THE WATER WHEEL
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What's plaguing the Olifants?

WATER RESEARCH COMMISSION

Water Demand Management in SADC

Building a Water Demand Management (WDM) culture in the Southern African Development Community (SADC) region to ensure effective and sustainable use of water.

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WATER DEMAND MANAGEMENT

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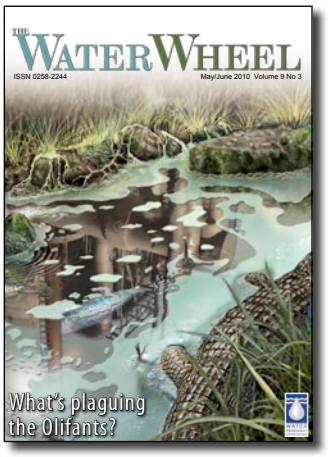
***Cover**: More than 30 researchers from the CSIR are racing against time to save the beleaguered Olifants River catchment (page 14). Cover illustration by Ralf Broemer.*



Letters to the Editor

New ways needed to deal with water offenders

Environmental awareness and water consciousness have significantly improved in South Africa and I express gratitude not only to government for their proactive stance in creating significant legislation (for instance NEMA, Air Quality Act, waste management and the recent advances in waste tyre management, National Water Act, etc.) – and also to a significant effort being made by *Water Wheel* to provide valuable information on progress in and development of water and its resources.

A recent editorial (January/February 2010) regarding the emphasis on dedicated courts being established, with skilled professional staff to hear water and environmental cases is the only solution to enhance the various legislation and to ensure that compliance is enforced, giving effect to the noble aspirations of government in preserving our environment and scarce water resources.

One suggestion would be to centralise the administration of the Court and to establish dedicated courts, sitting at intervals staffed by independent and part-time prosecutors and judicial officers with the respective Department conducting investigations. The process of disseminating cases can be via our traditional courts where a special register records the case numbers but the administrative allocation of cases for courts sitting in areas where the transgression occurs, will drastically limit the usual costs for establishing permanent courts.

Compliance and enforcement is lacking where there are transgressions committed by businesses and the only way a new culture of awareness will be created is if government takes the issue of enforcement seriously.

Government should also consider rewarding businesses for proactive steps taken to alleviate environmental hazards and pollution, to encourage and impose corrective measures as a form of punishment rather than the imposition only of fines, for instance, compulsory rehabilitation (and mitigation, bio-remediation) with regular audits being submitted, establishing committees and workshops on an ongoing basis where points are allocated to businesses who attend and which points could be redeemed for certain benefits to that business, setting ambient air quality targets as goals to reduce emissions. The forms of sanction should be innovative rather than punitive in nature as the general forms of punishment in our courts defeat the purpose for which our environment legislation is designed for. Sustainable development is measured by our ecological footprint we leave behind.

It is unfortunate that many municipalities, especially those in smaller towns, are oblivious about the importance of our environment and water preservation and the way to remedy this situation is to ensure that properly qualified and skilled persons are employed to protect our important commodity rather than it being seen as a secondary interest.

Rashid Patel, Estcourt

Climate change – more questions than answers

My article "Climate change - there is no need for concern" was published in the January/February, 2004 edition of the *Water Wheel*. There was an immediate, coordinated response by some 17 scientists in the following issue. I was denied the opportunity to respond.

In essence, we were arguing at cross purposes. I maintained, and still maintain, that there is no statistically believable evidence that supports the claimed consequences of global warming in my fields of interest. These are claimed increases in floods and droughts; changes in regional rainfalls; threats to water supplies; and large-scale environmental damage. The other side argued that global warming itself would have a whole range of adverse environmental consequences. My frequent requests that we get around the table to resolve our differences were ignored. The confrontation grew and became unpleasant.

The four-month period November 2009 through to February 2010 witnessed the total collapse of the climate change issue on an international scale. It suffered irretrievably on two grounds. The most important was political. The 192 nations of the world failed to reach an agreement at Copenhagen last December. The objective was to develop a binding international agreement whereby all nations would substantially reduce their emissions of the so-called greenhouse gases, principally carbon dioxide.

The divisions between the nations on political/economic grounds make it unlikely that a meaningful agreement will be achieved on the reduction of these emissions in the foreseeable future. These undesirable emissions must inevitably continue to increase.

The failure on scientific grounds was equally dramatic. It was claimed that if global emissions were not reduced, global temperatures would continue to rise, thereby threatening human habitation on this planet. Increasing global temperatures was the key assumption. Remove this assumption and the whole climate change issue must collapse.

Climategate

In November 2009 there was a leakage of earlier e-mail exchanges emanating from the UK University of East Anglia's climate research unit. This unit was the major source of information on global temperatures. The leakage was called Climategate.

The leaked e-mails showed that the principal institutions in both the UK and the USA manipulated the historical proxy temperature data from tree ring studies and other sources in order to demonstrate continued increase in global temperature.

They produced the now infamous 'hockey stick' global temperature graph that featured prominently in the 2001 assessment reports of the Intergovernmental Panel on Climate Change (IPCC). It showed a slow decline in global temperatures from about 1000 AD through to 1900 AD when it rose rapidly through to 2000 AD and beyond. It was claimed that this dramatic increase in temperatures was proof of human causality. The principal institution involved in this study has now acknowledged that during historical warm periods the global temperatures were higher than at present. Even more important it was also acknowledged that there has been no statistically significant increase in global temperatures since 1995.

Two important aspects associated with the Climategate Affair should be noted. The first is that the university is being held to account for the actions of its researchers. The second is that three national scientific institutions publically expressed their concern that the incident had broken honourable scientific traditions with far reaching

consequences for the reputation of science as a whole. They were the Royal Society of Chemistry, the Royal Statistical Society and the Institute of Physics.

There was more to come. During January and February, skeptical scientists uncovered fraudulent activities within the IPCC itself. Claims that the Himalayan glaciers would melt by the year 2035 were based on an earlier Russian report where the year was given as 2350 and not 2035. The source of the information that the glaciers were melting at an alarming rate was based on a telephone conversation reported in a scientific journal and not on refereed literature. This has been acknowledged by the IPCC.

Details in the IPCC reports quoting the percentage of the area of the Netherlands vulnerable to inundation by rising sea levels, were also grossly exaggerated. After publication, the statements were corrected on the insistence of the Netherlands authorities. Another example of fraudulent tactics was the IPCC's dire prediction regarding the imminent depletion of the Amazon forests as a result of climate change. This was based on unverified reports by a freelance journalist. There were other examples in the IPCC reports. The IPCC has lost all credibility as a trustworthy scientific institution.

A final embarrassment was that at the time that these fraudulent activities were exposed, despite the claimed global warming virtually the whole of the Northern Hemisphere was experiencing one of the coldest winters on record. This contradiction did not escape the notice of the media and the public.

Verification

An essential component of all prediction models is that the outputs must be verified by subsequent observations. My "No need for concern" article was published six years ago. It has been verified on two grounds. First, there have been no climate-related extreme events in South Africa during this period. Second, there has been no statistically significant increase in global temperatures during this period. My views expressed six years ago have been fully vindicated.

The future

A great deal is at stake. Many millions of dollars have been spent on climate change research. National emissions reductions programs if implemented, will adversely affect national economies especially those of the developing nations.

Consequently, all scientists involved in this issue should study the Declaration on science and the use of scientific knowledge produced by the United Nations Educational, Scientific and Cultural Organisation (UNESCO) and the International Council for Science (ICSU) in 1999. It is the complete disregard of these basic scientific requirements that is the direct cause of the present unsatisfactory situation.

Those who have an interest in the effects of climate variability from whatever cause, on South Africa's water resources, should study my 530+ page handbook *Analytical Methods for Water Resource Development and Management.* It is now in the hands of the Water Research Commission.

WJR Alexander, Professor Emeritus, Department of Civil Engineering, University of Pretoria

Soccer fans assured of 'safe' water during World Cup

Soccer fans due for South African shores to share in the international spectacle that is the Soccer World Cup can be sure that the tap water from the host cities are safe.

This is according to Water & Environmental Affairs Minister Buyelwa Sonjica. Releasing the *2010 Host Cities Drinking Water Quality Management Audit Report* in March, Sonjica said the world could rest assured that tap water in all host cities was safe to drink. All of the host cities scored 95% and have been awarded Blue Drop status under the Department of Water's (DWA's) inventive-based regulation system.

Johannesburg (98,39%) and Cape Town (98,18%) received the highest scores. Apart from water quality, host cities were also judged on, among others, water safety plans, submission of credible information, asset management and incident management.

Over the last six months, the country's overall drinking water quality measured 96%, an improvement over the 2009 *Blue Drop Report* when the country's towns and municipalities scored on average 93,3%. According to Sonjica, South Africa still had safe tap water, relevant to other countries. "You go to other countries and at the hotels there is a sign that says 'don't drink from the taps'. We have never had that," she said, adding that the country had few outbreaks of waterborne diseases.

However, this did not mean that the country should be complacent as water quality was continually threatened by population growth, dilapidated municipal infrastructure and pollution. Sonjica said the DWA issued directives against those municipalities where the supply of water had become unsafe. These directives would be followed up by 'strict monitoring' of the municipalities in question, but the department would also offer assistance to those towns that needed to improve their water standards.

To check out the Blue Drop status of your town Visit: www.dwa.gov/za/bluedrop.

Affordable housing to be beefed up

Government plans to upgrade 500 000 shacks in informal settlements by 2014.

This is according to Minister of Social Development Edna Molewa. About 1,2 million are living in informal settlements in South Africa.

Government's new plan is to upgrade 125 000 informal settlement units annually over the next four years through the National Upgrading Support Programme. According to Molewa this is an attempt to step up the delivery of affordable housing for all.

At the same time, government aims to boost the number of rental housing units by offering more housing finance and by setting aside 6 000 ha of land situated near city centres for affordable housing. "The reality is that many of the communities in informal settlements have been there for longer than the period that is stipulated in the laws. There is also the requirement that we need to integrate our people as much as we can into the cities."

Source: BuaNews

New report showcases best practices in asset management

The integrity of water and wastewater infrastructure is increasingly at risk as a result of the failure to invest in the maintenance of these assets.

The severity of this situation is now being taken seriously in many countries, including South Africa, where billions of Rand is required to maintain infrastructure over the next few years. This is according to a new report, *Compendium of Best Practices in Water Infrastructure Asset Management* commissioned by the Global Water Research Coalition.

Water Research Commission Director: Water Use and Waste Management, Jay Bhagwan, who spearheaded the compilation of the report says that recognising asset management as a fruitful area of research is relatively new. "Asset management covers a broad area and has roots in many disciplines. Recognition of the importance of the application of good science and innovation to this area is increasing, which is why it was deemed necessary to capture the novel and creative applications, techniques and processes that are emerging."

The report highlights examples in different countries of strategic initiatives at the highest level, from the development of policy and legislation towards ensuring that asset management becomes a legal requirement for all water services providers to innovative techniques for infrastructure risk assessment. Decision-making techniques for capital investments; studies on the implementation of asset management in utility practice and the use of geographic information systems (GIS) and information technology is also covered in the publication.

"This tapestry of best practice from around the globe demonstrates the giant strides the sector is taking in ensuring that the good principles of strategic asset management are implemented, applied and built on," notes Bhagwan.

To download the publication, Visit: www.wrc.org.za/SiteCollectionDocuments/News%20documents/2009-02-23%20GWRC%20final-Jay.pdf

New CT sewage pump station nears completion

The new R32-million Kuyasa sewerage pumping station and inlet works, currently under construction in south-east Khayelitsha, is set to greatly reduce sewage problems experienced in the area.

"Construction is on track, with the bulk of the concrete works already 95% complete and the electrical and mechanical installations underway," said Mayoral Committee Member for Utility Services Alderman Clive Justus. Final completion is scheduled for the end of June, 2010.

The existing Monwabisi pumping station, which the Kuyasa pump station is set to replace, has suffered several chronic problems over the years. In the event of an overflow, the sewage spills onto the dune area behind the pump station and causes pollution on the dunes and, occasionally, the beach areas. In addition, the poor performance of the existing inlet screens causes frequent blockages and a subsequent breakdown of pumps.

The new pump station is situated at the end of the sewer catchment area in Khayelitsha. About 11 500 erven will contribute sewage to the station. The pump station has a total pumping capacity of 400 ℓ/s and sewage will be pumped via a new 600-m-diameter rising main into a gravity sewer that connects to the Zandvliet Wastewater Treatment Works.

Foreign objects are the most common cause of blockages in sewers and Justus hoped the community would work with the municipality to eliminate this problem. "It is deeply distressing to see what is sometimes placed in sewers and the physical and environmental damage that this causes. I hope that the new pump station will provide the impetus for the community to be more careful with what they put into the sewers."

Billions required to improve bulk water infrastructure

A total of R2,1-billion has been budgeted for the next five years to make South African dams safer.

According to the Department of Water Affairs' latest *Strategic Plan (2010-2013)* a recent assessment of the country's national water resources infrastructure has shown a backlog of R10-billion in dam maintenance. To ensure operational efficiency of the supply of bulk water this backlog needs to be addressed urgently.

To this end, the Dam Safety Rehabilitation Programme, which started in 2005, will continue and planned rehabilitation works will be completed at 25 dams. A similar programme to rehabilitate water conveyance infrastructure has also been started.

The department also plans to complete seven new water augmentation projects to support sustained economic growth and meet growing social water needs. These include the Lesotho Highlands Water Project Phase 2 and the raising of Clanwilliam and Hazelmere dams. Prefeasibility studies to dam South Africa's largest free-flowing river, the Mzumvubu, is set to start in 2012.

Surveys done jointly with local government have also established huge backlogs in the rehabilitation and refurbishment of regional bulk water and sanitation infrastructure owned by municipalities. The department has now embarked on a programme to address these backlogs.

To pay for these rehabilitation and refurbishment programmes the public might have to pay much more for water in future. "A revision of the current water pricing strategy is required to improve the financial viability of government bulk raw water business," the department said. According to the DWA, appropriate pricing of water is necessary to ensure that this scarce resource is valued by all citizens.

Citizens urged to take care of their rivers

The departments of water and environmental affairs, together with the Water Research Commission (WRC) successfully hosted an event at the Eerste River, in Stellenbosch, to raise awareness about the plight of South African rivers. The event was also used to launch the government's Adopt-a-River campaign.

Pollution of South Africa's rivers remain one of the country's greatest challenges and very few of the country's rivers remain untouched by pollution from industrial, mining, domestic and/or agricultural sources.

The Eerste River, which is fed by the Kuils and Plankenberg rivers, is affected by sewage and stormwater runoff from surrounding informal settlements, industries and agricultural practices along its banks. The event, which took place during National Water Week, included a walk to the river, and demonstrations of the miniSASS (South African scoring system), which is used to determine the environmental health of a river.

The aim of the new Adopt-a-River campaign is to create awareness among South Africans about the importance of caring for our scarce water resources and to encourage citizens to actively participate in their protection and management, reports WRC Research Manager Bonani Madikizela. Interest in the programme was sparked by a Parliamentary question whether the country's rivers were healthy and fit for use. Some members of Parliament then volunteered to 'adopt' a river as a sign of their own commitment in protecting the health of the country's rivers.

Following the event at Eerste River, Winelands District Municipality Executive Mayor Nompumelelo Hani vowed to adopt the Eerste River and set an example for neighbouring municipalities. "If the councillors do not keep their promises they can be taken to court," said Deputy Minister of Water & Environmental Affairs Rejoice Mabudhafhasi, who participated in the event.

Two cycling for water research

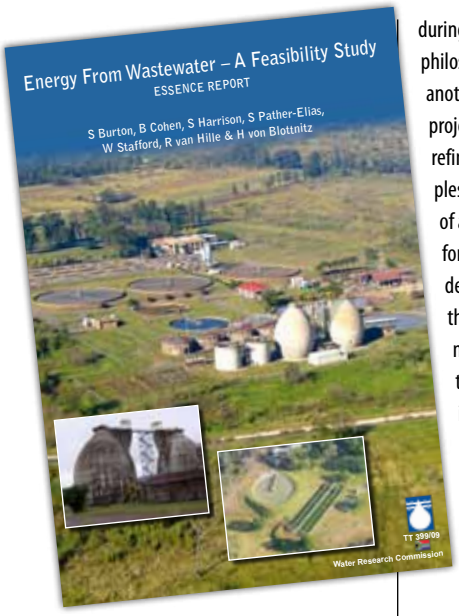
Two young motorcycling enthusiasts have criss-crossed southern Africa to raise awareness about South Africa's water research.

Altus Jacobs and Cobus Botes set off from Johannesburg, travelling through Botswana, Zambia, Malawi and Mozambique. This Wheels for Water, as the adventure has been dubbed, aims to create awareness about the state of water in southern Africa while promoting the NEPAD Water Centres of Excellence Initiative.

This initiative was launched last year to expand and strengthen water research capacity at various universities in the region. It is supported by the Department of Science & Technology, the European Commission, the Water Research Commission and coordinated by Stellenbosch University.

As part of the awareness campaign, the two motorcyclists visited Centres of Excellence at the Universities of Botswana, Malawi and Eduardo Mondlane in Mozambique. They also shared basic water treatment technology in local communities, and collected entrees for a drawing competition from schools in Zambia and Maputo.

New from the WRC



Report No: TT 399/09

Energy from Wastewater – A feasibility Study (Essence Report) (S Burton; B Cohen; S Harrison; S Pather-Elias; W Stafford; R van Hille & H von Blottnitz)

The opportunity exists to improve the current wastewater treatment processes by applying new solutions and technologies that can also reduce energy inputs and/or generate energy for other processes. This study explored the various waste streams and assessed the feasibility of appropriate technologies that could be used to generate energy. The assessment considered the net energy generated from wastewater foremost while the conservation of reclamation of water, reduction in disposal of wastes and the generation of byproducts were considered as added benefits.

Report No: 1689/1/09

Enabling Effective Learning in Catchment Management Agencies: Research Report (DJ Roux; K Murray; E van Wyk)

This work arose out of perceived need for basic guiding concepts for enabling effecting learning within catchment management agencies. This report describes the thinking and learning that took place during the development of the learning philosophy and strategy captured in another WRC Report (**TT 421/09**). The project aimed to further develop and refine a philosophy and set of principles that will enable the establishment of appropriate learning environments for good ecosystem governance; to develop a strategy that implements this philosophy in a chosen catchment management agency; and to facilitate roll-out and initialise implementation of the strategy in the chosen catchment management agency.

Report No: KV 224/09

Market Analysis for UASB Seeding Granules: Local and International Markets (N Musee & L Lorenzen)

The WRC has sponsored research on the development and cultivation of the upflow anaerobic sludge blanket (UASB) process since the late 1990s. This was in response to the limitations identified by the wastewater treatment industrial sector in the country that inhibit full-scale and wide application of UASB for treating high-strength wastewater. A need to design, fabricate, seed, optimise and commission a pilot-plant for producing UASB granules was identified. The research findings from this plant are envisaged to aid in achieving the long-term goal of designing and developing a full-scale industrial plant.

Report No: KV 230/09

Investigation of hybrid membrane system for purification of wastewaters from the olive industry with simultaneous recovery of valuable components (STL Harrison; CJ Garcin; EP Jacobs)

This report describes laboratory work performed on the development of a hybrid membrane system for the treatment and simultaneous recovery of value-added products from wastewaters generated by the olive industry. These wastewaters are produced during table olive and olive oil processing in large quantities. The wastewaters present an environmental disposal problem due to their high organic load and high phenolic content. The hybrid membrane system was comprised firstly of an ultrafiltration membrane to separate a valuable low molecular weight phenoloc compound, called hydroxytyrosol (HT) from higher molecular weight phenolic compounds (such as tannins). Secondly, a nanofiltration system was investigated to concentrate the HT, and to separate it from salts, organic acids and water, which could then be recycled.

Report No: 1749/1/09

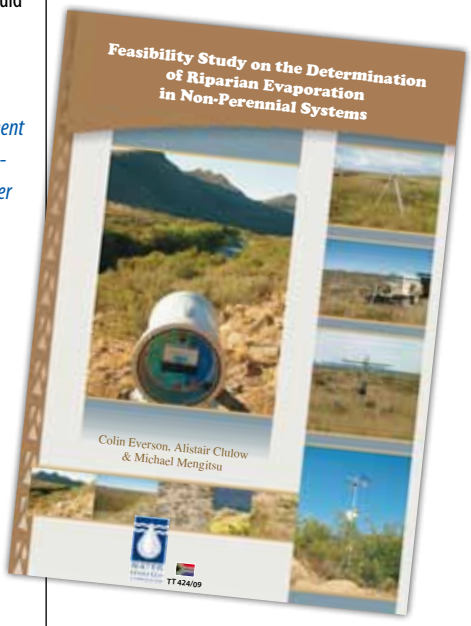
The Feasibility of a Health Risk Assessment Framework to Derive Guidelines for Oestrogen Activity in Treated Drinking Water (NH Aneck-Hahn; C van Zyl; C de Jager)

The WRC has funded research into endocrine disrupting chemicals (EDCs) in water since 1998. South African waters (both treated and raw waters) have recently been found to have oestrogenic activity present in varying concentrations. A previous WRC report proposed a framework to deal with EDCs and protect human health until it is possible to derive more specific guidelines for drinking water in South Africa. This project aimed to determine whether the proposed framework for EDCs is feasible for South African drinking water; to determine criteria to use for test inclusion in the proposed framework; to evaluate the selected battery of tests; and investigate the international status quo with regards to tools for assessing endocrine disrupting techniques other than reproductive effects.

Report No: KV 220/09

A Pilot Study on the Occurrence of Endocrine Disruptive Chemicals in a DDT-Sprayed Area (MS Bornman; EJ Barnhoorn; H Aneck-Hahn)

DDT has been used annually since 1945 in the Luvuvhu River catchment near Thoyoyandou, in Limpopo, for controlling malaria. A broad-spectrum insecticide, DDT is sprayed onto the interior surface of homes to decrease the incidence and spread of malaria by controlling mosquitoes. It is a known endocrine disrupting compound. The objective of this study was to analyse water, sediment and fish tissues for DDT residues and estrogenicity of water as a pilot for a more comprehensive study.



Report No: TT 424/09

Feasibility Study on the Determination of Riparian Evaporation in Non-Perennial Systems (C Everson; A Clulow; M Mengsitu)

Non-perennial systems are an important source of water in the semi-arid west of South Africa. A previous WRC study identified the importance of understanding the actual evaporation of riparian vegetation along these non-perennial systems and their link to groundwater systems. This study was aimed at estimating early summer and summer evaporation rates from three distinct vegetation types (two riparian and one dryland)

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along a non-perennial stream for the development of a water assessment methodology.

Report No: 1627/1/09

First Order Assessment of the Quantity and Quality of Non-point Sources of Pollution Associated with Industrial, Mining and Power Generation (RG Heath; HD van Zyl; CF Schutte; JJ Schoeman)

Non-point sources of pollution (or diffuse sources of pollution) play a major role in the degradation of water quality, specifically with respect to salinity, eutrophication, sediments, pathogens, pesticides, and some heavy metals. Thus, attention is increasingly being devoted to the quantification of non-point water source pollution and to identify means to control it cost-effectively at source. In-depth literature reviews on the mining industry, the industrial and power generation sectors were undertaken in an attempt to assist with the first order assessment of non-point sources of pollution from these sectors in South Africa.

Report No: 1772/1/09

Scoping Study on Water Use of Crops/Trees for Biofuels in South Africa (GPW Jewitt; HW Wen; RP Kunz; AM van Rooyen)

The demand for energy is growing rapidly all over the world, resulting in increased searches for alternative sources of fuel. The production of ethanol and diesel from vegetable biomass and oils (i.e. biofuels) has been promoted as an environmentally friendly alternative to oil-based fuels. Impacts on water resources are a major concern in the production of biofuels. In 2007, the WRC instigated a study to assess both the potential growing areas and water use of potential biofuel feedstock in South Africa. Among others, this study set out to identify all crops/trees grown in South Africa that can be used as a biofuel feedstock, assess the available knowledge on water use of these crops/trees; estimate the water requirements of selected crops/trees where information on water use is lacking; determine existing gaps in knowledge regarding water use and crop parameters, and recommend priorities for future research.

Report No: 1668/1/09

Guidelines for the Assessment of the Compliance of South African Potable Water Supply with Accepted Drinking Water Quality Standards and Management Norms (Maggy Momba; Chris Swartz & Larry Obi)

This study aimed to establish the compliance of South African potable water providers with the required water quality guidelines and a set of other operational and management norms, identify the reasons for non-compliance and suggest solutions to any problems experienced which prevented compliance with these guidelines and norms, and communicate these solutions to municipal management. The focus was on smaller and non-metropolitan water suppliers.

Report No TT: 422/09

Towards the Realisation of Free Basic Sanitation: Evaluation, Review and Recommendations (N Mjoli; G Sykes; T Jooste)

Access to basic sanitation as a right is enshrined in the South African Constitution. 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 strategy in 2004, the process of approval for this strategy has been slow as government realised that provision of Free Basic Sanitation was more complex than Free Basic Water.

The aim of this study was to assess the experience of municipalities in the implementation of Free Basic Sanitation services and to develop economic and financial models for sustainable service provision. Based on the findings of the study recommendations were made for improving the delivery of Free Basic Sanitation to the poor.

Report No: TT 406/09

The South African Oxidation and Disinfection Manual (Mias van der Walt, Marina Krüger and Charl van der Walt)

The purpose of this manual is to assist the reader in making a logical selection in matching the water treatment challenges with appropriate treatment processes and technology. First the reader is introduced to some of the literature available on the subject, followed by a more detailed description of the most commonly found water treatment and distribution system challenges, source characterisation and water quality standards. Other chapters discuss available treatment processes, occupational health and safety aspects and consumer health aspects, among others.

Report No: KV 231/09

An Investigation into the Relative Impact of Small-scale Mining Operations on the Contamination of Water Resources (Antoine Mulaba-Bafubiandi & Bhekie Mamba)

While small-scale mining has socio-economic advantages such operations, if not properly managed or controlled, have a potential to cause environmental damage, particularly with respect to the contamination of water resources. This project investigated the possible impact of small-scale mining on the contamination of surrounding water resources. Artisanal and small-scale gold, coal, clay, platinum group metal, diamond and sandstone operations were considered.

Report No: TT 408/09

Guidelines for the Sustainable Operation and Maintenance of Small Water Treatment Plants (Chris Swartz; Godfrey Mwiinga; Mike Marler; Verena Meyer; Mbhuti Hlophe; Rachi Rajagopaul; Kenny Charles)

The selection and implementation of the correct water treatment system is only a first step in ensuring sustainable supply of potable water to small communities. Of even greater importance for sustainability of supply is the following of the correct operational and maintenance procedures. This report offers a series of technical and management guidelines, the latter including soft issues at small water treatment plants that often present major challenges with the sustainability of these plants.

Cape aquifer modelling study shows promising results

Billions of litres of water hidden underground could provide a valuable water resource for the City of Cape Town.

This is according to large-scale studies of the Table Mountain Group (TMG) Aquifer, in which groundwater consultancy Umvoto Africa took part. The company took part in establishing, at a large first order scale, the total available storage of the different aquifers and the storage yield of the fractured quartzitic Peninsula and Skurweberg Formation aquifers of the TMG. To achieve this, Umvoto developed an in-house spreadsheet and geographic information systems model, based on the aquifer geometry and estimated values for porosity and specific storage.

Geologist Dylan Blake presented his company's findings at the Southern African Young Water Professionals Conference held in Pretoria in January. In the storage models, the Peninsula and Skurweberg Formation aquifers have confined pore volumes (i.e. the volume of open space within the rock that can hold water) ranging from about 29 billion to 173 billion m^3 and 4 billion to 26 billion m^3 respectively (based on using different porosity values ranging from 2,5% to 15%.

In comparison, Theewaterskloof Dam, the largest dam in the Western Cape and the seventh-largest dam in South Africa, can hold about 430 million m^3. Using an average hydraulic head decline of 1 m across the confined aquifer areas across all three groundwater exploration areas, and confined pore volumes based on a porosity of 5%, Umvoto geologists found that 6,9 million m^3 of groundwater is available from the Peninsula Formation aquifer and 1,1 million m^3 from the Skurweberg Formation aquifer. (Hydraulic head decline refers to a reduction in groundwater pressure within the rock through pumping, which is reflected in lowered groundwater levels in the aquifer if punctured by a borehole).

According to Blake, the storage yield approach was very conservative, as it used low-end geological values and did not take into account the annual replenishment of the aquifers, and constitutes the yield potential during drought conditions from the confirmed portion of the aquifers only. "The yield model provides a quantitative perspective to the common public and decision makers' perception that abstracting groundwater from the deep confined Peninsula Formation aquifer will somehow significantly dewater the system, with adverse ecological consequences."

"In fact, even where the regionally averaged decline in hydraulic head approaches 20 m, the volume released by aquifer compression generally remains in the order of 0,24% of the total volume in slow circulation within the deep groundwater flow system," he noted. A vastly greater volume of groundwater essentially cannot be extracted by any practical and/or economical method at present."

This model is continually being refined as further hydrogeological data is gathered.

City takes proactive stance in disaster management

The City of Tshwane has produced a comprehensive flood incident management plan believed to be the first of its kind in South Africa.

This plan, the culmination of an intensive four-year study, aims to mitigate the negative effects of flooding, and give guidance for swift and effective action in the event of flood-related incidents and disasters. The plan will guide all municipal departments on their roles and responsibilities when minor or major flooding occurs.

According to Matt Braune, partner in the Pretoria office of SRK Consulting, which assisted the municipality with the plan, the city has recognised the need to focus more closely on incidents. "In this case the focus is on flooding, but this approach can also be applied to other types of abnormal incidents such as fires, or pollution spills."

Each municipal department now knows what its responsibilities will be in the event of a flood. Responsibility checklists notify each functional unit what action to take when called upon. Resource and equipment checklists ensure that each unit will have appropriate resources and equipment available. In addition, departments are able to budget accurately for what is required.

This is probably the first plan of its kind by a local authority providing this level of detail, says Braune. "It brings the City of Tshwane in line with other international cities such as Perth, Sydney, and Melbourne, in Australia, where sporadic and severe weather patterns are also experienced."

Effect to the plan is given through the city's Disaster Management Centre. Residents experiencing an emergency can obtain help from the 24-hour emergency call centre. Based on information received and the guidelines of the plan, a flooding emergency will be dealt with effectively.

Braune adds that lessons learnt from each incident will be analysed and incorporated in the flood incident management plan's logging checklists. In this way Tshwane will continually update and improve its role and resource needs. Information and experience gained will also be used to minimise the risk of flooding and damage in the future.

The plan will enable the city to be more proactive through interventions such as flood risk assessment studies, the prioritisation of stormwater control projects to protect high-risk areas and flood-aware town planning for new urban developments.

Initially SRK Consulting compiled a GIS-based flood risk assessment model for the entire Tshwane area, identifying flood risk areas varying from a low to a high risk. Now the consulting firm is considering taking the system further to provide a digital integrated database, whereby flooding incidents can be logged by using GIS tools and a logging system. This would be the next generation of the flood incident management plan.

"This will assist local authorities towards better and easier management and compilation of historic data of flooding incidents that will improve reporting capability and motivating capabilities to acquire funding for improved proactive planning and remediation measures, for example," notes Braune.

Sporadic and extreme weather conditions experienced in some South Africa areas recently indicated a need for local authorities to be proactive and to entertain the possibility of flood incident management plans being put in place. Braune says the Tshwane model is a platform that can be modified to suit any other local authority.

Pretoria firm scoops award

Pretoria engineering company WRP has won the award for Demand Side Management at the Third Annual Africa Energy Awards.

This award is the latest of several other national and international awards won by WRP for its advanced pressure management project, which was commissioned south of Johannesburg in the Sebokeng and Evaton areas. The project has been running successfully for the past five years.

This is the first time the company has received an energy saving award. Although the pressure management project was designed specifically to reduce water wastage, it is located in Gauteng where virtually all water supplied has been pumped to some extent. Any savings in water use, therefore, also represent energy savings through the reduced pumping requirements.

The actual measured savings resulting from the installation are about 50 million kℓ of water over a five-year period. This represents financial savings to the municipality of more than R150-million. The energy savings have been conservatively estimated to be about 70 000 t of CO_2 equivalent – this was one of the main considerations on which the award was made.

The project has also won awards for technical excellence from the South African Association of Consulting Engineers, the South African Institute of Municipal Engineers and the South African Institution of Civil Engineering, among others.

Lani van Vuuren

CHANGING LONG DROPS INTO GREEN DROPS –

Authorities work to save sewage treatment sector from crisis

Assessment of the country's municipal wastewater services has revealed that almost half of our wastewater treatment plants are posing a critical risk to human health and the environment. Now authorities are racing against time to prevent the situation from reaching catastrophic levels. Lani van Vuuren reports.

***Above**: Minister of Water & Environmental Affairs Buyelwa Sonjica released the Green Drop report in Pretoria in April.*

South Africa has more than 850 wastewater treatment works treating on average 7 589 Mℓ of sewage every day. These range from small works in rural areas treating less than half a megalitre a day (73% of works) to macro works in metropolitan areas treating more than 25 Mℓ/day. More than R3,5-billion is spent a year on the operation of these sewage treatment plants.

Despite the importance of effective wastewater treatment in safeguarding human health and preventing environmental degradation, it is still considered an unsexy municipal service in many areas. This results in inadequate operation and maintenance, poor management, and severe understaffing. While mayors prefer to cut red ribbons on new community centres and sports fields, even basic maintenance remains a luxury for most sewage treatment works around the country.

Last year the Department of Water Affairs (DWA) launched its Green Drop certification process – an incentive-based regulatory approach to evaluate the performance of municipal wastewater services. A little over 7% of wastewater treatment plants achieved Green Drop status, mostly situated in and around Pretoria, Johannesburg, Cape Town, and Durban. Apart from these 'pockets of excellence' the report generally described the state of the bulk of the plants as 'poor to non-functional'. It said that in many cases extensive refurbishment and expansion of the current plants were required. Serious concerns were expressed over 55% of works, which scored between 0% and 49%.

"We acknowledge the shortcomings in the management of wastewater treatment works as revealed by this [Green Drop] report," said Minister of Water & Environmental Affairs Buyelwa Sonjica. Speaking at the launch of the report in April she said: "This programme forced the

management of wastewater treatment into the foreground of many municipal discussions..it was far too long neglected, under-funded and under-maintained."

However, this voluntary process only saw 449 municipal wastewater systems (53%) being assessed, with municipalities citing their lack of 'confidence in their levels of competence' and lack of management information as reasons for not participating in the process.

Consequently, a risk-based assessment was carried out in 848 wastewater treatment works across the country. Information collected to assess the potential risk of these plants included data on plant design capacity and receiving flows, licence status, effluent quality and permitted limit/standard, technical skills, as well as occupational health and safety appointments compared with legal requirements. This has become a base for intervention plans that are geared towards improving municipal technical proficiency and legal compliance with effluent discharge specifications.

Results of the risk-based assessment correlated largely with that of the Green Drop assessment, with 46% of sewage works assessed regarded as 'priority cases' as they are failing to comply with national legislation and good practice. Worryingly, in 37% of cases municipalities did not have information on the wastewater treatment plants they are responsible for.

"While mayors prefer to cut red ribbons on new community centres and sports fields, even basic maintenance remains a luxury for most sewage treatment works around the country."

This was especially the case in the Free State, Eastern Cape, Limpopo and North West, where more than 50% of wastewater treatment works had insufficient data. "In situations were no information or data is available, a municipality may not even be aware of its status and is most probably not complying as a result of this lack of flow and quality measurement," noted Acting Director: Water Services Regulation Leonardo Manus.

The majority of wastewater treatment works fail to meet at least three or more of the respective effluent discharge standards (determinants), most notably *E. coli*, faecal coliforms and ammonia. South Africa's water sources are clearly being contaminated by municipal effluent.

According to Manus, a further challenge is the fact that as many as 20% of (mostly smaller) sewage works are currently operating at or over their

Daspoort Wastewater Treatment Works in Pretoria was one of a few sewage plants which obtained a Green Drop.

Lani van Vuuren

Heidi Snyman

design capacity. Where the plants are well managed this is not so much of a problem. Manus cited Johannesburg's Northern Works, for example, a macro wastewater treatment plant which operated well over capacity for quite some time, yet still managed to operate within legal limits.

Of course, these competent technical and management skills are hard to come by. Not surprisingly, the DWA found that non-compliance is often underpinned by the lack of technical and management skills. Assessors found a dearth of all skills at many wastewater treatment plants, from junior operator level through to supervisors and management staff. The department is now working with tertiary institutions such as the Technical University of Tshwane to train competent staff and find ways of incentivising them to work on especially smaller sewage works.

Other challenges identified include funding constraints to upgrade or refurbish or augment the works, the age of some of the works, limited or restrained operations and maintenance budgets and inappropriate type of technology. The risk-based assessments has identified priority areas for urgent regulatory attention while, at the same time, presented municipalities with tangible targets to reduce the risk of their wastewater treatment plants. "We have already communicated the findings with the municipalities and have advised them how to reduce their risk – in many cases this does not involve investment of millions of Rands," noted Manus.

However, in many cases a sizeable financial investment is required to make up for years of neglect. At least R23-billion is required to overhaul the country's wastewater treatment plants. The DWA is currently in discussion with Treasury and other departments to formulate a bulk infrastructure and refurbishment grant, which is to include funds for wastewater treatment infrastructure improvements.

Litigation is seen as a last resort and is only initiated where other avenues have failed. The DWA has issued around 400 directives and instituted 11 court cases, including charges against the local municipalities of Machabeng in the Free State and Madibeng in the North West.

Sonjica has denied that the situation has reached crisis levels. "It is not a crisis yet, but we do not want it to become a crisis, which is why we are doing everything we can. It will not become a crisis."

To access the *Green Drop Report 2009* Visit: www.dwaf.gov.za/Documents/GreenDropReport.pdf ❑

South Africa has around 390 small and micro wastewater treatment plants, most of which are overloaded and under-resourced.

CSIR isotope technician Grant Hall displays an invertebrate sample to be analysed (All photographs by Lani van Vuuren).

All eyes on Olifants as EXPERTS SEARCH FOR ANSWERS

What has been described as the most intensive operation yet to save a river system from total degradation is currently being undertaken in the Olifants River basin. Lani van Vuuren visited the catchment.

One of the country's hardest working rivers, the Olifants River, which flows through Mpumalanga and Limpopo on to Mozambique, has been subject to prolonged and cumulative ecosystem stress as a result of human activities in the catchment. While the river's plight first caught the attention of the public following the death of hundreds of crocodiles in the Loskop Dam and downstream in the Olifants River gorge situated in the Kruger National Park two years ago, its problems go back a lot longer than that. (For more on the crocodile deaths, see the article in the January/February 2009 issue of *the Water Wheel*).

Intensified irrigated agriculture, large-scale mining, power generation, heavy industry and inadequate domestic sewage treatment have seen the river turn from a majestic water source into little more than a pollution drain in places. Fish kills have become commonplace over the last five years, especially in the area of the Loskop Dam. Most of the pollution occurs in the upper basin.

INTENSIVE EXAMINATION

Thankfully there are a handful of people who see the Olifants as a river worth saving. For the Olifants River Forum (ORF), a group of concerned individuals, organisations and companies that work and live in the catchment, things had deteriorated far enough. It was time to take drastic action and the non-profit organisation has contracted the CSIR to lead a three-year, multidisciplinary study to pin-point the pollution sources in the Upper Olifants River catchment with the view of making strong recommendations towards its remediation and restoration.

This is not the first research to be undertaken on the Olifants River. Different scientific groups have, over the years, looked at different aspects in different reaches of the river. However, this study, known as the Olifants River Research Project, goes far beyond water quality.

This is the first time in South Africa that such a big team is looking at the ecological health of the entire ecosystem in the catchment and how that impacts on water quality, reports project leader Dr Paul Oberholster, limnologist at the CSIR. A team of about 30 scientists and government officials from the CSIR, the universities of Stellenbosch and Pretoria, the Department of Water Affairs and the Mpumalanga Tourism and Parks Agency have come together to tackle the problems of the catchment.

Oberholster explains that although the Upper Olifants River is affected by many variables, such a system is usually driven by a few controlling variables (e.g. heavy metals from acid mine drainage and high total phosphate concentrations from inflows of untreated to partially treated sewage). "With this study we aim to identify the critical variables

in the Upper Olifants River and its tributaries and to determine their thresholds."

The project team is making use of a novel set of ecological indicators at different trophic levels (the position that an organism occupies in the food chain) as well as a comprehensive set of molecular techniques that provide accurate estimates of the ecosystem health in the study area. These data will be used to clearly identify the sources of different stressors and will be particularly useful to develop and refine appropriate water quality management responses, decision-making processes or remediation measures for the rivers in the Upper Olifants catchment.

The objective of this study, which has also received funding from Coaltech, is not to point fingers or apportion blame. "This is a highly complex catchment and aquatic ecosystem, with many factors involved in creating the current situation. It is important that we sit together, look at the bigger picture and involve as many stakeholders as possible to restore the Olifants River," notes Dr Oberholster.

FROM PHYTOPLANKTON TO ISOTOPES

A total of 14 sampling sites were identified in September last year (12 in the Olifants River and two in the Wilge River), and in November the first samples were taken followed by another set of samples taken in March. Senior CSIR researcher Dr James Dabrowski explains that the sites were selected to be representative of the different types of pollutants entering the Olifants River system. "However, finding a site where only one impact was present proved exceptionally difficult!"

***Right**: The Upper Olifants River and its tributaries are under the microscope in what is believed to be the biggest investigation of its kind ever to be undertaken in South Africa.*

***Top left**: Inadequately treated sewage flows into the Olifants River when a subsistence fisherman hopes to catch a meal for his family.*

***Bottom left**: CSIR limnologist Dr Paul Oberholster inspects the illegal dumping of industrial chemicals into a stream in the Upper Olifants catchment. This has become so toxic that it contains not even single-celled life forms.*

Visiting these sites with the researchers it is not difficult to see why the Olifants River is in such a state. At one site, partly-treated sewage forms a white, bubbly foam in which subsistence fishermen cast their lines. At another, the stench of sulphur from illegally dumped industrial waste is so strong it penetrates one's clothing and lingers long after one leaves the site. At a third toxic mine-water from an abandoned mine trickles down to a nearby spruit used as a resource by an indigent community.

Apart from standard chemical analysis, the research team is analysing a variety of indicators, including fish, macroinvertebrates, invertebrates, protozoa, phytoplankton, benthic algae and riparian vegetation. Water

***Top left**: Mpumalanga Tourism and Parks Agency ecologist Jannie Coetzee been a witness to the increased pollution in the Loskop Dam.*

***Bottom left**: Acid mine-water from an abandoned mine flowing into the Brugspruit, ending up in the Olifants River.*

samples are also being tested for the presence of endocrine disrupting compounds, bacteria, viruses and pathogens, among others. Samples are also taken back to CSIR head-quarters in Pretoria where isotopic studies are performed to indicate the possible accumulation of heavy metals in the fish and invertebrates. In April, a related CSIR health impact study started to determine the potential health impacts of the river water on the communities dependent on its water.

A LOOK AT LOSKOP

The Olifants River Research Project is also tying in with similar CSIR research being under-taken at the Loskop Dam. The dam receives all the water from the upper catchment before it flows fur-ther down to the Kruger National Park and eventually Mozambique.

Four sites in the lake are currently sampled regularly.

Oberholster reports that the dam is showing strong signs of becoming hypertrophic. When we visited the dam in March the wall was still overflowing from the recent heavy rains and yet the first signs of algae blooms had already started to appear. The dam experienced its first massive microcystic (blue-green) algae bloom in March 2008.

"Every aquatic system has a relatively limited ability to absorb continual pollutant loads before a dramatic change takes place in the structure and functioning of the ecosystem components," explains Dr Oberholster. "If an aquatic system consistently moves beyond a critical threshold it is likely to change dramatically and start to behave in a different way, often with unforeseen

***Top right**: CSIR aquatic scientists Leanie and Arno de Klerk measuring the dissolved oxygen, water temperature, pH and electrical conductivity values at a sampling site.*
***Bottom right**: The CSIR team taking samples on the Loskop Dam.*

OLIFANTS RIVER FACTS AND FIGURES

- The catchment of the Olifants River, which rises in the Highveld grasslands, covers about 54 570 km^2 and is subdivided into nine secondary catchments.
- The Olifants River basin is home to about 10% of South Africa's population.
- More than 55% of South Africa's electricity is produced here.
- About 90% of the country's saleable coal is mined in the Olifants River basin.
- There are more than 200 dams located in the Olifants River basin, 37 of which are major dams (i.e. have a reservoir capacity of more than two million m^3). These include Blyderivierspoort Dam, Loskop Dam, Middelburg Dam, Ohrigstad Dam, Phalaborwa Barrage and Witbank Dam. Most of this water is used to irrigate about 110 000 ha.

Source: State of the Rivers Report: Crocodile, Sabie-Sand and Olifants River Systems, 2001

***Right**: Loskop Dam is showing increasing signs of becoming eutrophic.*
***Bottom**: CSIR aquatic scientist Leanie de Klerk, invertebrate specialist Peter MacMillan and aquatic scientist Arno de Klerk analyse invertebrates found in a section of the Olifants River. The scientists are not only recording the presence and/or absence of species, but also looking at species dominance.*

or undesirable consequences for people who rely on the system for water supplies."

In the case of the Loskop Dam this change can be seen in the more frequent occurrences of algae blooms and massive fish die-offs in the past few years. "This aquatic ecosystem appears to be in a new state where the basic structure and function of the aquatic ecosystem are different from the original conditions that occurred several years ago," says Dr Oberholster.

One man hoping that the research study will make a difference is Mpumalanga Tourism and Parks Agency ecologist Jannie Coetzee. Over the last few years he has witnessed the demise of the crocodile and hinged terrapin population around the dam. Coetzee explains that the dam seems mostly affected at the inlet, ironically the area which has been cordoned off as the wildlife zone of the dam. "It is unfortunate that the one area which is supposed to offer sanctuary to animals and birds is now becoming dangerous to them."

It is not only for the sake of the environment that the research team needs to find answers. Loskop Dam provides water to the second-largest irrigation scheme in the country. "Many of these farmers currently have lucrative contracts for export and with large retailers. The deteriorating quality of the dam water is certainly a big concern for them," says Dr Oberholster. "If we do not get this right, and these farmers lose their contracts, 30 000 jobs could be on the line."

Dr Pat Manders, Executive Director of the National Resources & the Environment division at CSIR, believes this study could be replicated in other catchments around the country. "The challenges we face in the Olifants River catchment occur in catchments all over South Africa. However, we currently have a situation where we lack the detailed understanding in order to deal with these challenges effectively. Studies such as the Olifants River Research Project will become increasingly important in the future."

"It is unfortunate that the one area which is supposed to offer sanctuary to animals and birds is now becoming dangerous to them."

The team expects to have preliminary findings by the end of this year. It is hoped that the answers will be found before it is too late. ❑

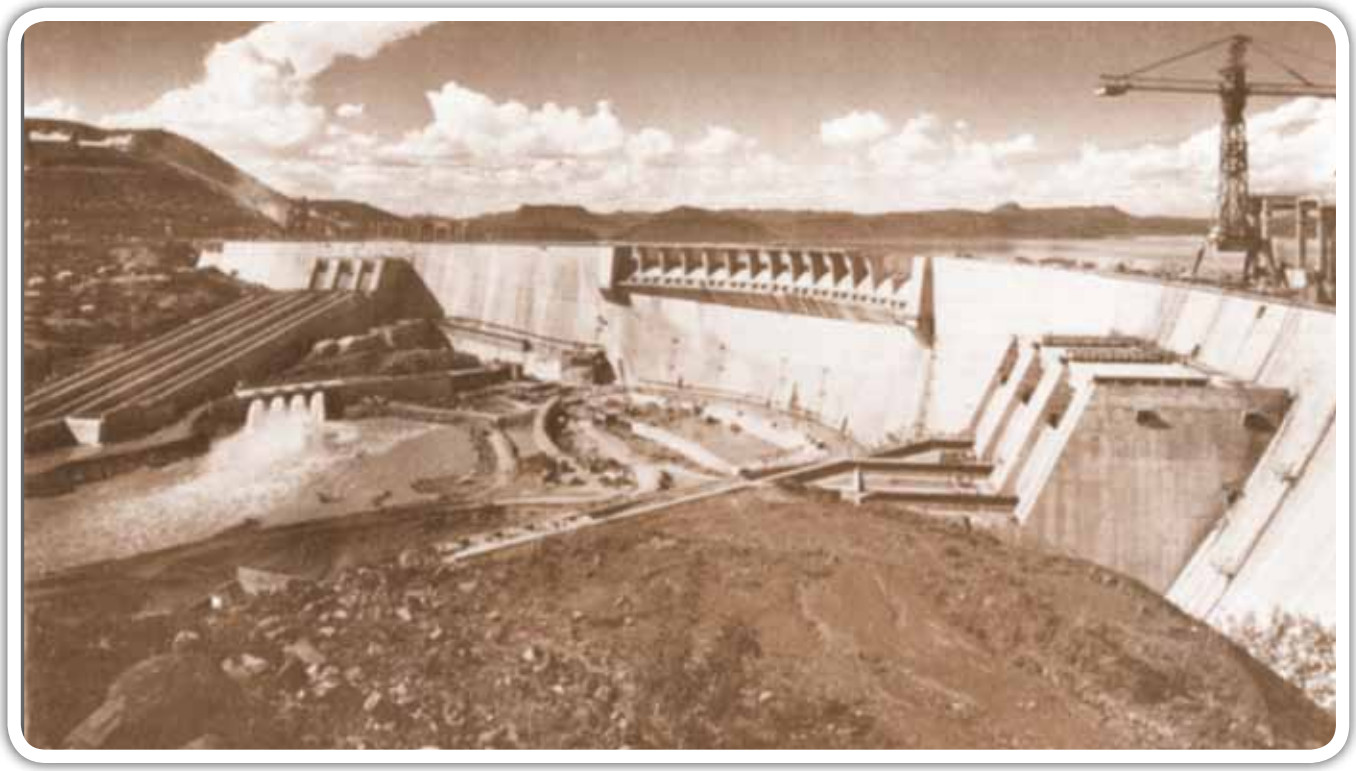
GARIEP

– The dam that tamed the Great River

On 18 November 1966, then South African Prime Minister BJ Vorster pressed a button and blasted a ton of rock into the air to signal the start of construction of the Gariep Dam on the Orange River. Lani van Vuuren looks at the history of the country's largest dam.

Engineers had studied the Orange River for potential water storage sites since the 1870s, however, until the construction of Gariep Dam (or Hendrik Verwoerd Dam as it was known before 1996) the only dam to have been constructed was Buchuberg, in the Northern Cape. At only 10,7 m high, this dam, constructed as a white poverty relief project in the 1930s, would be dwarfed by what was to become the country's largest dam.

Dr Alfred Lewis, who later became Director of the Department of Irrigation (DoI), had a personal fascination with the Orange River or



DWA

The Gariep Dam as it looked close to completion. The dam was eventually completed in 1971.

Gariep (meaning 'Great River') as it was known to the Khoi people. In 1912, when he was a Circle Engineer with the DoI's Northern Circle (headquartered in Kimberley) he undertook a journey down to the banks of the river from Kenhardt to sea.

This journey of around 400 km took 16 days to complete. He started travelling by horse and cart, however, the extremely tough terrain took its toll on his animals, forcing him to complete much of this arduous journey by foot in temperatures of over 41°C.

Written following his ordeal, his detailed report printed in December 1912 was of such value that it served as an information source for planning for many years. In this report Dr Lewis put forward many of the thoughts behind what was to become the Orange River Project, including the whole idea of diverting part of the river's water through a long tunnel to the valleys of the Great Fish and Sundays Rivers.

Lewis' idea germinated until 1944 when field surveys and drillings were initiated, culminating in a technical report. This report was presented to Government in 1948 and proposed a project consisting of a diversion dam on the Orange River, and a diversion canal and tunnel to lead the water under the divide into the Great Fish River Valley, with a diversion into the Sundays River Valley. At that time the scheme was deemed too expensive and it was shelved only to be resurrected in the 1960s.

POLITICAL DECISION

The 1960s were a tumultuous time in the political history of South Africa. In 1960, the Pan African Congress announced a campaign to defy the National Party government's pass laws, which severely restricted the movement of black South Africans. On 21 March, a crowd turned up at the police station in Sharpeville on the eastern Witwatersrand to demonstrate. The police, jumpy after an event in Durban where nine policemen were killed, fired upon the hapless crowd and 69 people died.

The event sent shockwaves through the nation. The political turbulence that followed caused a major outflow of capital. The government countered that by imposing strict controls on the repatriation of profits. But it needed to restore

DAM STATISTICS

- **Type**: Concrete double curvature arch dam
- **Lowest foundation level**: 1 177,4 m above sea level
- **River bed level**: 1 191,7 m above sea level
- **Full water supply level**: 1 258,8 m
- **High flood level**: 1 264,9 m
- **Crest level**: 1 267,9 m
- **Maximum height above foundation level**: 90,5 m
- **Crest length of dam**: 947,9 m
- **Gross storage capacity**: 5 500-million m^3
- **Excavation**: 1,91-mllion m^3
- **Concrete poured**: 1,92-million m^3
- **Final area of lake formed by dam**: 374 km^2 (it inudates about 40 000 ha)

confidence in the country's economy. Shortly after that the announcement came that South Africa would see the construction of its biggest engineering feat yet: the Orange River Project (ORP), of which the Gariep Dam formed the main storage dam.

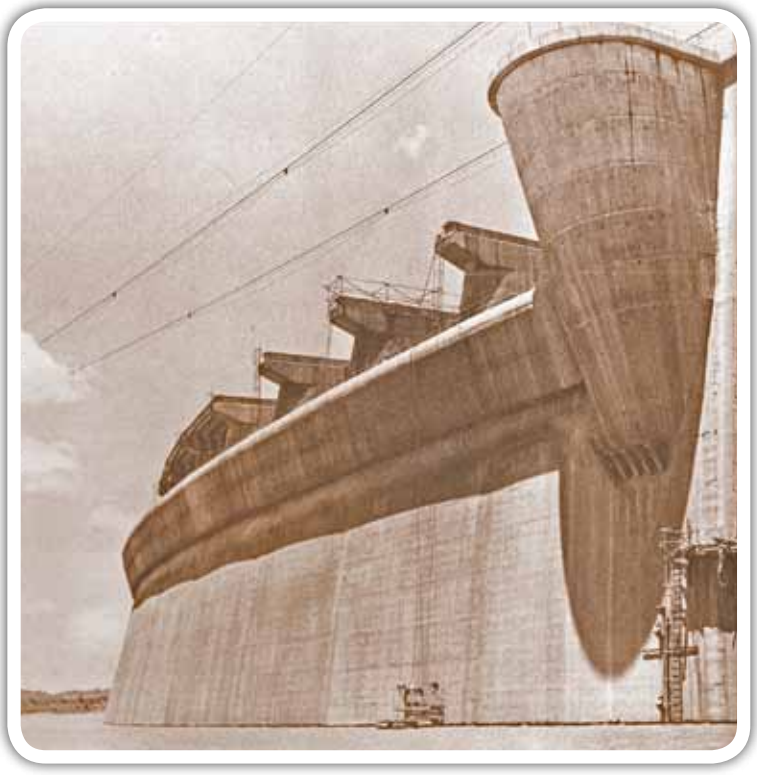
On 23 March 1962, Minister of Water Affairs, PMK le Roux, announced in Parliament the commencement of the construction of the ORP. During his announcement, Le Roux said that "the government has therefore decided to undertake the biggest, most important and most spectacular water supply project ever initiated in the history of our country's water affairs. Not only is it the biggest in Africa, when seen as a whole, but it will be one of the biggest projects of its kind in the world."

"In the history of all young civilised countries the time arrives when big and imaginative water development projects must be launched to promote the growth of areas of development, the formation of industries and the generation of electric power, and to create a means of coping with the future population increase, so as to maintain the rate of progress for the country as a whole. That is the principal aim of the Orange River Project," said Le Roux.

Top right: *An upstream view of the giant intake openings.*

Bottom right: *The main wall of the dam is of the double curvature concrete type, based on solid dolerite foundations. The two intake sections on either side of the river serve as abutments for the higher portions of the main arch.*

DWA



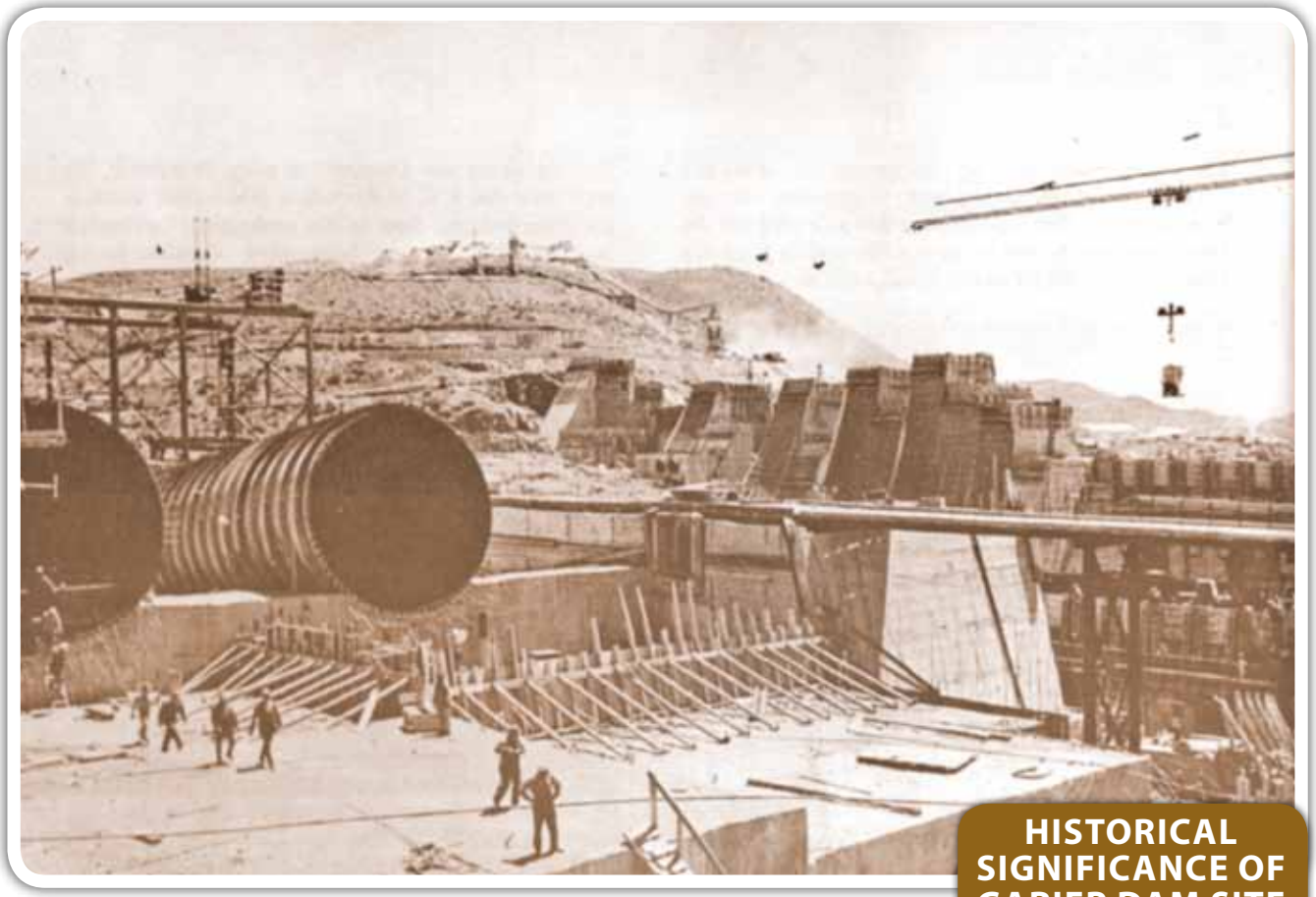
DWA

"In the history of all young civilised countries the time arrives when big and imaginative water development projects must be launched to promote the growth of areas of development, the formation of industries and the generation of electric power, and to create a means of coping with the future population increase, so as to maintain the rate of progress for the country as a whole. That is the principal aim of the Orange River Project."

PMK le Roux

According to the government, the ORP would 'transform the desert into a paradise' by increasing land under irrigation in the country by 40%. It would also provide much-needed water for domestic and industrial purposes, while supplying additional hydropower to Eskom.

The entire project was divided into six phases to be implemented over a period of 30 years. In June 1962, Parliament authorised the expenditure of R85-million for the first phase of the project. While it included several



DWA

The double curvature wall is effective in holding back the millions of tons of water pressing against the dam as it deflects the force of the water towards the solid rock hillside into which the gravity sections of the wall abut. The thrust of the water is so tremendous against the convex side of the wall which faces upstream, pushing against the directional flow of the river, that the wall actually gives or bends under it.

elements, in this article the focus falls only on the Gariep Dam.

PLANNING AND DESIGN

The decision as to where to site the Gariep Dam was a complex one. West of the Vaal-Orange confluence the rainfall was too low and undependable to be worth collecting, but above that point the further east the dam was placed the less water it would receive. On the other hand, the furthest east and higher it was the more irrigable land would lie below it and the greater would be its potential for generating electricity.

To serve one of its main purposes it had to be placed high enough above sea level for water to gravitate to the Great Fish River valley. Another consideration was to place the dam wall where it could impound the maximum quantity of water for the smallest cost in construction: that is making it as short and low as possible. With all of these factors in mind, the present site was selected in a gorge at the entrance to Ruigte Valley, five kilometres east of the Norvalspont. Consulting engineers on the project were International Orange River Consultants Company, a consortium of South African and French firms.

Competitive tenders were called from contractors all over the world. Meanwhile, during 1965 to 1967 several self-contained towns were built to accommodate the families of the men who would be engaged on the project. In April 1966, the main contract for the civil engineering works of the Gariep Dam was awarded to the French-South African consortium of Union

HISTORICAL SIGNIFICANCE OF GARIEP DAM SITE

It was only a few kilometres east of the Gariep Dam site that Colonel Robert J Gordon, who gave the Orange River its name first saw the river, and with his draftsman made a panoramic picture of a ravine he called Orange Poort (Orange Gorge). This site was submerged by the dam.

It was at the dam site that John Norval established his pont in 1841.

Near the same spot Voortrekker pioneers of the Great Trek floated their tented wagons and swam their cattle across the muddy flood water on their way to the interior.

Along the south bank the British forces in the South African War of 1899-1902 built block houses connected by fences to control the crossings; and at Norval's Point established a large concentration camp in which hundreds of Boer internees died.

Corporation-Dumez-Borie Dams. Veteran European dam builder André Borie himself paid a special visit to the dam site. Construction started soon after.

While the South African side of the consortium was responsible for the labour and management, general engineering services, drawing office facilities, purchasing, secretarial and medical-related activities, specialist engineers were drawn from France. As such the construction township of Oranjekrag, near Norvalspont, developed a distinctly cosmopolitan atmosphere where French was spoken as often as Afrikaans and English. In turn, it is said that Italian virtually became an official language in the towns of Venterstad and Steynsburg.

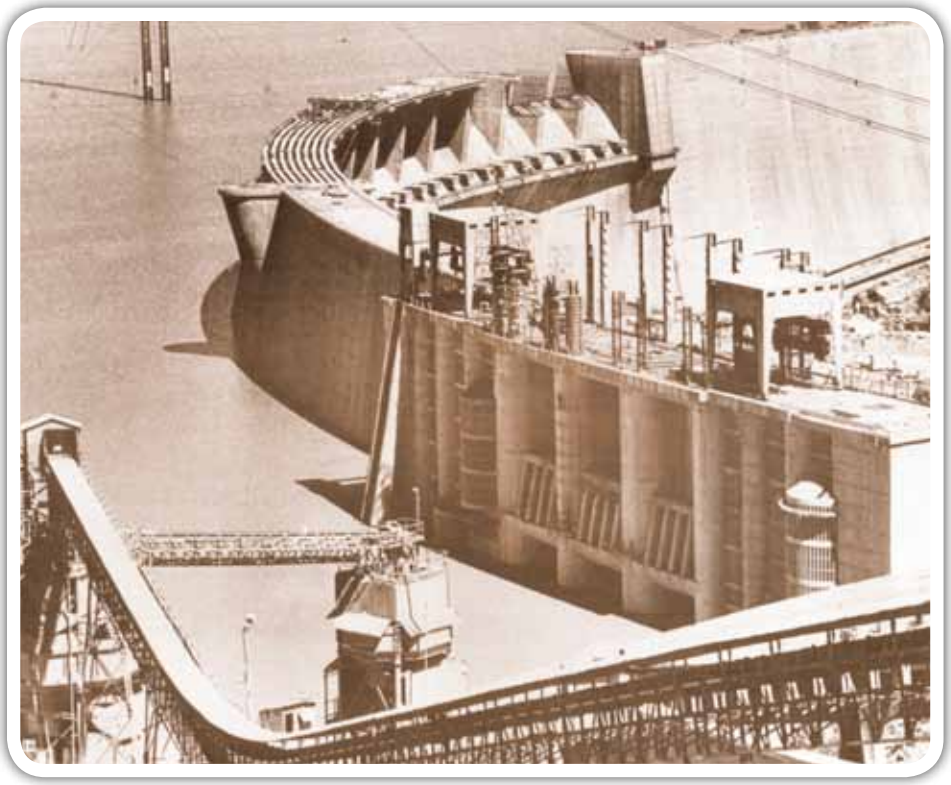
ENGINEERING ASPECTS

A combined gravity-and-arch dam, the Gariep wall was constructed entirely of concrete. Since the gorge at the site where the dam was built was too wide to allow for a complete arch shape, only the central section of the dam is arched. Two concrete gravity section flank walls form artificial gravity abutments for this arch.

The Gariep Dam is a double curvature structure, i.e. shaped like an egg shell (Apparently a cheaper design was initially drawn up, however it was rejected by politicians in exchange for this more impressive and aesthetically pleasing option). The thrust of the water is so tremendous against the directional flow of the river that the wall actually gives or bends under this. This factor had to be taken into account in the design of the dam.

Two huge water sections – one of each flank of the main arch – control the release of water. In the wall on the right (Free State) bank of the river there are river outlet pipes; while in the wall on the left (Northern Cape) bank of the river there are four electric power penstocks.

Six flood spillway openings are situated in the water intake sections, three on each bank, symmetrically positioned, and there are six large



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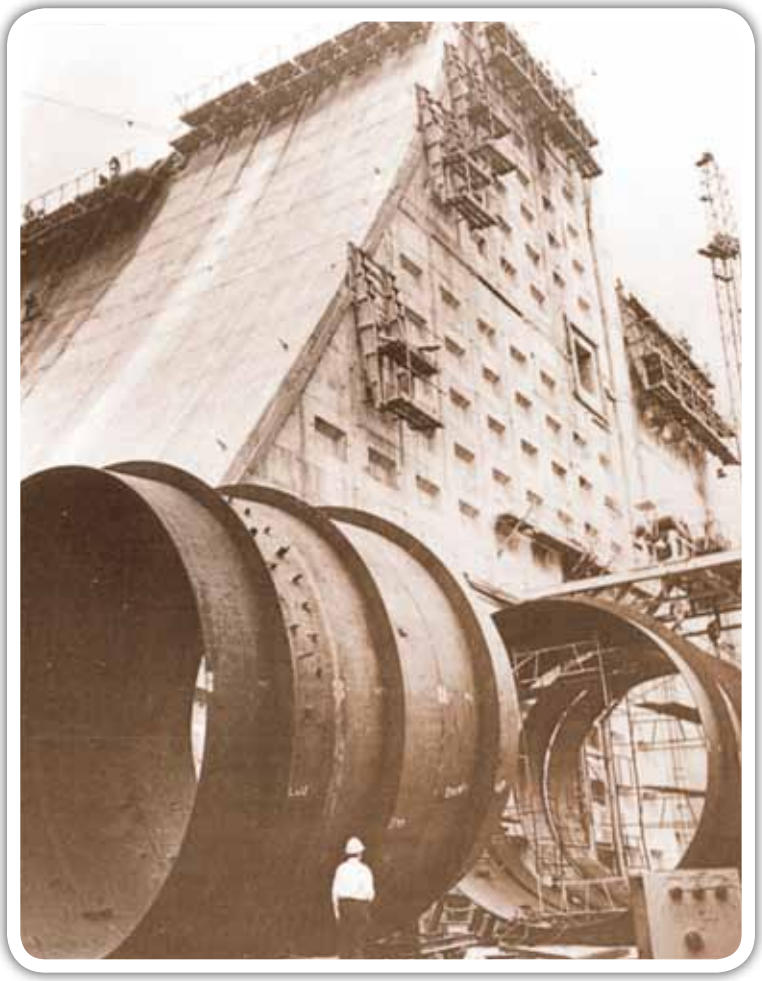

DWA

Above: *The Gariep Dam (formerly known as the Hendrik Verwoerd Dam) was the first internationally designed and constructed dam in South Africa.*

Left: *Sections of steel liners of water penstocks. Water is released downstream into the Vanderkloof Dam through four generators for the generation of hydro-electric power.*

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This is an introductory course to the field of water management covering the historical basis and modern day application of water allocation principles and how they are affected by the social economic paradigm.

Course number: P001828-01-2010
Date: 20 - 23 September 2010
Fee: R7800.00

Operation of Water and Wastewater Treatment Plants

This course is designed to provide valuable information and reference tools for both technical persons and decision makers in the field; it is also a valuable preparatory tool for persons who are planning to enrol in the Water Utilisation and Environmental Programmes in the near future.

Course number: P001013-01-2010
Date: 26 - 30 July 2010
Fee: R7590.00

Short Course in Water Quality Management and Effluent Treatment

The course is aimed at engineers, scientists and technologists involved in water quality management and control, and in the operation of water and wastewater treatment plants. It is also a valuable preparatory tool for persons planning to enrol in the postgraduate degree programme.

Course number: P000867-01-2010
Date: 16 - 20 August 2010
Fee: R7590.00

For academic enquiries, please contact the Course Leader:
Professor Evans Chirwa
Tel: +27 (0)12 420 5894
E-mail: evans.chirwa@up.ac.za

For brochures and registration forms please contact the event coordinator:
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Tel: +27 (0)12 420 5015
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E-mail: info.ce@up.ac.za

Short Course in Industrial Waste Management

This course is aimed at scientists and technologists involved in waste management or individuals who would like to supplement their experience in waste management.

Course number: P001396-02-2009
Date: 10-12 May 2010
Fee: R4070.00

Short Course in Membrane Processes

After successful completion of the course, delegates will have adequate theoretical and practical knowledge to make informed decisions about the functioning and application of membrane processes in desalination and in water and waste water treatment.

Course number: P000847-01-2010
Date: 20-22 October 2010
Fee: R5060.00

For academic enquiries, please contact the Course Leader:
Professor Japie Schoeman
Tel: +27 (0)12 420 3569
E-mail: japie.schoeman@up.ac.za

For brochures and registration forms please contact the event coordinator:
Refilwe Selepe
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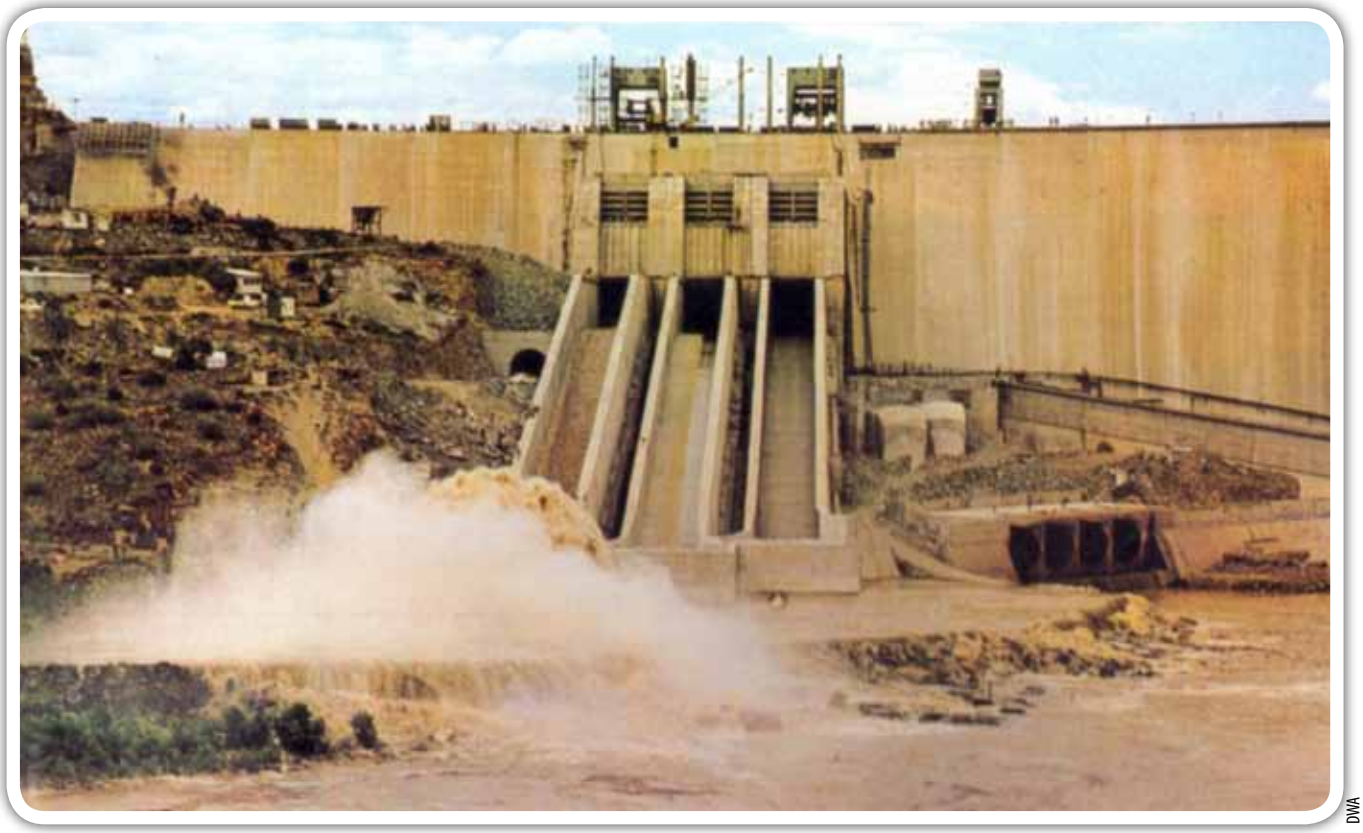

DWA

Sluice tests taking place at the dam. Gariep features six flood spillway openings situated in the water intake sections, three on each bank, symmetrically positioned. There are six large concrete channels or chutes – three on each side – and a concrete apron beneath the overspill to prevent the falling water from eroding the rock at the base of the dam.

concrete channels or chutes – three on each side and a concrete apron beneath the overspill to prevent the falling water from eroding the rock at the base of the dam. Under normal maximum flood conditions 8 000 m^3/s of water can be discharged. This is in addition to the 8 100 m^3/s of water which can be discharged through the chute spillways.

Enormous radial gates, three on each side, are situated in the gravity sections of the wall on either side of the main arch. These discharge floodwaters into the six chutes. The radial gates are 8 m high, and the moving parts along in each gate weigh 95 t. The gates were rubber-sealed and faced with stainless steel. These gates are said to have a life expectancy of three centuries – way beyond the life of the dam itself.

Gariep Dam's design also features Roberts splitters or energy dissipaters to break up the sheet of water discharging over the spillway. This design, developed by Lt-Col DF Roberts, was first used on the Loskop Dam in the 1930s. While provision has been made to increase the height of the dam to recover storage capacity lost to siltation this has never been necessary.

In February 1967 the Orange River in one last act of defiance sent down a flood of 8 500 m^3/s through the works. The river catchment received 150 mm of rain in 12 hours, resulting in a peak river flow of 31 350 m^3/s. Luckily no significant damage was done to the dam structure.

Gariep Dap started storing water in September 1971. It was finally commissioned in 1971 and overflowed for the first time in 1972. At its official opening in March 1972, Prime Minister BJ Vorster emphasised the importance of water to South Africa: "Water is too scarce in our country ever to be cheap and water tariffs must be high enough to make everybody realise this and to encourage users of water to do so sparingly... in this way the scarcity value of water in our country will be brought home to all consumers." ❑

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Weathering the STORM(WATER) IN CAPE TOWN

Sue Matthews

Managing stormwater in an urban environment is challenging for any city. Sue Matthews looks at the City of Cape Town's approach to water-sensitive urban design.

Landscape architects, town planners, civil engineers and environmental practitioners responded so positively to an invitation to the City of Cape Town's presentation on its new stormwater, catchment and river management policies that a second presentation had to be scheduled to accommodate them all.

The two policies – approved by Council in May 2009 – build upon guidelines on stormwater management and floodplain management published in 2002 and 2003 respectively. The Floodplain and River Corridor Management Policy promotes an approach for dealing with development proposals adjacent to watercourses and wetlands, taking into account the risk of flooding as well as ecological and socio-economic considerations. It recognises that urban waterbodies are an integral part of the stormwater system, and that even those that have been canalised or constructed play an important role in sustaining flows to aquatic ecosystems downstream, while also having significant recreational and aesthetic value for the city's inhabitants.

"By dealing with runoff and pollution on site, sustainable urban drainage systems can help lower flow rates, improve water quality, increase groundwater recharge and create a 'greener' environment for wildlife and local residents."

In terms of the policy, no development will be permitted in the high hazard zone of a floodplain, closest to the watercourse, nor will obstruction to the free flow of water be allowed within the 20-year floodline. Some developments or activities may be permitted between the 50 and 100-year floodlines, but buildings with special evacuation or emergency response concerns, such as senior citizen centres, hospitals, schools, chemical plants – and even halls that may be needed to accommodate evacuees in an emergency – will only be allowed above the 100-year floodline.

In addition, ecological buffers will be maintained to provide habitat for fauna and flora, reduce erosion and protect waterbodies from

polluted runoff, while also enhancing the urban landscape. The buffer and adjacent area set aside for socio-economic use, as well as the watercourse and associated wetlands, will comprise the river corridor, which will be managed in an integrated manner that balances the flooding, environmental and socio-economic issues.

"The City will be developing river corridor plans to give effect to this," explained Martin Thompson, of the City of Cape Town's Roads and Stormwater Department. "We shouldn't work in isolated fragments where we look only at a particular development or river reach."

While the above policy aims to control development alongside watercourses, the Management of Urban Stormwater Impacts Policy focuses on minimising the impact of stormwater from developed areas on watercourses, wetlands and other receiving waters. It recognises that urbanisation negatively impacts waterbodies by hardening surfaces and accelerating stormwater runoff, which reduces groundwater recharge and increases erosion, apart from causing a deterioration in water quality, ecosystem integrity and biodiversity.

The policy is therefore based on the principles of Water Sensitive Urban Design (WSUD), an internationally accepted approach to ensure urban development is planned, designed, constructed and maintained in a way that will help reduce negative impacts on the natural water cycle and protect aquatic ecosystems.

"Although the guidelines for new developments published in 2002 looked at both quantity and quality of runoff, the quality aspects were largely ignored, and were not specific enough," said Rod Arnold, also of the City of Cape Town's Roads and Stormwater Department. "We therefore decided to develop policy, which is given legal teeth by the by-law promulgated in 2005."

Sue Matthews

The City of Cape Town's new River Corridor Management Policy recognises that even canalised rivers may have recreational and aesthetic value for the city's inhabitants. A popular walking trail follows the Liesbeek River as it flows through Rondebosch and Rosebank.

The City of Cape Town's by-law relating to stormwater management prohibits discharge of anything other than stormwater into the stormwater system, and also outlines measures to protect the stormwater system from damage, pollution and flooding. The new policy goes a step further, aiming to improve the quality of runoff by specifying a pollutant removal target of an 80% reduction in suspended solids and a 45% reduction in total phosphorus. It also stipulates measures to protect against erosion and flooding. These are contained in an annexure to the policy entitled 'Interim criteria for achieving Sustainable Urban Drainage System objectives in various development scenarios'. Sustainable Urban Drainage Systems – commonly known as SUDS – is the component of Water Sensitive Urban Design focusing on stormwater management.

Following Rod Arnold's presentation, Prof Neil Armitage of the University of Cape Town's Civil Engineering Department gave a

THE CENTURY CITY SUDS SYSTEM

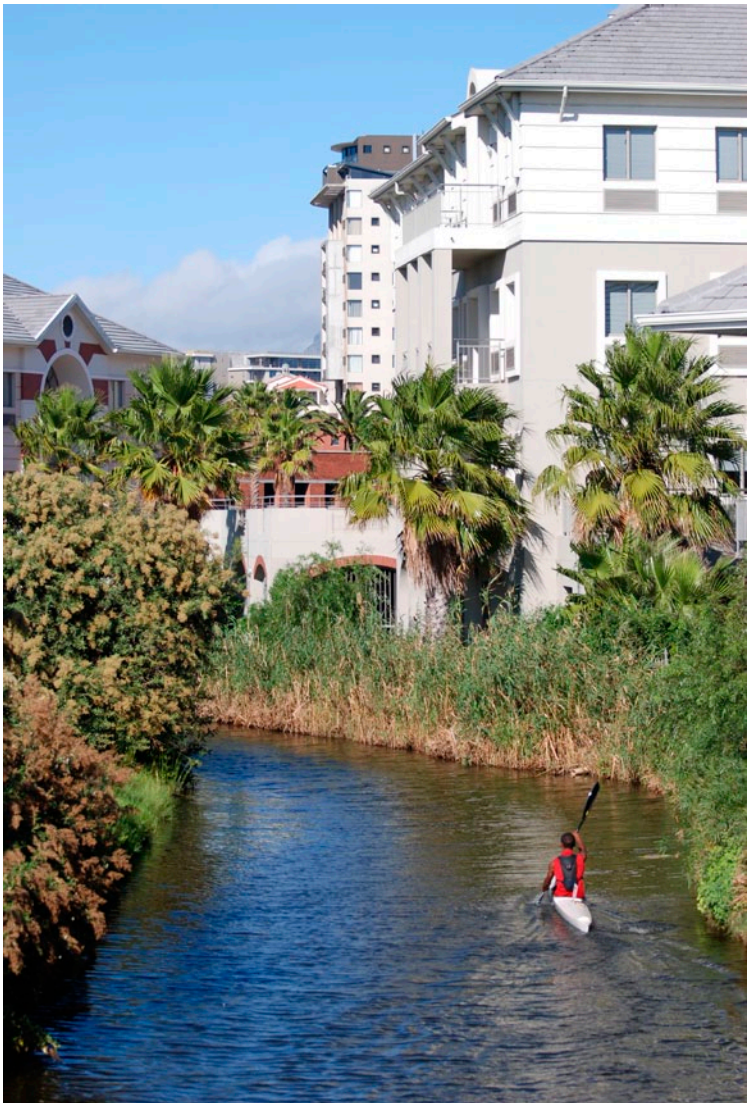
The Century City sustainable urban drainage system collects stormwater runoff from the surrounding area and 'polishes' it in a constructed wetland consisting of four ponds with different functions.

Ponds 1 and 2 have reed beds that not only slow the flow of water, encouraging settling of suspended particles, but also take up phosphate from the polluted stormwater. Pond 3 has a large expanse of deep open water that is aerated by the wind, allowing bacteria that break down nitrogenous compounds to flourish.

Pond 4 is a shallow pond that is well aerated and densely vegetated, facilitating removal of residual phosphates and nitrates. The constructed wetland and natural, seasonal pans adjacent to it are important bird habitat, while the canals provide recreational opportunities.

presentation on the SUDS approach, which attempts to replicate natural drainage rather than carrying stormwater away in pipes and canals as quickly as possible. By dealing with runoff and pollution on site, SUDS can help lower flow rates, improve water quality, increase groundwater recharge and create a 'greener' environment for wildlife and local residents. This is achieved with permeable surfaces such as gravel, kernel or wood chip; infiltration devices that drain water directly into the ground; filter strips and swales – vegetated slopes and channels that slow the flow of runoff – as well as detention ponds and artificial wetlands containing reeds and other riparian plants.

Prof Armitage is currently the project leader of a WRC-funded project entitled Alternative Technology for Stormwater Management, which aims to identify, develop and evaluate WSUD technologies for use in South Africa, and compile practical and user-friendly guidelines for their implementation. The research team consists of the Urban Water Management Group at UCT – a multidisciplinary group that includes researchers from the Civil Engineering, Environmental and Geographical Science, and Social Anthropology departments, among others – as well as representatives from the municipalities of Cape Town, Durban (eThekwini), Johannesburg and Pretoria (Tshwane), SRK Consulting Engineers and IDS (Information Decision Systems).



Sue Matthews

***Left**: The Century City sustainable urban drainage system collects stormwater runoff from the surrounding area and 'polishes' it in a constructed wetland consisting of four ponds.*

One of the project deliverables that has already been completed is a report showcasing a number of existing SUDS-type developments in South Africa. Examples include Century City's canals and wetlands in Cape Town, the University of Witwatersrand car parks and the Cotswold Downs golf estate in Durban. Another component of the project is a scientific experiment to investigate how well riparian

Sue Matthews

plants perform as biofilters.

Dr Kevin Winter of UCT's Environmental and Geographical Science Department heads up this study, which also involves researchers from the Botany and Chemistry Departments.

"The City of Cape Town's policy of an 80% reduction in suspended solids and a 45% reduction in total phosphorus is a bold initiative, and one that I think is very progressive," says Dr Winter. "But technically it's difficult to do – for instance, we don't know what kind of plants would be most effective as biofilters. There's also a risk that organic pollutants would accumulate in the soil of these biofilters over time, and eventually reach toxic levels."

"So we've set up an experiment in one of UCT's glasshouses with 300 plants of nine different species. These include the *Typha* bulrush and *Phragmites* reed – the two species that dominate wetlands in the Western Cape – as well as two Cape restios, the arum lily, agapanthus, sour fig, and buffalo and kikuyu grass. All are indigenous apart from kikuyu, but we wanted to look at it because if you design a swale with natural vegetation it will probably be taken over by kikuyu anyway. *Typha* and *Phragmites* are also highly problematic in eutrophic environments, and they don't offer much in the way of ecological services or habitat."

Above: *Dr Kevin Winter of the University of Cape Town's Environmental and Geographical Science Department is project leader for a WRC-funded greenhouse experiment to test the effectiveness of various plant species for use as biofilters.*

"The plants are watered with an automatic irrigation system every three days, each with a litre of water simulating the phosphate, nitrogen and ammonia concentrations of different types of water. A third of the plants are dosed with clean water, a third with water representing diluted stormwater, and a third with water typical of extremely polluted runoff. The water that drains through the soil – consisting largely of Malmesbury shale – is collected for laboratory analysis of phosphorus and suspended solids, in line with the City of Cape Town's stormwater policy."

"I'll also have a student modelling in-stream flow of wetlands – probably those at Century City – to look at biological responses to inflows, while another component of the broader project is investigating the 'green roof' concept. Both the Cape Town and eThekwini Municipalities have pilot studies on their own premises, and by getting the municipalities involved as partners in the project we've got them excited about the possibilities."

"We've also drawn in students from a range of different departments at UCT, so we're learning from each other in a cross-disciplinary way. This has helped make us far more critical about the assumptions we make and the way we communicate our research, which has been hugely beneficial."

In light of this progressive approach, it is anticipated that the project – due for completion in 2012 – will contribute to changing thinking and improving practices in managing the drainage of surface water in South Africa. ❑

Ostrich sector takes giant strides to PRESERVE THE LITTLE KAROO

Researchers and conservationists have teamed up with the commercial ostrich sector to restore and protect the rich botanical heritage of the Little Karoo. Lani van Vuuren reports.

Despite its arid climate, the Little Karoo boasts some of the richest plant biodiversity in the world. The botanical diversity found here is unrivalled by any other arid region on earth. The area is especially rich in succulent species. For example, in the central Little Karoo, which lies in the valley between the Langeberg and Swartberg mountains, there are more than 1 300 species, including 182 species that are endemic. Unfortunately much of the biodiversity of this area has been affected by human activities, including agriculture and livestock grazing.

Known as the ostrich capital of the world, Oudtshoorn has been the centre of the South African ostrich industry for over 150 years. Due to their physiology ostriches are kept on the lowlands. Ostriches are known for their restless behaviour, continual foraging, dustbathing and nesting activities. These characteristics together with overstocking are extremely damaging to the veld.

"Flock breeding – where a flock of ostriches are put on natural veld to breed – is a traditional ostrich farming style that has been used for many decades," explains Susan Botha, head of the South African Ostrich Business Chamber's biodiversity management project. Traditionally, a three-camp system is used. Three areas of natural veld (about 300 ha in size) are fenced off. Ostriches are placed in one camp for eight months and then totally removed from the veld for four months. In the second season the ostriches are moved to the second camp while the first camp is rested and so on. Each camp is rested for

Lani van Vuuren

says Prof Sue Milton of Renu-Karoo. "As a result the topsoil is exposed to erosion by wind and rain. The bare soil surface becomes compacted so that rain does not soak into the soil and dongas form along the paths. Seeds germinate with difficulty under these conditions. Where vegetation does return, it is often the unpalatable species that dominate the veld."

OVER TO ACTION

There has been a realisation among ostrich farmers of the importance of finding a balance between utilisation and conservation of natural veld; especially in ecological hotspots such as the Little Karoo, notes Botha. The sector needs to be sustainable if it is to continue supporting its thousands of employees and keep its top spot in the global market.

This has resulted in the establishment of the South African Ostrich Business Chamber's biodiversity management project. With funding from several local and international sources, this project aims to quantify the conditions of the natural resources where commercial ostrich production occurs and assists farmers with alternative plans were necessary.

One of the first steps in the project has been the launch of a pilot project on four farms to test various restoration methods on old ostrich camps. Led by ASSET Research, the project also forms part of a larger project funded by the Water Research Commission to investigate whether biodiversity restoration yields the desired results and improves the socio-economic value and agriculture potential of restored land. The Little Karoo project is also supported by the Succulent Karoo Ecosystem Programme (SKEP).

"The bare soil surface becomes compacted so that rain does not soak into the soil and dongas form along the paths."

"It is hoped that through this research we will be able to convey the best restoration methods to farmers," says Botha. However, it is understood that active restoration is a big financial commitment to make. It is thus expected that the cost/benefit model that will be produced about two years, whereafter it should be suitable for stocking again.

"Unfortunately, because of the dry climate and little rain, vegetation is often not restored within the two years rest period," reports Botha. This situation is exacerbated by overstocking of the camps. While the recommended stocking rate is one ostrich per 23 ha, actual stocking rates can be 30 times as dense to ensure profitability.

This overstocking leads to trampling of the veld as well as overgrazing (ostriches peck at vegetation whether or not they receive supplementary food), which together destroy the vegetation,

***Above**: A series of hand-dug holes dug a metre apart to capture seed and water.*

***Right**: One of the succulent plants which has established itself in the veld restoration hollows.*

Lani van Vuuren

Wood-chip mulch was scattered over the planted areas to improve the capacity of the soil to hold water.

as part of this research will assist ostrich farmers in making informed management decisions regarding the improvement of their veld's condition.

RESTORATION METHODS

Vegetation cover and plant diversity regulates the flow of water, ensuring good rain infiltration. It also facilitates aquifer recharge and increases water quality while reducing wind and water erosion and providing improved grazing.

Ecology Masters student at the University of Cape Town, Petra de Abreu, tested methods for re-establishing indigenous vegetation on the degraded ostrich farmland, while, Stellenbosch University economics Masters student Worship Mugido undertook a financial and cost benefit analysis of the veld restoration.

Two methods were employed in the restoration, which started in February last year. The first method consisted of hand-dug holes (0,25 m deep and 1 m across) a metre apart. The soil was loosened and sculpted in such a way that each would retain rainfall runoff.

For the second method the soil surface was broken using a track-drawn ripper. Breaking the hard-caked soil surface allows both rainwater to infiltrate into the soil and plant roots to penetrate so that the plants can establish. Naturally occurring Karoo shrub and grass seedlings – bushman grass and anchor Karoo shrub were then planted by hand into the loosened soil. Wood-chip mulch was scattered over the planted areas to improve the capacity of the soil to hold water.

Monitoring the success of the restoration methods were

THE SOUTH AFRICAN OSTRICH INDUSTRY

Ostrich farming started in the 1860s in the Oudsthoorn area, first with wild birds and later with domesticated ostriches following the invention of the ostrich egg incubator. The sector was concentrated around the production of feathers only and reached a peak in 1913. At that time, ostrich feathers became South Africa's fourth-largest export earner after gold, diamonds and wool. Following the outbreak of World War I the global feather market crashed and only recovered later when the sector was expanded to include the production of meat and leather.

South Africa remains the world leader in the ostrich industry and there are currently about 560 export-registered farms producing around 300 000 slaughter birds a year. There are ten export-approved abattoirs and 15 tanneries. The ostrich industry contributes about R1,2-billion a year to the South African economy, and employs around 20 000 people (including production and processing.) More than 90% of products are exported. The industry is concentrated in the Western and South Western Cape, with about 25% of farms found in the Eastern Cape. Other ostrich farms can be found in the Free State, Gauteng, Limpopo, Mpumalanga, North West and Northern Cape. Ostrich leather is responsible for 65% of the sector's income, meat 30% and feathers only 5%.

Source: South African Ostrich Business Chamber

quite challenging – while there are no longer ostriches kept on these stretches of veld such as springbuck, helped themselves frequently to the palatable vegetation that managed to grow. However, the first method proved more effective than the second and the hollows trapped water and windblown seed. It also reduced the ratio of unpalatable plants to palatable plants, allowing more edible plants to establish.

EXPENSIVE PROCESS

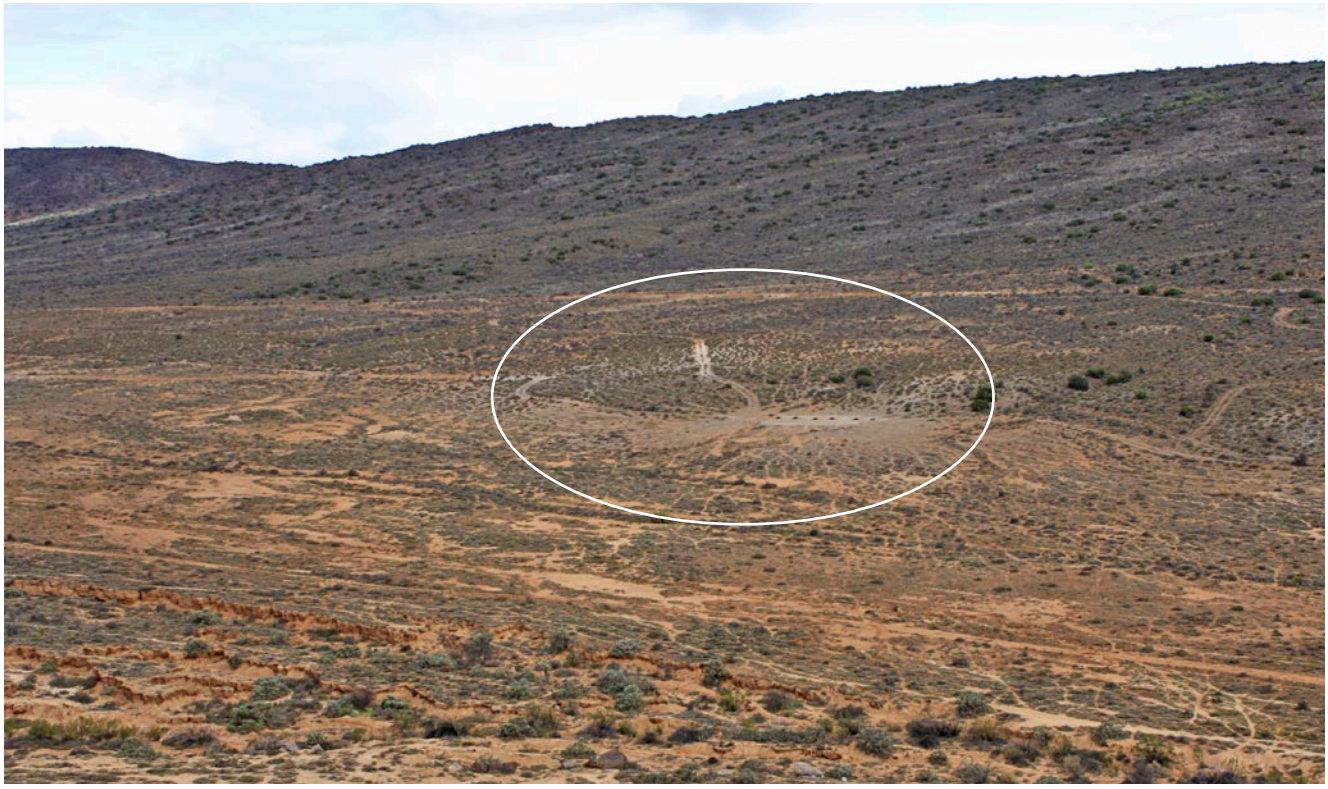
Unfortunately, despite this success the high cost of active restoration in this area can be an inhibitor to its widespread implementation. This is despite the fact that cost savings can be achieved if farmers do the work themselves. "The ostrich sector is currently in a recessive state (income dropped on average 30% over the past 12 months due to the strong Rand), and as a result restoration is very low on the agenda of most ostrich farmers," notes Botha.

Veld rests seems to be a preferred option at this stage. With the knowledge gained from this project future projects might be tackled looking at active restoration in areas that are considered of extreme importance from a species richness point of view. Meanwhile the ostrich farming sector is also looking at implementing alternative farming methods that are less damaging to the veld.

Despite the challenges the project has proved beneficial to the ostrich sector. "The industry is extremely grateful for the opportunity to be part of this research, as it provides a valuable scientific model that can be communicated to the farming community," says Botha. "This project illustrates our commitment as a world leader in the conservation of natural resources, and it is hoped that other ostrich producing countries will follow suit." ❑

***Right**: Trampled, overgrazed land can quickly form dongas.*

***Bottom**: A typical ostrich feeding station (see ellips). Note the sparseness of vegetation in the vicinity of the feeding station.*



All photographs Lani van Vuuren

MMA TSHEPO – celebrating a life dedicated to water

The South African water sector has a few endearing personalities, who have dedicated their lives to ensuring the conservation of this precious resource and the reform of the sector for the benefit of all. A new publication celebrating the life and work of one of these personalities, grassroots activist Tshepo Khumbane, is now available from the Water Research Commission (WRC). Compiled by Lani van Vuuren.

In many especially poor communities water remains a limiting factor, especially for small-scale agriculture and other productive enterprises. Rainwater harvesting, where rainfall is stored for times of need, has the potential to transform the lives of such communities that experience protracted periods of low rainfall. One person who has recognised the advantages of rainwater harvesting and has used it successfully to not only enhance people's lives economically but also to uplift their spirits and self-esteem is Tshepo Khumbane.

Mma Tshepo as she is affectionately known is a well known woman in rural development and food security circles. As a renowned grassroots activist, she has worked with, mobilised, and inspired people on both local and international soils. In the last decade she has specialised in development strategies focusing on nutrition and home food production, and is a founding member of the Water for Food Movement. Her understanding of poverty and the institutional, psychological and technical pathways out of poverty, determine her place as an invaluable resource on any developing, planning and policy formation team.

Her life and work has now been captured in a new book available from the WRC. *The Journey of Mma Tshepo Khumbane* was written by Jaqui Goldin and Tiffany Gorden and provides some insight into the history and workings of this stalwart social activist.

"While her achievements and awards reflect her well deserving acclaim and applaud her achievements, it is the emotional responses that she elicits from those she has touched, that truly reveal who Mma Tshepo is," note the authors. "She mesmerises people and commands their attention. She crafts her message through poetry, physical touch, emotive speech, appropriate and original technical designs that she follows through with practical action. A character that enthrals, she is volatile, emotional, energetic and irrepressible."

Born on 26 April, 1937 in the rural area of Tšhukudung, Limpopo, Mma Tshepo, showed herself to be a pioneer from an early age. The first in her family to matriculate and go to university, she first studied teaching before turning to social work. Her mother passed away while she was still a child, and her grandmother played an important role in her upbringing.

Despite her poor background, she thinks back fondly of that time: "The community members of Tšhukudung raised all the children in that small village as a big extended family; guiding us and protecting us to grow up with a deep sense of human values and norms, that have shaped us to be responsible citizens of our communities and country, enhancing ubuntu

with clear commitment for peace at all times. I sometimes wish I could turn back the clock to those days when I see crime and conflict ruling our communities."

Her non-conforming nature made it difficult for her to feel comfortable working as a social worker. For her, it was a restrictive work space that inhibited her and she revolted against the principles that citizens were treated as objects and were dependent on handouts from the State. It was her opinion that the educational system as well as the social work environment were unhealthy because they fostered dependence and operated in such a way that development of people was not advanced but hindered.

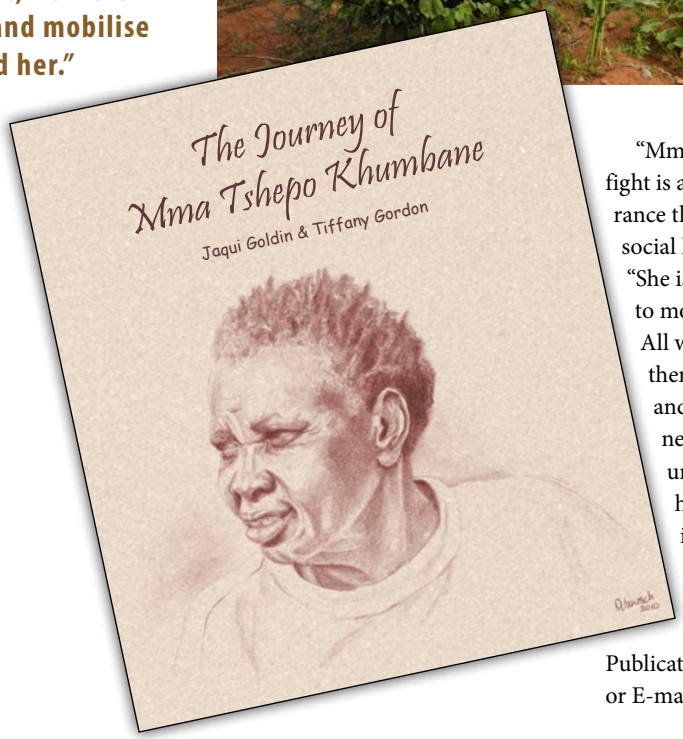
As an independent spirit, her role was to inspire, empower and mobilise communities around her. Her choice was to treat people as equals and to get them to determine their own destinies and be active agents in their development path, not passive recipients of State grants and handouts.

Today, she lives and breathes this philosophy from her plot outside Cullinan, near Pretoria, which was purchased in 1996. From this base, with very little donor or government funds, she mobilises community participation, tackling poverty issues and inspiring people to help themselves. She works as an independent development activist and is a Board member of the Mvula Trust.

"As an independent spirit, her role was to inspire, empower and mobilise communities around her."

Mma Tshepo teaches communities, mostly women, about organic gardening, waste management, food storage and processing, time management, recordkeeping of crop production, self reflection and vision building, among others. Her rainwater harvesting methods that have been put in place are unique and they are 'best fit' for the communities where they have been applied.

Mma Tshepo's house and garden in Cullinan, outside Pretoria.



"Mma Tshepo is a fighter and her fight is against impotence and ignorance that undermines natural and social landscapes," say the authors. "She is single minded in her quest to mobilise grassroots women. All women must be able to feed themselves and their families and water and food should never be in short supply. Her unique approach to rainwater harvesting has made its mark in South Africa and beyond."

To order the booklet, *The Journey of Mma Tshepo Khumbane*, contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za. ❑

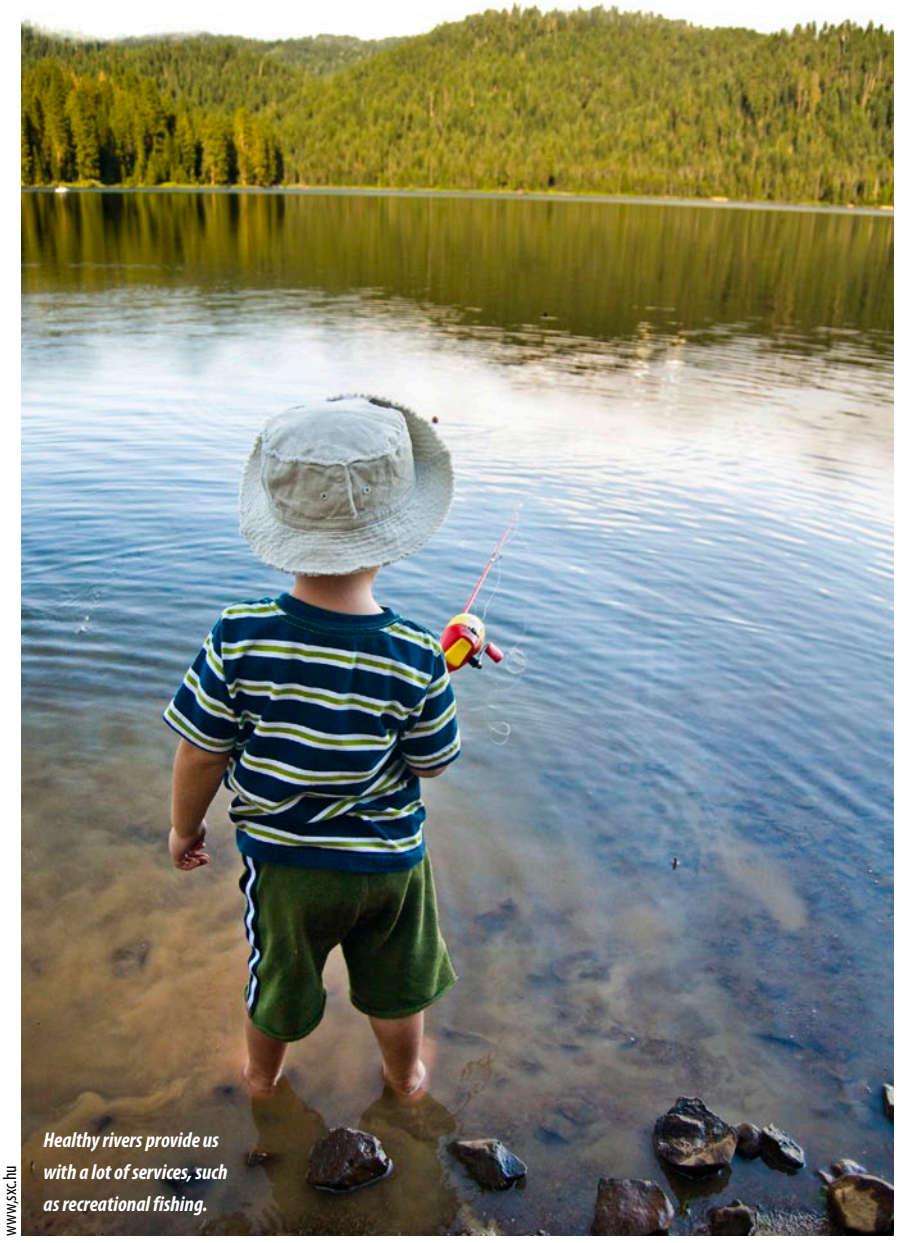
WATER Kidz

RIVER HEALTH – what are the symptoms?

When you get very sick you usually go to a doctor, who will determine your illness by looking at the symptoms you have. But how do we determine the health of our rivers?

Rivers are extremely important sources of water, especially in South Africa, where they provide about 70% of water used. For rivers to keep on providing their goods and services they need to be kept as healthy as possible.

But how do we monitor this health? It is not just the water that needs to be of good quality: a multitude of factors determine the health of a river ecosystem. Freshwater experts, therefore, look at a multitude of things to determine what the state of health of a river system is.



Healthy rivers provide us with a lot of services, such as recreational fishing.

www.sxc.hu

RIVER HABITATS

Loss of habitat is regarded as the single most important factor that has contributed towards the extinction of species in the last century. When destruction of a particular type of habitat takes place it can result in the disappearance of certain species of plants and animals.

Examples of river habitat types are pools, rapids, sandbanks, stones on the river-bed, and vegetation fringing the water's edges. For this reason, knowledge of the state of habitats along a river system forms an important part of assessing the overall health of that river system. Experts look at the things that can impact these habitats such as water abstraction, flow regulation, removal of indigenous riparian vegetation and encroachment by exotic (invasive alien) vegetation.

RIPARIAN VEGETATION

Healthy riparian vegetation (those plants that grow on the banks of rivers) maintains channel form and serves as filter for light, nutrients and sediment. It can reduce the amount of sediment and pollutants entering a river and provides a valuable habitat for birds and animals. Riparian vegetation can be influenced by things such as farming or people collecting firewood as well as invasive alien plants.

In South Africa, experts use what is called a Riparian Vegetation Index to determine the status of riparian vegetation within river segments. They look at things like vegetation removal, cultivation, construction, erosion/sedimentation and the presence of exotic (alien invasive) species of plants to determine how healthy the riparian zone is.

FISH

Fish are good indicators of long-term influences on a river as they generally live long and move around in a system. The number of species of fish that occur in a specific reach, as well as factors such as

Lani van Vuuren

At a glance rivers might seem healthy, but closer inspection may uncover pollution problems.

Seeing how many types of invertebrates there are in a river are a good indicator of its health.

SOURCES

WRC Lesson Plans (www.wrc.org.za/Pages/Learning_School_lessonplans.aspx)
River Health Programme (www.csir.co.za/rhp)

different size classes and the presence of parasites on the fish can be used as indicators of river health.

Different non-lethal ways are used to collect fish for river health purposes. One of the most interesting methods is that of electrofishing. A field of electricity is passed through the water that causes a muscle response reaction from the fish forcing them towards the netsman. The fish is caught in the net and once assessed is let go again.

AQUATIC INVERTEBRATES

A variety of invertebrate organisms (e.g. snails, crabs, worms, insect larvae, mussels, beetles) live in rivers. These animals (called invertebrates as they have no backbone) require the river to be in a certain state of health of survive. By catching a sample of these invertebrates and checking which species are present (or not present) experts can determine how healthy a river system is.

DIATOMS

Diatoms are one of the most common types of phytoplankton. They are delicate single-celled organisms that one can find in freshwater. Diatoms are increasingly used as a component of river health monitoring.

They are at the bottom of the foodchain (meaning other animals feed off them) and their response at this level (assemblages and type of species present among others) reflects what is happening in the water. So, for example, changes in water quality due to, say, pollution, will allow some types of diatoms to grow and reproduce, outcompeting other species. Thus when experts look at the type of diatoms found in a river section they can see what the water quality is like.

WATER QUALITY

When assessing river health, experts also look at the quality of the river water. This indicates suitability of that water for aquatic ecosystems. Among others, measurements are taken of the temperature, pH, electrical conductivity, total phosphate, total nitrogen, ammonia and dissolved oxygen levels in the water. ❑

WORDS RELATED TO RIVER HEALTH

Anthropogenic: Caused by human activity.
Biodiversity: The diversity of life from a taxonomic, ecological or genetic point of view.
Biomonitoring: Monitoring of living organisms, usually as indicators of habitat integrity.
Biota: The living organisms of a region or system.
Biotope: An area of uniform environmental conditions.
Catchment: The land area from which a river or reservoir is fed.
Crustacea: Crabs, prawns and amphipods.
Ecology: The study of the interrelationships between organisms and their environments.
Ecosystem/ecological health: A descriptive term for the combination of all factors that make up a particular environment and its organisms.
Effluent: That which flows out (usually discharge wastewater).
Environment: All the physical, chemical and biological factors and conditions that influence an object.
Fauna: Collective term for all the animals living in a particular area or period.
Habitat: The combination of biotopes that makes up the living space of an organism.
Indigenous: Living or growing naturally in a particular area, but not naturally confined to that area.
Invertebrate: Animal without a backbone.
Riparian: Pertaining to a river bank.
Sediment: Fragmentary material (e.g. sand, silt and mud) weathered from rocks and (recently) deposited.
Source: *Environmental water quality in water resources management* by Unilever (**WRC Report No: TT 217/04**)

Minister launches new weather radar network

In March Minister of Water & Environmental Affairs Buyelwa Sonjica officially launched the South African Weather Service's (SAWS's) new state-of-the-art weather radar network. The R240-million network, which comprises 12 new Doppler (10 S-Band and 2 X-Band) weather radars, has catapulted South Africa to the forefront of weather and climate forecasting technology. The network replaces the SAWS's existing 30-year-old radar system to bring about a substantially improved weather observation network. Among others, the new radars will play a vital role in enhancing adaptation tools and products such as the Severe Weather Forecast project and the Flash Flood Guidance system. "South Africa cannot afford to be left out of the scientific process that will assist our communities in the long term, especially with the major concerns of climate change now upon us. We need to keep our place at the cutting edge of technology and assist our scientists to achieve the ideals of the work they have to carry out for a better South Africa," noted Sonjica. Three new radars have already been installed at Irene (Gauteng), Bethlehem (Free State) and Mthatha (Eastern Cape). For a more detailed technical report on the benefits of the new weather radar network see the next issue of *the Water Wheel*.

One of two new mobile X-band Doppler radar systems to be deployed to the Oliver Tambo and Cape Town International Airports. Among others, the radars will be used to detect wind shear, which can be very dangerous for aircraft during take-off or landing.

Weather radar network project manager Georgie George (far right) explains the workings of the new network to SAWS Chair Khungeka Njobe, DWEA Minister Buyelwa Sonjica, and Department of Environmental Affairs Director-General Nosipho Ngcaka.

Minister of Water & Environmental Affairs Buyelwa Sonjica and South African Weather Service Chair Khungeka Njobe at the plaque unveiled at the official launch of the new weather radar network.

DWEA Minister Buyelwa Sonjica cuts the ribbon on one of the new weather radars.

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