the Guide to self-assess and improve its implementation of waste minimisation practices and, hence, its aquatic environmental performance
- Similarly, use of the Guide will assist factories in achieving compliance with environmental management standards e.g. ISO 14000, and, thereby, improving their international competitiveness
- Local regulatory authorities can use the Guide both as a training tool and as a management tool for monitoring and assessing the performance of textile manufacturers in their area of jurisdiction.

Report No: TT 139/00
ISBN: 1 86845 659 5
Overseas price: \$20-00
Excl postage

CATALOGUE OF AVAILABLE TT REPORTS

• Waste minimisation guide for the textile industry: A step towards cleaner production. Vol II

Report No: TT 140/00
ISBN: 1 86845 659 5
Overseas price: \$20-00
Excl postage

Human resources planning and management system (HRPMS) user manual

Stewart Scott

The study has developed a management tool to help managers to implement integrated human-resource planning of water service institutions. The report focuses on the human resources that are required in order to support the infrastructure, as well as the organisational structure requirements of various sizes of water service institutions. The computerised human resources planning and management system (HRPMS), which was developed for water service institutions through this study, includes facets of both a management information system (MIS) as well as a decision support system (DSS). The management component of the HRPMS includes portions of the job analysis and employee profile modules. The reporting facilities provided by the HRPMS facilitate management, planning and decision-making.

Report No: TT 146/01
ISBN: 1 86845 686 2
Overseas price: \$15-00
Excl postage

Assessment of the attended coupon-operated access-point cost recovery system for community water supply schemes

Lima Rural Development Foundation

The study highlights parameters in which attended coupon operated access point cost recovery system operates efficiently by analyzing seven existing schemes. The research to identify the operational constraints that community water supply schemes are currently facing by conducting sample surveys in the schemes.

Report No: TT 150/01
ISBN: 1 86845 716 8
Overseas Price: \$15-00
Excl postage

• Development of a simple and pragmatic approach to benchmark real losses in potable water distribution systems in South Africa: BENCHLEAK

Ronnie McKenzie & Allan Lambert

The BENCHLEAK software and this User Manual are part of the ongoing process of refining and improving the methodologies for calculating and presenting performance data associated with management of public water supply systems in South Africa.

Report No: TT 159/01
ISBN: 1 86845 773 7
Overseas Price: \$20-00
Excl postage

The BENCHLEAK software is available from the Water Research Commission and further details can be obtained from the web site at: <http://www.wrc.org.za>

• Development of a Windows based package for assessing appropriate levels of active leakage control in potable water distribution systems: ECONOLEAK

Ronnie McKenzie

The ECONOLEAK model is aimed specifically at determining when a water supplier should invest in active leakage control for a specific zone metered area.

Report No: TT 169/02
ISBN: 1 86845 832 6
Overseas Price: \$20-00
Excl postage

The ECONOLEAK software is available from the Water Research Commission and further details can be obtained from the web site at: <http://www.wrc.org.za>

Guidelines for the implementation of benchmarking practices in the provision of water services in South Africa

Pybus P

The guidelines are intended to encourage the local authorities to benchmark their activities with their peers with a view to delivering water and sanitation services in a more effective and efficient manner. Benchmarking offers a route to more effective and efficient service delivery.

Report No: TT 168/02
ISBN: 1 86845 842 3
Overseas price: \$20-00 Excl postage

Environmentally responsible mining: Water management guidelines for small-scale mining

Clacherty A; Moodie P

This report identifies and characterises the critical water-related impacts of small-scale mining and is developing appropriate tools to assist their environmental management. The study focused primarily on the water-related issues of peat extraction, clay-mining for brick making, alluvial diamond-mining and other small-scale mining activities associated with gravels, alluvial sands and sediments.

Report No: TT 170/04
ISBN: 1 86845 833 4
Overseas price: \$20-00
Excl postage

Guidelines for the application of natural stone trickling filters with some reference to synthetic media trickling filters

Wates, Meiring & Barnard (Pty) Ltd

Trickling filters are applied in many domestic and industrial wastewater treatment plants in Southern Africa. Trickling filtration technology is still evolving and this document provides current information on the design, operation and maintenance of filters.

Report No: TT 178/02
ISBN: 1 86845 852 0
Overseas price: \$15-00
Excl postage

Water and wastewater management in the oil refining and re-refining industry: NATSURV 15

CSIR

In this study the water intake, water use and pollutant loads of the crude oil refinery, synthetic fuel refinery and refining sectors of the industry were surveyed and characterised. Crude oil refineries in the RSA were found to have a relatively narrow range of specific water intake (SWI 0.51 to 0.67 m³/t) and re-refining SWIs were found to vary widely (0.06 to 7.2 m³/t), depending on the type of process used. The results obtained present a snapshot of the water and wastewater characteristics of the industry in which crude oil refining (at four refineries) is around 20 million t/a, syn-fuel refining (at two refineries) is around 9 million t/a and oil re-refining is around 120 000 t/a. In addition to the water and effluent survey data, the Guide produced contains a number of specific recommendations for reducing water use and effluent generation in the industry.

Report No: TT 180/05
ISBN: 1 86845 508 4
Overseas Price: \$15-00
Excl postage

Elementary handbook of water disinfection

Carlsson FHH

The salient features of the handbook covers:

- Description of water disinfection processes, principally chlorination and chloramination but including ozonation, peroxone, chlorine dioxide and ultraviolet treatments
- Written such that it is understandable by non-specialists in water treatment plants and informed lay-persons
- To be used as an aid in effective education and training of plant personnel while avoiding detailed chemistry
- To be used as a ready reference for daily use on water purification plants where disinfection is implemented.

Report No: TT 205/03
ISBN: 1 86845 983 7
Overseas price: \$20-00
Excl postage

Watrex expert system for water treatment plant design: (South African price: R500-00)

FR Sutherland

This is a Windows-based software package that applies expert system technologies to water treatment plant design. The software allows data acquisition, unit process design and modeling, process selection, and dynamically responding plant design, modeling and sensitivity analyses.

Report No: TT 206/03
ISBN: 1 77005 016 7
Overseas price: \$200-00
Postage inclusive

An assessment of the trickle feed system as a tool for implementing the free basic water policy

Lenehan AM; Abelitis L

This study investigated the cost-recovery efficiency of the trickle feed system. In this system a known quantity of water is delivered each day to a storage tank at each customer's house. This allows the implementation of a monthly prepaid cost-recovery system with relatively low administration. There are potential benefits of implementing the trickle feed system in rural areas and it is currently implemented in pilot projects in Northern KwaZulu-Natal.

CATALOGUE OF AVAILABLE TT REPORTS

Report No: TT 210/03
ISBN: 1 77005 031 0
Overseas price: \$10-00
Excl postage

The measurement and reduction of urban litter entering storm water drainage systems

Marais M Armitage N

This project addresses the following aims:

- The improvement in the knowledge of the source type and amount of urban litter coming from different types of urban catchments; and
- Provision of scientific data on the efficacy of various management techniques in reducing the amount of urban litter reaching drainage systems. This information, together with the knowledge, would enable the development of Litter Management Plans (LMPs) resulting in reduced litter loadings and realizing considerable cost savings.

Report No: TT 211/03
ISBN: 1 77005 041 8
Overseas price: \$30-00
Excl postage

A guidebook on household water supply for rural areas with saline groundwater

Goldie I; Sanderson RD

This report captures and presents options of small-scale water purification technologies for potable water supply to farms, schools, clinics and small communities from brackish surface water sources. The report produced in the form of a guide will assist decision makers in the selection of these technologies. Both membrane-and distillation-based technologies have been assessed, mostly in terms of a desk study. Recently developed local innovations are also included into this guide.

Report No: TT 221/04
ISBN: 1 77005 107 4
Overseas price: \$30-00
Excl postage

Feasibility of water fluoridation for South Africa

Genthe B; Herold CE Haarhoff J; Hosking S; Syke G

A team, consisting of five experts in their fields, was requested to perform a desk study to identify both the positive and negative consequences which could be expected to arise following the fluoridation of potable water supplies in South Africa.. Results from the study for the

first time summarize and bring together a whole spectrum of aspects to take into consideration when potable water supplies are fluoridated. The results show that further actions, including further research, are required before fluoridation can be effected with full safety and confidence in a developing country such as South Africa.

Report No: TT 222/04
ISBN: 1 177005 108 2
Overseas price: \$25-00
Excl postage

A summary of lessons and experiences from the Ethekwini pilot shallow sewer study

Patti Eslick; John Harrison

Sanitation, because of the major impact it has on health and quality of life, is a service with a high priority. Findings from a previous WRC study indicated that shallow sewer systems provide a viable intermediate sanitation alternative, with a total cost between Ventilated Improved Pit latrines (VIPs) and conventional sewerage. With this as a stimulus, the Durban Metro Water was the first local authority to indicate interest in taking the recommendations further. This study captures the lessons and experiences from the pilot implementation of the shallow sewers.

Report No: TT 225/04
ISBN: 1 77005 135 X
Overseas price: \$20-00
Excl postage

An introduction to the concepts of customer relations management for water services institutions

Naidoo J; Mosdell T

The fact that the concept of customer service has received little attention in South Africa is perhaps related to the historic situation where water supply and sanitation services were provided on a monopolistic take it or leave it basis, particularly in the case of poorer customers. It is now recognized increasingly that successful water services provision is strongly associated with the application of good business principles. This implies a service orientation, with a primary focus on the customer. This report provides an overview of customer management, principles and methodology.

Report No: TT 227/04
ISBN: 1 77005 147 3
Overseas price: \$20-00
Excl postage

Community identified performance indicators for measuring water services

Schoeman G; Magongoa

This work implements the major recommendation arising from the comprehensive multi-stakeholder WISA Sludge Management Group in the consultative process coordinated by the WRC to review and update the current published sludge management guidelines.

Report No: TT 228/04
ISBN: 1 77005 158 9
Overseas Price: \$15-00
Excl postage

Guidelines for economic regulation of water services in South Africa

Palmer Development group

For the regulation of water services to become effective in South Africa, considerable work needs to be undertaken. In particular the methodology to be used in undertaking economic regulation is one of the key components. This report has investigated the subject of economic regulation and its relevance to South Africa and has defined the manner in which water services authorities should regulate water services providers, within the current legislative framework. It highlights the importance of the methodology for economic regulation and in particular regulating tariffs and associated financial parameters. This report is aimed to stimulate discussion on the subject matter, towards effective economic regulation.

Report No: TT 229/04
ISBN: 1 77005 164 3
Overseas price: \$20-00
Excl postage

Guidelines on reduction of the impact of water infiltration into sewers

Stephenson D; Barta B

The effects of urban developments on storm water quality and quantity as well as groundwater infiltration into the sewer facilities cannot be left anymore to ad hoc solutions and there is an urgency for a strategic approach to these problems. This report based on identifying and quantifying the problem of ingress, provides the necessary strategy and answers to these problems.

Report No: TT 239/05
ISBN: 1 77005 264 X
Overseas Price: \$20-00 Excl postage

Benchmarking of leakage from water reticulation systems in South Africa

McKenzie RS; Seago C

In the attempt to get a better handle on the level of leakage at a municipal and national level, this study was undertaken in order to assess the levels of leakage in various water utilities throughout South Africa. The standard water auditing model BENCHLEAK, previously developed through a WRC study was used for the analyses since it is relatively simple to use and follows the standard IWA and BABE leakage benchmarking methodology. Benchleak introduces the concept of Infrastructure Leakage Index (ILI) as a standard method for the purpose of leakage evaluation, as it has been found to be the most reliable and meaningful indicator.

Report No: TT 244/05
ISBN: 1 77005 282 8
Overseas Price: \$25-00
Excl postage

Water and waste-water management in the power generating industry (NATSURV 16)

Van Zyl HD; Premlall K

The power-generating industry in the RSA is a substantial water user and effluent producer and impacts nationally both on water use allocations and the maintenance of resource water quality. The report provides the volumes and breakdown of water taken in and discharged by major and minor power generating plants, to determine pollutant loads and identify suitable wastewater management processes and strategies, and to a guideline document assisting both the industry and regulators in effective water and wastewater management of this sector.

Report No: TT 240/05
ISBN: 1 77005 270 4
Overseas Price: \$15-00
Excl postage

Ecological sanitation - Literature review

Austin LM; Duncker LC; Marsebe; Phasha MC; Cloete TE

Urine-diversion sanitation systems have been successfully implemented in many countries; including South Africa where about 3 000 of these toilets are already in existence. However, despite much research having been carried out internationally and locally, various questions still remain, particularly on the health aspects of operation, maintenance, and excreta reuse or disposal. This report captures the state of knowledge on urine diversion toilets.

CATALOGUE OF AVAILABLE TT REPORTS

Report No: TT 246/05
ISBN: 1 77005 322 0
Overseas price: \$25-00
Excl postage

Guidelines for ensuring sustainable effective disinfection in small water supply systems

Momba MNB; Brouckaert BM

This is a follow-up to a previous project that evaluated a combined chlorine-monochloramine disinfection process for the inhibition of bacterial and bio film re growth in a laboratory-scale system. The emphasis is based on the maintenance of an effective residual disinfectant throughout the water system. This report provides strategies which will ensure sustainable effective disinfection in small municipal water distribution systems.

Report No: TT 249/05
ISBN: 1 77005 321 2
Overseas price: \$30-00
Excl postage

Water poverty mapping: Development and introduction using a case study at the local municipal scale for the Eastern Cape

Cullis J

This report demonstrates the feasibility of using water poverty mapping to define and study the nature of water poverty in South Africa as well as the basis for a clear decision tool for the allocation of scarce resources to development initiatives that will be most effective and as a way of measuring the impact of these initiatives.

Report No: TT 250/05
ISBN: 1 77005 337 9
Overseas price: \$20-00
Excl postage

Handbook for Waterworks Operation

Christiaan Frederick Schutte (Editor)

There are a number of different books and instruction guides (mostly sourced from abroad and excessively priced in South African terms) available to assist with training of water treatment works operators, but a survey of these showed that none of the existing books is suitable to be used as a basis book for reference and for training. This report is an excellent reference book for training of water plant operators, as well as for the operation of water treatment works.

Report No: TT 265/06
ISBN: 1 77005 428 6
Overseas price: \$25-00
Excl postage

The development of a successful unaccounted-for water management programme in the rural water supply context

Ross-Jordan J

The challenge to develop simple and effective systems that are easily understood by water committees has resulted in this report which can be used by the community as well as their local authority to manage water losses in distribution systems.

Report No: TT 256/06
ISBN: 1 77005 392 1
Overseas price: \$20-00
Excl postage

The use of key performance indicators in the benchmarking of rural water supply schemes: An aid to development of meaningful local government capacity

Still D; Balfour F

New local authorities have limited knowledge on the nature of inspection needed to promote good management at community level. Therefore, the challenge was to develop simple and effective systems that are easily understood by water committees. These can be used to report to the community as well as to their local authority. This report provides a set of key performance indicators (KPIs) which have been tested on a number of RDP projects that are presently being transferred from Umgeni Water to relevant district councils in KwaZulu-Natal.

Report No: TT 255/06
ISBN: 1 77005 391 3
Overseas price: \$25-00
Excl postage

The WRC community based health and hygiene model and implementation kit

Bolu O; Maliti N

This research seeks to support the acceleration of sanitation service delivery without improving developmental principles such as demonstration of ownership and community based participation. The study will investigate methods of improving communities so that they can earn

an income which will enable them to make a partial contribution to the costs of building toilets. The study will be undertaken in selected villages in the Eastern Cape.

Report No: TT 264/06
 ISBN: 1 77005 427 8
 Overseas price: \$20-00
 Excl postage

A strategic framework for water-related human health research

Venter SN; Mjoli NP

The report is a compilation of a framework and strategy plan to guide the future funding of priority research on the improvement of water related human health in Southern Africa. The plan had to include health related aspects of all human-water interactions. The plan further identifies research gaps for future, local, research on water related human health and a list of institutions and researchers active in health research, both nationally and internationally.

Report No: TT 257/06
 ISBN: 1 77005 404 9
 Overseas price: \$20-00
 Excl postage

1. Waste Minimisation Clubs in SA (Facilitator's Manual)
2. Waste Minimisation Clubs in SA (Training Manual)

Barclay S; Buckley C

Previous WRC Project No. 973 detailed the feasibility of waste minimisation (WasteMin) clubs as a model for achieving significant improvements in environmental performance by local industry. The aim of this follow-up project No. 1171 was to develop a methodology for promoting, managing and sustaining waste minimisation clubs, by producing inter alia guides for effectively establishing and managing WasteMin clubs, specific sectoral self-assessment guides, and training material for WasteMin consultants in a franchised operation.

The project's two technology transfer products are a Facilitator's Manual and a Training Manual. The Facilitator's Manual is aimed at a person or organisation that wishes to initiate a waste minimisation club and requires guidelines for undertaking such a project. It addresses aspects such as how to form a club, call meetings, determine the level of contributions from companies, identify some of the problems that can occur, and explains the various roles of the people involved. It also provides sample letters and presentations, and provides sources of information. The

Facilitator's Manual draws on the experiences gained in the previous WRC project no. 973 and also that gained from facilitators of other waste minimisation clubs in South Africa, facilitated by various organisations such as consultants, University researchers and, in at least one case, by the company itself as an in-house club.

Report No: TT 283/07
 ISBN: 978 1 77005 493 6
 Overseas price: \$30-00
 Excl postage

Report No: TT 284/07
 ISBN: 978 1 77005 494 3
 Overseas price: \$20-00
 Excl postage

Life cycle costing analyses for pipeline design and supporting software

van Vuuren SJ; van Dijk M

There are various factors that influence the hydraulic capacity and pipeline designers need to take all of these into consideration during the design. For instance the estimation of roughness parameter for a pipeline has a significant effect on the hydraulic capacity and operational costs. An underestimation of this parameter can be catastrophic when the required demand cannot be met. Findings identified that the two main contributing factors of energy losses are:

- Inherent resistance against flow exerted by the fluid (i.e. viscosity) and
- The friction losses resulting from the interface between the fluid and the conduit boundary (i.e. shear), as well as secondary losses resulting from abrupt local changes in the system.
- The roughness parameters that are normally quoted by manufacturers tend to be to low.

Report No: TT 278/07
 ISBN: 1 77005 449 9
 Overseas price: \$20-00
 Excl postage

A research strategy for the detection and management of algal toxins in water sources

Harding WR

This analysis undertaken in support of the development of a cyanobacterial and cyanobacterial toxin research strategy in South African water sources has identified two vital planning elements, viz.

- The need to create a management and support infra-

structure and

- The research aspects best suited to South African cyanobacterial research needs.

In addition, there is a clear indication that successes will be limited should collaboration with overseas specialists and organizations not be implemented. To South Africa's advantage is its current involvement in both the Global Water Research Coalition (GWRC) and CYANONET initiatives, plus willingness expressed by international specialists formerly associated with cyanobacterial work in South Africa to continue their association. Allied to this is the cosmopolitan nature of the cyanobacterial problems as experienced worldwide. This analysis was fortunate to have been commissioned during the year (2004) that saw the launch of the GWRC and CYANONET initiatives, as well as two key international conferences that allowed for the identification of globally-relevant research initiatives and emerging issues.

The strategy proposed here is based on comparing and contrasting the current directions and emerging issues in international cyanobacterial research with identified South African needs. From this analysis a suite of key research issues have been formulated.

Report No: TT 277/06
ISBN: 1 77005 461 8
Overseas price: \$20-00
Excl postage

Guidelines for the design, operation and maintenance of urine-diversion sanitation systems

Austen LM

If a dry toilet (i.e. not requiring water for its operation) is designed and constructed in such a way that the faeces vault can be quickly, easily and safely emptied, then one of the biggest maintenance problems will be obviated. If the processed excreta can also be productively and safely used for agriculture, the technology will become even more attractive. In South Africa, where many rural communities rely on subsistence agriculture, often in poor soils, and with urban agriculture becoming more common, this is an important aspect. Urine-diversion sanitation systems address the above opportunities. They have been successfully implemented in many countries, including South Africa where more than 3 000 of these toilets are already in existence. However, despite much research having been carried out internationally and locally, various questions still remain, particularly on the health aspects of operation, maintenance, and excreta reuse or disposal. A need has thus been identified to create further competence in this area of sanitation in South Africa, and to increase knowledge concerning the technology. The technology is

increasingly being introduced in a manner which consists of faulty design, poor implementation and improper use. This study developed strategies and guidelines, through monitoring and evaluating existing schemes, which would provide fundamental answers in the sustainable management of this technology.

Report No: TT 275/06
ISBN: 1 77005 456 1
Overseas price: \$15-00
Excl postage

A desalination guide for South African municipal engineers

du Plessis JA; Burger AJ; Swartz CD; Musee N

Municipalities have to develop Water Service Development Plans (WSDP's) as part of Integrated Development Plans (IDP's) as a first requirement in their budgetary process, and have to be aware of what options are available to provide adequate water services. While 25ℓ/person/day has been set as the minimum basic water supply and while many consumers receive far in excess of this amount, there are areas of the country where enough fresh water of acceptable quality is not available for household use. However, in many areas adequate quantities of saline water may be or are readily available. This is especially the case for coastal cities and towns. The cost of treating water is a fraction of the total cost of making water available to the consumer. This, together with the fact that membrane desalination technology is becoming more affordable, makes the overall water tariff less dependent on the cost of desalination. In other words, desalination may in many cases become a viable option to supply fresh water for domestic purposes. Therefore, DWAF identified a need to provide guidelines and procedures to select and evaluate suitable treatment options for desalinating sea water from both the Indian and Atlantic oceans, or brackish water from boreholes.

The specific objectives of the project were to identify the technologies which may currently be commercially implemented in South Africa to treat saline water to drinking water standards, to identify typical pre-treatment requirements, and to identify the most common technical, operating and environmental problems experienced in the selection and use of these technologies. An important aspect was also to provide estimates for capital and operating costs, as would be required to successfully bring the water to the accepted standards for potable and domestic use. Of particular importance for the South African application was to identify the level of skills required for daily operation of the desalination plants, the level of skills required to provide technical back-up and advice, and to identify and advise on the competencies, training needs and capacity

building required at operator and management levels. Lastly, the relevant local environmental legislations governing desalination were also identified.

Report No: TT 266/06
ISBN: 1 77005 431 6
Overseas price: \$30-00
Excl postage

Generic incident management framework for toxic blue-green algal blooms, for application by potable water suppliers

Du Preez H; van Baalen

An increase in the eutrophication of surface water resources is leading to increased incidence of toxic blue-green algae growth – thereby increasing health risks when drinking water from a treatment plant which does not use activated carbon adsorption in its process train. No structured framework yet exists in South Africa to manage the supply of safe drinking water during a persistent blue-green algae bloom in the source water. The project aims to establish such a pro-active approach by means of a generic algal bloom incident management framework to effectively manage potable water supply when toxic algal blooms are present. Such a system will be widely applicable to water services providers and will reduce the risk of human incidents related to blue green algae toxins by providing this framework for informed and appropriate pro-active management measures.

Report No: TT 263/06
ISBN: 1 77005 472 3
Overseas price: \$25-00
Excl postage

An assessment of non-revenue water in South Africa

Seago CJ; McKenzie RS;

Municipal water use in South Africa has been under investigation for many years and the Department of Water Affairs and Forestry has been trying to establish the levels of wastage from all water supply systems countrywide. This has proved a very difficult task due to the absence of reliable data in many Municipalities as well as confusion regarding how such wastage should be estimated. Until the wastage can be quantified accurately, it is impossible to develop and prioritise the actions that must be taken to ensure that water is used effectively and efficiently in this water scarce country. Despite many problems associated with the gathering of data from the various water utilities, the study was able to obtain information from 62 of the largest water reticulation systems throughout South Africa.

It was found that the average bulk system input volume per property served for the 19 low income areas analysed as part of the study was approximately 37 kℓ per property per month. The losses (real and apparent) for the 62 systems analysed was estimated to be 623 million m³/annum or 29% of the total water supplied.

Report No: TT 300/07
ISBN: 978 1 77005 529 2
Overseas price: \$20-00
Excl postage

KSA 4

1. On-farm application of in-field rainwater harvesting techniques on small plots in the central region of South Africa : Vol 1 – Main Report

JJ Botha, JJ Anderson, DC Groenewald, NN Nhlabatsi, TBZere, N Mdibe and MN Baiphethi

Report No: TT 313/07
ISBN: 978 1 77005 595 7
Overseas price : \$20 00
Excl postage

2. On-farm application of in-field rainwater, harvesting techniques on small plots in the central region of South Africa – Vol 2: Extension manual

Botha JJ; Anderson JJ; Nhlabatsi NN

Water harvesting is the process of concentrating rainfall as runoff from a larger area for its productive use on a smaller area. A number of Water Research Commission projects on the In-field rainwater harvesting (IRWH) technique have demonstrated that rural communities can greatly benefit from this production practice. Intensive field experiments on clay and duplex soils, conducted over a period of six seasons, indicated that IRWH increased maize and sunflower yields by as much as 50%, compared to conventional production techniques (CON). Research results over a number of years have indicated that the IRWH technique is sustainable in terms of increased agronomic productivity, reduction of risk, conservation of the natural resources base, social acceptability and economic feasibility. This technology transfer project was initially planned for implementation in six rural communities around the towns of Thaba Nchu and Botshabelo in the Free State province

The technology exchange process expanded rapidly resulting in many more households and communities than initially anticipated implementing the IRWH technique that the need arose to employ a proper exit strategy that ensured continued implementation of the technique by interested communities. As the number of farmers and

communities using IRWH techniques increased, a decision was taken by representatives from each group and community to form a municipal-based water harvesting interest group (MB:WHIG). This body was later named the Tswelolepele Small Farmers Cooperative (TSFC). Amongst the organisations that were co-opted into the structure were the municipality, the tribal authority and the local agriculture office.

Report No: TT 314/07
ISBN: 978 1 77005 596 4
Overseas price : \$20 00
Excl postage

Technology transfer and integrated implementation of water management models in commercial farming

AJ Pott, N Benadé, P van Heerden, B Grové, JG Annadale and M Steyn

This integrated transfer of technology project targeted the commercial irrigation sector in particular since, according to the National Water Resources Strategy (NWRS, first edition, 2004), this sector is responsible for over 62% of South Africa's total water use. The terms of reference required the research team to (i) identify, (ii) negotiate with and (iii) select 5 to 7 Water User Associations or Irrigation Boards to participate in the technology transfer (TT) project. A key objective of the project was for the decision support models to be used sustainably after the completion of the project to increase efficiency of water use. As such, the potential participant WUAs / IBs were evaluated in terms of (i) their user needs for the respective models, (ii) the level of commitment shown and (iii) the level of infrastructure of the respective schemes. The participants were ranked in terms of these criteria, and short-listed. It is expected that the WUAs/IBs which were selected will act as centres of excellence, from which other WUAs/IBs can learn over time.

The models which were included in the TT exercise were ACRU, WAS, SAPWAT, SWB and RISKMAN. All models are driven by some form of input data, which is then transformed into information via computational processes through the models. A central approach of this integrated technology transfer project was to capture high quality data of the targeted participant Water User Associations and Irrigation Boards in a Geographical Information System (GIS). In the course of the implementation of the models, further developments were undertaken to improve the user friendliness. It was clear from earlier WRC projects that stakeholders showed a strong interest in GIS packages, largely due to the understanding that the use of GIS promotes for spatial and temporal information. This is due to the graphical (visual) nature of GIS which enables features to be viewed in a spatial context. In order to promote the

buy-in from potential WUA and IB participants, a key feature of the project was the collection of data pertinent to the WUAs and IBs which would then be captured in a GIS. The data incorporated in the GIS could then be used (with other input data) to drive the models associated with the TT project.

The WUAs/IBs have shown a very high interest in the use of GIS, which is very encouraging, as the GIS data, if kept current over time, will provide valuable input data for the various models forming part of the TT project. The current user needs for some of the models is very high, resulting in the models either being used now, or the intention to use the model in the near future (e.g. WAS & SAPWAT). For some of the other models the user need is growing, and is anticipated to grow significantly once the compulsory licensing process has been completed in many of the over-allocated catchments in the country. Models like SWB and RISKMAN will be very useful to test the hydro-economic impact of various water-use and land-use scenarios. Like-wise, the ACRU-MIKE BASIN model combination is well placed to assist water resource managers and stakeholders evaluate water management scenarios.

It is recommended that the WRC and/or DWAF provide funding to support a technical user support unit, which continues supporting the use of the models associated in the TT project. Although the technology transfer project was successful, it targeted only 7 WUAs/IBs, which is a very small percentage of the total number of WUAs and IBs in the country. At some stage all water users will require assistance in the management of their water, be it a catchment scale, scheme scale, or field scale. An organisation such as the former Computer Centre for Water Research (CCWR), would be a suitable organisation to provide support and assistance for this purpose.

Report No: TT 267/08
ISBN: 978 1 77005 703 6
Overseas price: \$30 00
Excl postage

Best management practices for small-scale subsistence farming on selected irrigation schemes and surrounding areas through participatory adaptive research in Limpopo Province

Wim van Averbek

The project was conducted as a case study of the Dzindi Irrigation Scheme. Dzindi is a canal Irrigation scheme that was constructed shortly after World War II and is found about 6 km south west of the town of Thohoyandou, in the Vhembe district of Limpopo province. Dzindi has a total command area of 135.6 ha, which is subdivided into 106 plots of 1.28 ha each, held by a total of 102 plot holders.

Fieldwork was also conducted at Khumbe Irrigation Scheme and Rabali Irrigation Scheme to determine the extent to which the situation at Dzindi was unique. Both Khumbe and Rabali are canal irrigation schemes and their characteristics are fairly similar to Dzindi. All three schemes can be described as maize (summer) and vegetables (winter) schemes, but there were differences among the schemes in the types of vegetables that featured most prominently.

The overall objective of the project was to develop and implement technologies and knowledge useful for farmers in order to improve rural livelihoods. Two types of research and development activities were conducted, namely initiatives aimed at understanding management practices and initiatives aimed at improving management activities. Methods used in data collection at Dzindi included; the use of Rapid Rural Appraisal (RRA) techniques; surveys involving probability sampling and structured interview schedules; experiments in the green house, on-station and on-farm and qualitative methods. Methods of data collection at Khumbe and Rabali were largely limited to the use of RRA techniques.

The analysis of livelihood and farming of plot holder households revealed that for the purposes of developing best management practices, the 'one size fits all' perspective is not valid. At individual farm level best management practices need to be tailored to the objective of the farmer and the role of farming in the overall livelihood strategy of the household. The longitudinal study of the livelihood and farming of a selection of households at Dzindi showed that both were dynamic and subject to interaction. The development of livelihood types, farming styles and the relationship between farming and overall livelihood were shown to be useful approaches to make sense of the diversity that was observed. The study of the social and institutional domains of Dzindi showed that there was considerable room to improve the management of shared resources. On smallholder canal irrigation schemes, the sharing of water and the maintenance of the irrigation infrastructure influence the availability of water for irrigation at the plots. Collaboration among farmers, or the lack thereof, also affects access to markets. However, the study found that state intervention (through the compulsory introduction of the co-operative model) in areas where smallholders successfully operate their own organisations should either be avoided completely or be done in ways that allow smallholders sufficient time to internalise the new concepts and adapt them to suit their own circumstances. Land tenure and farmers' interpretation of the prevailing tenure system influence land exchange among farmers, which is important for farmers seeking to expand their operations. Collaboration among farmers is also important in terms of access to land preparation services. Research and development activities aimed at improving

management practices focused on production aspects and included the integration of crop and animal production systems, improvement of the production of selected indigenous crops (African leafy vegetables) and the improvement of green maize production.

The findings of this study revealed that the development of best management practices for farmers on smallholder irrigation schemes needs to consider three important domains, namely the individual farm enterprises, the irrigation scheme as a whole and the scheme and its surrounds, because these domains interact. The development of best management practices at the level of the individual farm enterprises, within the Terms of Reference for this project, is mostly technical in nature. This suits the biological and technical disciplines in the agricultural expert system. However, social and institutional issues are of cardinal importance in the domain of the irrigation scheme as a whole and its surrounds. This raises questions about the appropriateness of the composition of the South African expert system, which has long been dominated by specialists in agricultural production and agricultural engineering.

Report No: TT 344/08
ISBN: 978 1 77005 689 3
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Excl postage

Water-use in relation to biomass of indigenous tree species in woodland, forest and/or plantation conditions

Dye PJ; Gush MB; Everson CS; Jarmain C; Clulow A; Mengistu M

Report No: TT 361/08
ISBN: 978 1 77005 744 9
Overseas price: \$30-00
Excl postage

Nutritional status of South Africans with specific reference to malnutrition

Wenhold F; Faber M

Report No: TT 362/P/08
ISBN: 978 1 77005 756 2
Overseas price:
\$25-00 excl postage

Developing a land register and a set of rules for application of infield rainwater harvesting in three villages in Thaba Nchu: A pilot project

Manona S; Baipethi M

The Water Research Commission (WRC) is funding a 5 year research project in rural villages around Thaba Nchu, titled Social and economic factors affecting the adoption of rainwater harvesting and conservation practices. The solicited project commenced in April 2006 and is being undertaken by the University of the Free State. The project follows on other WRC funded projects in the same area that aimed at the improvement of crop production, thus poverty alleviation, through the use of infield rainwater harvesting (IRWH) techniques developed by the Agricultural Research Council's Institute for Soil Climate and Water (ARC-ISCW). There is a need for up-scaling IRWH from the household food gardens to the communal croplands. This requires the development of a land register and clear rules to gain access to land. Umhlaba Consulting have specialist capabilities in this regard to make a contribution and thereby support ongoing research efforts.

The study revealed the complex nature of land tenure and the total collapse of land administration in the three villages. The underlying drivers of the collapse of land administration can be attributed to lack of a coherent policy and legislative framework since 1994. On the one hand government discontinued the implementation of permission to occupy (PTO) legislation and did not replace it with new legislation, while other organisations that were historically key role players in land administration were removed from the functions they played in the past.

A survey conducted among the three villages showed a widespread support for extension and/or revitalization of cultivation to arable fields, albeit with conventional technologies in mind, as shown by the appeal for the provision of machinery commonly used in conventional tillage methods. The observation was not surprising since the farmers had not been exposed to the use of the IRWH techniques beyond the household food plots. Furthermore, land rights holders expressed sufficient support for an improved local land administration system that would support land exchange agreements. While fencing of the fields does not necessarily fall within the realm of land administration, it was seen to be a major constraint towards the cultivation of arable fields. This is largely because of the threat of damage to crops by livestock from within and the neighbouring villages.

Following from support to developing and/or strengthening local land administration, an initial framework of rules that would govern local land administration was agreed to by the three villages. This process was undertaken mind-

ful of the lack of a supportive legislative framework and therefore lack of enforcement mechanisms. Nonetheless, the communities were willing to devise and revitalize some of the traditional and collective initiatives to ensure the launching of the local land administration system. There was consensus across all three villages on how a local land administration structure should be set up. The process of setting up of rules was seen as a dynamic and continuous process which should be facilitated by the local land administration structures over time.

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Training manual for small-scale rainbow trout farmers in net cages on irrigation dams water quality, production and fish health

K Salie, D Resoort, D du Plessis and Ma Maleri

This project investigated the suitability of on-farm irrigation dams for aquaculture fish production and the effect this would have on the quality of the water for irrigation purposes. A study of irrigation dams in the Western Cape and the Makhathini flats canal system in KwaZulu-Natal, indicated that water exchange rate and inflow water quality are main factors in determining the suitability of water bodies for fish production. While the water chemistry did not show effects of aquaculture or differences between production and control sites, the phytoplankton composition and biomass did. Especially during the winter dam turnover, overall biomass of phytoplankton was higher at all production sites. The additional clogging of filters as a result of changes in phytoplankton biomass was the most significant impact of aquaculture on the quality of water for irrigation. It was further found that a significant portion of the fertiliser requirements of the crops irrigated from the dams would become available because of aquaculture activities.

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The social/cultural acceptability of using human excreta (Faeces and Urine) for food production in rural settlements in South Africa

Duncker LC; Matsebe GM; Moilwa N

Introducing and operating sanitation systems that promote the use of human excreta in rural areas require a combination of technical and managerial aspects that fit

the prevailing socio-cultural context in the specific area. An in-depth understanding of the social and mental fabric concerning people's views towards recirculation of nutrients is necessary in order to understand the motivational factors behind people's acceptance or rejection of using human excreta for food production. No research has been conducted so far in this field of study in South Africa, and therefore the scoping study is required to investigate the status quo, determine the views and attitudes of people towards the use of human excreta in food production, and to guide relevant future interventions and actions regarding use of human excreta. Use of human excreta for agricultural purposes may not only have direct benefits of protecting and improving natural resources such as water and soils and enable households to increase food crops, but also indirect benefits of improved food security resulting in improved health of the individual, greater productivity, increased economic output and opportunities, and a decreasing burden on social services.

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A Procedure for an improved soil survey technique for delineating land suitable for rainwater harvesting

Hensley M; Roux PAL; Gutter J; Zerizghy MG

Subsistence farmers in rural semi-arid areas with low cropping potential are a category of poor people in South Africa that the Government urgently wants to assist. Their well-being is jeopardized by a low income and inadequate food security. To address this problem a number of research projects, managed and funded by the Water Research Commission (WRC), have been launched during the last ten years by the ARC-Institute for Soil Climate and Water (ISCW) located at Glen. Success in this regard was achieved, shown by the fact that large numbers of households in the region now successfully use IRWH to grow maize and vegetables in their backyards. The time is now ripe for expanding the application of IRWH to the relatively large unused cropland areas available to these subsistence farmers. The need then arises to identify and delineate the portion of each village area that is suitable for IRWH. Because of the relatively small area of cropland allocated to each household it is essential that the soil survey be conducted on an intensive basis, at a scale of at least 1: 10 000, but preferably larger. Intensive soil surveys at this scale, carried out using the traditional grid technique, are costly. It was hypothesised that it should be possible to develop a more effective survey procedure to select suitable land for IRWH by maximising the application of tacit knowledge and employing modern and innovative technology.

Aware of this need the WRC has wisely created this research project to test this hypothesis.

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A Manual for cost benefit analysis in SA with specific reference to water resource development: Second Edition (Updated and Revised)

Mullins D; Mosaka DD; Green AB; Downing R; Mapekula PG

This guideline is in the format of a manual for conducting Cost-Benefit Analysis (CBA) in South Africa with specific reference to evaluating the development and management of water resources. This evaluation of projects is often a difficult task since costs and benefits do not occur only once but appear over time. The CBA method, provides a logical framework by means of which projects can be evaluated, serving as an aid in the decision making process. This manual is specifically aimed at the decision maker in the public sector, but can also be used outside the public sector.

It is interesting to note a few highlights of the CBA Manual. A broader approach is followed to incorporate the relationships between CBA and other aspects of the economy. In this regard the following aspects have been included:

- the relationship between the principles of CBA and welfare economics;
- CBA as one component of the range of decision making support instruments;
- The equity and efficiency principles;

Thus it deals specifically with the uses, limitations and basic principles of CBA in order to explain the underlying conceptual framework to the reader. This manual advocates that the CBA concept needs to be widened to include the broader social costs and benefits derived from a project. Furthermore it is also accepted that CBA is only one of several instruments for evaluating proposed projects. One of the main objectives therefore was to incorporate an income weighting system. This system provides for the recognition of some of the macroeconomic policies of the government e.g. combating poverty and promoting regional development.

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Technology transfer for implementation of the FARMS system

Botha PW; Oosthuizen LK; Meiring JA

Over the last 10 years, three WRC funded research projects were undertaken to develop user-friendly models to provide decision-support for farmers. The aims of this technology transfer project were firstly, to train agribusinesses, bureau services and advisors in the main irrigation areas of South Africa to implement the Risk Man (Risk Management), IrriCost (Irrigation Cost Estimator) and FARMS (Firm Level Agricultural Management Simulator) computer software for decision-taking support in the field of risk management, irrigation cost estimation and whole farm planning respectively; and secondly, to give these organisations and individuals the necessary support in order for them to apply the abovementioned computer software on a continuous basis.

New technology must pass through several stages before it is accepted. The five stages of adoption are awareness, interest, evaluation, trial and adoption. The implementation strategy with this technology transfer project consisted of a combination of methods, messages and approaches followed by the research team. The first step was to identify target groups to whom the three programs were demonstrated. The demonstrations were attended by the contact person of that area together with potential adopters of the technology. These demonstrations were used to create awareness and interest in the use of the models. The next step was to arrange workshops for interested persons for specific models to make further progress with the technology adoption process. The website was used to provide additional information about forthcoming courses and continuous support on larger scale adoption and application.

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Building capacity in irrigation management with wetting front detectors

R Stirzaker; CSIRO; Stevens J; Annandale J; Maeko T; Steyn M; Mpandeli S; Maurobane W; Nkgapele J; Jovanovic N

Scheduling of irrigation does not only ensure that adequate volumes of water are applied. It also ensures that many people who rely on the limited water resource can share. Much as irrigators are aware of the importance of scheduling, very few practice it. A wide range of reasons for not scheduling exists, the common ones being the high

level of management required and the costs involved. With simple and cheap scheduling tools, water savings will be achieved and farmers will soon realise the importance of irrigation scheduling and its benefits. The project is aimed at improving adoption of irrigation scheduling through the introduction of a cheap and simple technique. It also evaluates factors affecting the acceptability of this irrigation scheduling technology by resource-poor and commercial farmers.

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Using Sapwat to estimate water requirements of crops in selected irrigation areas managed by the Orange Vaal and Orange – Riet water users association

Van Heerden PS, Crosby CT & Crosby CP

This report serves as a user manual for the application of SAPWAT. Furthermore, it demonstrates that the estimation of irrigation requirements can be credible and that the requirements that the National Water Act (36 of 1998) sets for future water management can be met.

Report No: TT 163/01
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Micro-irrigation for smallholders: Guidelines for funders, planners, designers and support staff in SA

Du Plessis FJ; Van Averbeke W; Van der Stoep I

The objective of this project was to assess how small-scale farmers experience the concept of micro-irrigation systems and how they cope with problems. The aim was to identify those aspects that eventually determine the success or failure of small-scale crop production, utilising these systems. During the course of the project it became apparent that external factors, generic to any small-scale farming system and seemingly unrelated to micro-irrigation, had a significant influence, and that it would, therefore, be almost impossible to evaluate the former without taking the latter into account. The aim of the guideline report is to help prevent mistakes of the past and, hopefully, it will contribute to policy-making on a small scale regarding the utilisation of micro-irrigation. Thus, the successful use of the systems is ensured.

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Contribution of aquaculture to rural livelihoods in South Africa: A baseline study

Rouhani QA; Britz PJ

At present there is a lack of information on the importance of fish production systems in agricultural activities, the contribution it makes to household food security and constraints or opportunities which exist for expansion. This study should highlight specific topics for research projects that need attention. Particular emphasis will be placed on research of water-related issues that will lead to an improvement of rural livelihoods.

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Guidelines for irrigation water measurement in practice

Vd Stoep I; Benade N; Smal HS; Reinders FB

Effective management of water resources can be vastly improved if water use is measured accurately. This applies in particular to efforts to influence the quantity of water demanded by levying tariffs on the volume of water actually consumed. However, on most irrigation schemes water flow is not measured and water tariffs are presently still levied on an area and not a volumetric basis. This report is as a result of a comprehensive study of water measurement in irrigation.

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Irrigation scheduling using the Soil Water Balance (SWB) model as a user-friendly irrigation scheduling tool

Annandale JG; Steyn JM; Benade N; Jovanovic NZ; Soundy P

Most commercial farmers recognise that effective irrigation scheduling is a prerequisite to save on irrigation water and to improve on water-use efficiency. However, only a small percentage of irrigation farmers currently uses any scientific irrigation scheduling aid. One important reason may

have been the lack of quick, simple and reliable irrigation scheduling techniques. This aspect has been addressed to a large extent by the development of the SWB model. Although the model follows a scientifically based mechanistic approach, a user-friendly interface makes it accessible to any person with basic computer training.

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Principles, approaches and guidelines for the participatory revitalisation of smallholder irrigation schemes: A rough guide for irrigation development practitioners: Vol 1

Denison J; Manona S

The guidelines document best South African and international practice and are intended for Government decision-makers, technical and extension staff, consultants, development practitioners and scheme leadership.

The 'Rough Guide' (Volume 1) is a quick reference guide that covers policy implications and revitalisation objectives, as well as recommended principles, approaches and methodologies for scheme diagnosis, participative planning, feasibility evaluation and formulation of farmer support programmes.

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Principles, approaches and guidelines for the participatory revitalisation of smallholder irrigation schemes: Concepts and cases: Vol 2

Denison J; Manona S

The guidelines document best South African and international practice and are intended for Government decision-makers, technical and extension staff, consultants, development practitioners and scheme leadership.

'Concepts and Cases' (Volume 2) contains the theoretical rationale for the guidelines. Four major South African revitalisation initiatives are compared with international initiatives and success factors are identified. Eight farmer support approaches are documented, providing lessons of best practice as well as alternatives for programme design, and new approaches are presented. These are a tailored consultative planning approach, a land-leasing strategy for irrigation schemes and the formulation of four basic

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farming styles to guide planning.

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