THE
WATER WHEEL
ISSN 0258-2244 September/October 2014 Volume 13 No 5

SPECIAL FEEDBACK ON THE NATIONAL WATER SUMMIT

WATER RESEARCH COMMISSION

SANCOLD ANNUAL CONFERENCE 2014

5 - 7 NOVEMBER - BIRCHWOOD HOTEL AND O R TAMBO CONFERENCE CENTRE

"TOWARDS SUSTAINABLE DAMS IN SOUTHERN AFRICA"

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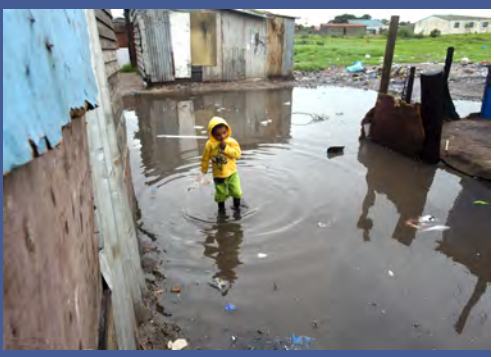
SOUTH AFRICAN NATIONAL COMMITTEE ON LARGE DAMS



THE WATER WHEEL is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament. Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

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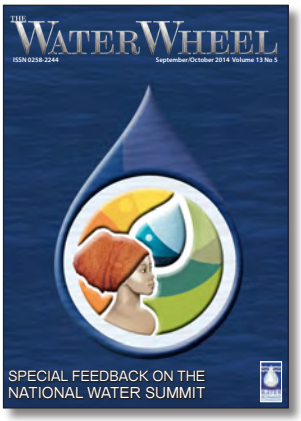
Cover: *The National Water Summit, held on 1 and 2 August 2014, is seen by many as a start to a new conversation on the challenges of the South Africa water sector. Read more on p 10. Cover illustration by Denise Janisch.*



Letters to the Editor

Remember the 'Golden Rules' for water management

I have been a regular subscriber and occasional contributor to *the Water Wheel*.

I have been an ISO 14001 auditor for 13 years in a wide range of industries. I continue to be amazed by the lack of understanding of fundamental water management issues, particularly on industrial sites in municipal areas.

Along the way I have developed my own Golden Rules of water management:

1. Don't waste water (leaking taps, toilet cisterns etc.)
2. Nothing goes into the stormwater system except rainwater. (The most widely breached rule, e.g. car washing, oil spillage in car parks, off-loading of diesel etc.)
3. No industrial effluents to the sewerage system without a permit. (What do you do when there are no bylaws?)
4. No stormwater allowed to go into the sewerage system (why do our sewage plants overflow every time it rains?)
5. No sewage allowed to run into the stormwater system. (Pipes blocked by cigarette packets, cold drink bottles and other rubbish. Perhaps protection of the sewerage system should be rule number six).

On most sites that I visit, at least three rules are breached, in some all five.

My most usual protest is: Where does it say in the legislation that I must/or am not allowed to do, whatever ?

Tracking down the specific legal requirements is complicated by the fact that there are over 100 environmental Acts, 1 000s of regulations, nine sets of provincial legislation and about 300 municipalities, some of which do not yet have gazetted bylaws.

There are of course exceptions to the above, e.g. water from dewatering of foundations may be discharged to stormwater. Contaminated rainwater can be discharged after treatment in terms of a water use license, etc., but I believe the Golden Rules are quite robust for most circumstances.

I would welcome comments on the Golden Rules.

GW Northwest

The sanitation wheel turns

I enjoyed reading your article on the pour flush toilet in the July/August edition of *The Water Wheel.*

The content of which is not to dissimilar to a presentation which I delivered at the Zambia Water Conference in 2012 ("… On site Sanitation no one size fits all…"). At least somebody at the conference was paying attention! It seems that the circle of sanitation has turned yet again!

Only this time I hope that we don't repeat the mistakes that were made in the late 1980s when pour flush/low flush toilets that drain into pits were rolled out. Without naming and shaming anybody I urge the WRC to go back in history and learn from the disaster of this type of technology before Carte Blanche is given to its implementation as was the case with the VIP.

It was as a direct result of these failures that lead to Calamite's development of its low flush and pour flush technologies for which it was awarded the Agrement Certificate in 1994 (a world first).

Sadly these technologies had limited success due to the wheel turning in favour (policy) of the VIP toilet where the emphasis was placed on the toilet structure (read concrete structure) rather than the actual sanitation system i.e. from the toilet seat backwards.

It is thus with great interest that I read about the zinc-clad timber frame top structure and rewind to the 1990s when the then Minister of Water Affairs Ronnie Kastrils declared the zinc toilet to be undignified and all but banned its use! I only hope that Minister Mokonyane is better informed on sanitation technologies before she gives her nod of approval! PS. Perhaps an article on all the other types of sanitation would be in order?

John Telford, Calcamite Water and Sanitation

Grootdraai emergency scheme

Ek het met belangstelling julle artikel oor die Grootdraai Noodskema (*The Water Wheel* July-August 2014) gelees. Toevallig het ek pas my herinneringe aan my loopbaan in wateringenieurswese voltooi en ook oor die onderwerp geskryf.

Ek wil langs hierdie weg iets regstel. Dit gaan oor die woorde: "Said to be the brainchild of Dave George...." Ek weet waar die gerug waarskynlik vandaan kom. Dave wou dieselfde tegniek aan die Departement van Waterwese "verkoop" as alternatief vir die Lesotho Hoogland Waterprojek. Hy het op eie koste 'n groot studie geloods om die Oranjerivier vanaf die samevloeiing met die Vaalrivier in trurat sit, op dieselfde wyse as wat die Vaalrivier tussen die Vaaldam en die Grootdraaidam in trurat gesit is.

Dave het vir laasgenoemde projek net geologiese dienste gelewer en was daarom wel op hoogte van wat daar aangaan. Die Departement het nie sy voorstel aanvaar nie, hoofsaaklik omdat op die wyse die besoedelde water steeds weer stroomop sou gepomp word!

Dave het die verwerping baie kwalik geneem, want hy was daarvan oortuig dat sy voorstel goedkoper was, alhoewel hy myns insiens die koste van onteiening van die grond wat onder water sou kom al langs die rivier heeltemaal onderskat het.

Trouens, hoe sou 'n geoloog ooit betrokke geraak het by die samesprekings tussen ons en Eskom hoe om die naderende katastrofe op te los? Ek weet dit baie goed want ek was ampshalwe ten nouste betrokke by die krisis.

Ek doen aan die hand dat jy vir Dave George self opspoor en hom vra!

Dr Theo von Robbroeck, Stellenbosch

Appeal to department to support municipal engineers

It was disappointing to see that the Department of Water & Sanitation (DWS) did not have a stall at the Conference of the Institute of Municipal Engineering in Southern Africa (IMESA) held in Port Elizabeth in October 2013. While we know that DWS works closely with the Water Institute of Southern Africa with regards to the Blue/Green Drop system they should also support municipalities through IMESA. The DWS literature and documentation, which is world class, is important to be available to municipal engineers as well as the presence of DWS personnel. I therefore appeal to DWS to have a stall at the IMESA Conference in Durban in October 2014.

David Raymer, Professional Engineer, Port Elizabeth

Overcoming southern Africa's irrigation challenges together

The importance of irrigation for increased food production and food security in southern Africa cannot be overemphasised. One organisation aimed at harnessing the collective power of the region's knowledge towards greater implementation of sustainable irrigation is the Southern African Regional Irrigation Association (SARIA).

Currently comprising members from 15 SADC countries, SARIA's activities are aimed at enhancing research, development and training of appropriate science and technology in irrigation and drainage for gender-balanced poverty eradication and economic development to improve the livelihoods of people in the region.

The Association stimulates and promotes the development and the use of the arts, science and techniques of agriculture, socio-economics and engineering in managing land resources for irrigation and drainage, including human-resource development and capacity building, adapting comprehensive approaches and up-to-date techniques for sustainable agricultural growth.

Earlier this year, association representatives met in Pretoria to share ideas on agricultural irrigation water issues at a regional level. The meeting was hosted by the Water Research Commission (WRC). The objective of the workshop was to facilitate the exchange of ideas and practices between researchers, advisors and government officials from the SADC countries.

A highlight of the meeting was a field trip undertaken to a commercial mushroom farm in Krugersdorp. Delegates were able to see first-hand how mushrooms are planted, managed and harvested.

Another highlight was the workshop on extension for management of agricultural water. This training workshop for SARIA representatives was presented by Dr Joe Stevens from the University of Pretoria. The workshop was based on WRC-published training material for extension advisors in irrigation water management.

As a major challenge for all SARIA members, it was agreed that the training resource material will be used as a basis for organising further courses in the respective member countries.

The third day of the gathering saw presentations from SARIA country representatives on activities of national committees on irrigation issues. The steering committee meeting also mapped the way forward for SARIA over the next three years. Some of the issues which were discussed during the meeting were the strategic roles and actions for a viable SARIA.

It was also agreed that issues such as: Rainwater harvesting and conservation for food production; as well as aquaculture and fisheries should form part of the SARIA capacity building and knowledge exchange for the year 2014/2015 and the year 2015/2016 respectively. The SARIA workshop was funded and supported by the Department of Agriculture Forestry and Fisheries.

SARIA representatives at the recent meeting in South Africa.

Water diary

Civil engineering
October 28-31

The 9th World Congress on Engineering Asset Management will be held in Pretoria. Engineering asset management encompasses all types of engineered assets, including built environment, infrastructure, plant, equipment, hardware systems and components. *Visit: http://2014.wceam.com/ for more information.*

Municipal engineering
October 29-31

The 2014 Conference of the Institute of Municipal Engineering in South Africa (IMESA) will be held at the Durban International Convention Centre, in Durban. *Visit: www.imesa.org.za*

Large dams
November 5-7

The South African National Committee on Large Dams (SANCOLD) will be holding a conference titled 'Towards sustainable dams in southern Africa' in Gauteng. *Enquiries: Lerato Miyen; Tel: (011) 676-3464; Email: secretariat@sancold2014.org.za; Visit: www.sancold.org.za*

Irrigation and drainage
November 18-20

The South African National Committee on Irrigation and Drainage (SANCID) is holding a symposium titled 'Water, food and energy in the 21st century' in Gauteng. *Enquiries: Puleng Mofokeng (Chair of Organising Committee), Email: PulengM@daff.gov.za or SANCID Chair, Felix Reinders, Email: reindersf@arc.agric.za*

Health and nutrition
November 19-21

The Second International Conference and Nutrition will be held in Rome, Italy. The conference, hosted by the World Health Organisation and the Food and Agriculture Organisation of the United Nations, along with several other parties, will focus on how to address major nutrition challenges over the coming decades. *Visit: http://www.who.int/mediacentre/events/meetings/2014/international-conference-nutrition/en/ for more information.*

New from the WRC

Report No. KV 330/14

Dynamic, evidence-based, ecosystem services decision-support model for climate change adaptation: Exploring a method to provide credits to water users in dry climates (SA Mitchell; JG Crafford; and M Wilkinson)

This exploratory project focused on the need to increase the resilience and robustness of, and to achieve water equity for, vulnerable, poor communities in an uncertain future. The high natural climatic variability in arid and semi-arid southern Africa means that policies and strategies developed to increase the resilience and robustness of social-ecological systems in the face of climate change in the medium to longer term are likely to be immediately relevant in the face of the natural variability. This will give governments the opportunity to finetune their policies and strategies aimed at adaptation to future climate change.

Report No. 2119/1/14

Decision-support models for the selection and costing of direct potable reuse systems from municipal wastewater (CD Swartz; CJ Coomans; HP Muller; JA Du Plessis; and W Kamish)

A need was identified for a decision-support model for municipalities and water boards to identify, evaluate, compare and select appropriate water reclamation and reuse options which can produce sufficient quantities of safe drinking water from available secondary treated wastewater sources. The guide also included the development of a reuse costing model, REUSECOST. This project focused on direct potable reuse as a water-supply option to augment conventional water source in water scarce areas.

Report No. 2087/3/14

A choice experiment study of user preferences for levels of water services (SG Hosking; J Hosking; M Du Preez; and JG Hosking)

Discrete choice experimentation is one form of choice modelling. It utilises a stated preference survey technique to gather data for modelling choice. The aims of the study were to demonstrate that discrete choice experiment analysis and the survey instrument on which it is based could provide useful information about how consumer groups valued water service delivery and how they rated the water services that they were provided. The motivation for undertaking this study was that technical and cost considerations are inducing greater interest among South Africa's municipal providers of water services to adjust the levels of water service offered to various groups. Such adjustments have consumer welfare implications and potential impacts on the demand for water services, and these implications and impacts need to be considered along with the technical and cost consequences.

Report No. 2165/1/13

The economics of sustainable aquifer ecosystem services: A guideline for the comprehensive valuation of aquifers and groundwater (D Pearce; J Crafford; K Riemann; C Hartnady; H Peck; K Harris)

As groundwater gains increasing recognition in South Africa, so the efforts have been bolstered to detail the extent to which the unseen resource is utilised and consumed. The field of research regarding groundwater ecosystems services is in its early phases of development. Using the Millennium Ecosystem Assessment Framework, in combination with a work-shopping method known as a Comparative Risk Assessment, this study investigated the ecosystem services of groundwater resources through the expert analysis of three case studies.

Report No. 2015/1/13

Evaluating approaches to and benefits of minimising the formation of acid rock drainage through management of the disposal of sulphide waste rock and tailings (STL Harrison; J-P Franzidis; RP van Hille; T Mokone; JL Broadhurst; CK Mbamba; A Opitz; R Chiume; E Vries; H-M Stander; M Jera)

The ideal approach to handling of sulphidic waste rock is to prevent the potential for generation of acid rock drainage through the removal of the sulphide phase before its disposal, thus avoiding the need for long-term mitigation. This report is focused on the goal of establishing feasible approaches for the prevention of the formation of acid rock drainage from mining wastes by the removal of the risk rather than its delay.

Report No. 2040/1/13

Sediment as a physical water quality stressor on macro-invertebrates: A contribution to the development of a water quality guideline for suspended solids (AK Gordon; J Niedballa & GC Palmer)

The Department of Water and Sanitation has undertaken to revise the South African water quality guidelines for fresh waters, and update the current guideline for instream particulates with one based on biological effects. Research undertaken in this report represents the start of work toward providing appropriate biological response data in this regard, and the beginning of investigations into improving the management of this aquatic ecosystem stressor.

Report No. 2148/1/13

A non-parametric multi-site stochastic rainfall model with applications to climate change (J Nadirity & J Nyaga)

The planning and operation of most of the large water resource systems in South Africa has been applying a multi-site monthly streamflow generator since the 1990s, but it has recently been recognised that the use of stochastic rainfall generation may hold advantages over stochastic streamflow generation. As in other parts of the world, climate change is an increasing concern in South Africa. However, climate change impacts have not specifically been incorporated into the comprehensive probabilistic approach applied by the Department of Water Affairs and Sanitation and its consultants. This project then set out to develop and test a monthly non-parametric stochastic rainfall generator that would comprehensively incorporate climate change and changing variability, including information from global climate change models. The project also compared the non-parametric generator with the parametric PEGRAIM-W generator.

Report No. 2022/1/13

The long-term impact of Acacia Mearnsii trees on evaporation, streamflow, low flows and groundwater resources. Phase II: Understanding the controlling environmental variables and soil water processes over a full crop rotation (CS Everson; AD Clulow; M Becker; A Watson; C Ngubo; H Bulcok; M Mengistu; S Lorentz & M Demlie)

This project was a direct consequence of the need for high-quality scientific research, in response to national needs for application of the National Water Act of 1998 and for future policy and forest management decisions. The main aim of the project has been to answer: 'What processes allow exotic tree plantations to use more water than grassland in areas being converted to commercial forestry plantation?', and 'What are the long-term effects of commercial forestry species on deep soil-water profiles, streamflow and total evaporation?'

Report No. 2074/1/13

The role of knowledge in a democratic society: Investigations into mediation and change-oriented learning in water management practices (J Burt, H Lotz-Sisitka, N Rivers, R Berold, M Ntshudu, T Wigley, M Stanford, T Jenkin, M Buzani & E Kruger)

This project emerged from two previous WRC research projects – one on participation in the establishment of integrated water resources management structures and the other on the use of knowledge and learning resources about water and its management and how such resources were being used. This latest research project had as its main aims to identify and support the skills that are needed to mediate learning about water management practices in an Eastern Cape

community, and to research the development of a knowledge resource that could be used to develop the capacity of community-based mediators of water knowledge.

Report No. KV 326/14

The South African water history archival repository (SAWHAR) project at North-West University (Vaal) and a historical overview of the Waterlit collection (J Tempelhoff & G Stopforth)

This report consists of two sections. The first provides an overview of the progress made towards establishing the South African Water History Archival Repository (SAWHAR) at North-West University's Vaal campus in Vanderbijlpark. Details are provided of the organisational structure and lines of communication established with key stakeholders, such as information scientists at the University of South Africa, the National Archives Repository in Pretoria and the WRC. The history of the so-called Waterlit Collection, which forms a seminal part of the SAWHAR project, is discussed in the second part of the report.

Report No. 1962/1/13

Implementation of the rule-based agent for Microcystis in Rietvlei Dam (S Barnard, CE van Ginkel, LZ Coetzee & S Booyens)

In the hypertrophic Rietvlei Dam, in Pretoria, long distance circulators are used as an advanced treatment option. The application of these circulators is based on the principle of habitat disturbance by means of continuously circulating the dam's epilimnion where maximum algal growth takes place. This project tested the robustness of an early warning/prediction tool, CEGAP, in case of advanced water treatment procedures. The main aim of this study was to use data collected prior to, as well as after the deployment of the circulators to implement the model and assess its applicability and robustness as an early warning/prediction tool for algal blooms.

Report No. 2037/1/13

Hyperspectral remote sensing to detect biotic and abiotic stress in water hyacinth (Eicchornia Crassipes) (SW Newete, BFN Erasmys & MJ Byrne)

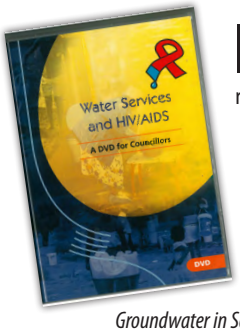
Water hyacinth is the most notorious aquatic weed in the world. South Africa has released seven biocontrol agents against water hyacinth since 1974, none of which have achieved a satisfactory result to reduce the scourge. As a result, water hyacinth control in the country has shifted to integrated management, which combines the application of herbicides with biological control methods. However, this requires regular monitoring of the weed's physiological status in relation to the habitat, in order to facilitate the decision when to intervene and what intervention measures are appropriate and timely. Remote sensing of vegetation reflectance has the potential to be that monitoring tool.

Report No. 2085/1/14

Wastewater treatment plants: The financing mechanisms associated with achieving Green Drop rating (SA Mitchell, MP de Wit, JN Blignaut & D Crookes)

The objectives of this project were to determine challenges and their contribution to the cumulative risk rating that various categories of wastewater treatment works are facing, to determine what the financial cost implications are for improving the performance of wastewater treatment works, to determine the high-level environmental, health and economic implications of not improving the performance of wastewater treatment works and lastly, to determine a pricing and financing mechanism towards improving the performance and cumulative risk rating of wastewater treatment works.

Multimedia products available from the WRC



In addition to its paper-based reports, the Water Research Commission has various multimedia resources available to the public.

One of the most popular multimedia products is the *mini-SASS guideline video*. This DVD explains the miniSASS method and tools to assess river health as well as how this tool can be used to create awareness of river health in South African communities. Also popular is *Water from Stone: Groundwater in South Africa*. This DVD, featuring former 50:50 television new presenter, Erald Felix, takes viewers to varied landscapes around South Africa to explore groundwater-dependent ecosystems.

There are also two DVDs focused on local government. The first, *Blue Horizons: Local government and water resource management,* introduces key water resource challenges facing local government, followed by examples of good practice and innovative solutions by local government in South Africa today. The second DVD, *Water Services and HIV/AIDS: A DVD for councillors,* aims to raise awareness of the central role that municipal services delivery plays in managing the impact of HIV/AIDS. It features home-based care workers in Jeppe's Reef, Mpumalanga. This DVD is designed for use in training environments, as a discussion aid, as well as for general awareness raising.

All of these DVDs can be ordered free of charge from the Publications Office.

To order any of these reports, contact Publications at Tel: (012) 330-0340; Fax (012) 331-2565; E-mail: orders@wrc.org.za or Visit: www.wrc.org.za

Fluid Thoughts

Having a frank discussion on the status of SA's water

The recently held National Water Summit has opened the door to the creation of a shared vision for the future of water and sanitation in South Africa, writes Water Research Commission (WRC) CEO, Dhesigen Naidoo.

Water is the lifeblood of both the economy as well as our personal well-being. This axiom is revisited and re-confirmed every day in our country and around the world.

We have the three-dimensional challenge of servicing an increasing and developing population; meeting the needs of a water-intensive economic growth pathway; and dealing with the vagaries of the water challenges associated with climate change in an already water scarce South Africa. In addition, like many developing countries and now even some OECD states, we have a backlog on both safe sanitation, and to a slightly lesser degree, safe water access.

Newly appointed Minister of Water and Sanitation, Novula Mokonyane, in her budget speech to Parliament on 15 July, talked about the mandate of this fifth democratic administration being "to move South Africa forward through radical socio-economic transformation." In this spirit she added that "As we strive to consolidate our successes and celebrate the good story in the water sector we shall, with immediate effect use this budget to deal with 10% of existing services that are dysfunctional and a further 26% where the provision of water is not reliable."

She went on to list a series of "game-changers" to turn South Africa's water and sanitation fortunes around and concluded that "the participation of our people in the water sector is key." In the first week of August 2014, the Department of Water and Sanitation, with the Water Research Commission, convened a two-day National Water Summit where all stakeholders in the water family came together and defined our working relationship.

This great Water Indaba, held on 1 and 2 August, for the first time, offered an opportunity for a deep multi-stakeholder engagement to very critically examine both our water and sanitation challenges as well as our responses to them in the last 20 years, with no holds barred. We sought to use the diversity of minds we had in the room to develop and converge on the innovative solutions that we will need in order to successfully solve these problems.

This is the very crux of the Summit investment – the convergence to both a shared vision for the future of water and sanitation in South Africa, as well as multi-stakeholder ownership of the journey to realise that vision.

The South African water and sanitation effort in these last 20 years has been primarily government driven. There have been bouquets for successes, which included a globally acclaimed legislative framework that was indeed worthy of the Stockholm Water Prize in 2000. We have also achieved an increase of primary or basic water access to 40% of the population that never had it before 1994.

This has yet to be matched anywhere else in the world. Our water storage and inter-basin transfer schemes continue to be applauded as world leading. At the same time, we have received brickbats for not ensuring human dignity through universal access to safe water and sanitation services. We are also faced with mounting water quality challenges both on the back of

Elske Photography

WRC CEO Dhesigen Naidoo and WRC Executive Manager, Dr Inga Jacobs, with Water and Sanitation Minister Nomvula Mokonyane, department Acting Director-General, Trevor Balzer, and Deputy Minister Pamela Tshwete.

current water behaviours and infrastructure integrity challenges, as well as historic poor practices that have come home to roost, such as acid mine drainage.

Government has had this responsibility of the broader water programme, driven in large part by a rights-based constitution with government having the final responsibility on the realisation of those rights. There are important issues to be drawn from this.

The first is that, while there has been a budgetary convenience for the other parties with government picking up the tab, there is a price to pay. One direct consequence is that ironically this country, which boasts many world first in the water domain, does not have a significant water industry outside the public space.

Further, the global presence of the South African water industry is very limited. In fact, South Africa is increasingly becoming attractive as a market for international water companies. These very same water companies could soon become the dominant players in our neighborhood in the absence of significant competition from South African counterparts.

So an important part of the Summit discussions was to look at the role of the private sector in both realising a water secure South Africa, as well as the development of a significant South African water industry in both the public and private sectors.

The second important issue associated with government currently looked at as having the sole service delivery responsibility is of course the limited partnership model. While the public participation and consultation processes have been very robust, it did not manage to foster the desired co-ownership model.

This is a combination of co-ownership of the asset as well as co-responsibility in its sustainability including security, operations and maintenance. So another important outcome for the Summit is the design of the co-responsibility model to attain a water successful future for South Africa.

A third important issue is the limited non-government investment in research, development and innovation. The WRC has a cache of world leading research from which knowledge has been used to develop marketable products for the real economy, but in other parts of the world where the water innovation and development industry is much more vibrant. Not only is this a net loss of intellectual capital, but also an important missed opportunity not only to better service South Africa's needs, but also to become an important supplier of water and sanitation solutions globally.

The Minister of Science and Technology, Naledi Pandor, in her budget speech, reiterated South Africa's desire to both increase the country's research and development enterprise on the back of a drive to achieve a 1.5% GDP investment as well as organize for the country to increasingly become a preferred destination for science and technology in the world.

Water has very attractive offerings in this regard. We have the opportunity to become a world leader in water climate change adaptation solutions and technologies, for example. Another opportunity is to up our game in the acid mine drainage arena and become a leading producer of acid mine water, and, salinity and brines solutions. The latter being increasingly acknowledged as the next wave of challenges for global water as all of our resources become increasingly saline from our various industrial and agricultural processes.

But perhaps our best opportunities lie in the realm of assisting the world's poor and marginalised. The first would be to develop low-cost, safe, water-supply options. This would include point-of-use and more decentralised water treatment solutions, as well as alternative supply such as rain and fog water harvesting. The second dimension of this is no or low water, safe sanitation solutions, particularly for peri-urban and rural environments which house the vast majority of the world's poor.

The Summit's objectives were ambitious. The challenges tabled above are both complex and daunting. They will require a huge multi-stakeholder and trans-disciplinary effort to engage them successfully. The rewards for that effort are clearly high and very desirable. A water successful future for South Africa is achievable. The extent and timeframe to attain that future depends on our level of investment – financially, intellectually, politically and indeed emotionally. It began at the Summit on 1 August. ❑

Elske Photography

The National Water Summit allowed for discussion by various stakeholders over the challenges facing the South African water sector.

National Water Summit: Opening Address by Minister of Water and Sanitation, Nomvula Mokonyane

On behalf of both myself and the Deputy Minister, I wish to humbly express my gratitude to all of you for having honoured our invitation to this two-day summit.

It is imperative to remind you that not so long ago, millions across the length and breadth of South Africa went out to cast their vote. The different political parties through their manifestos made communities to choose a party that is better positioned to hold high the legacy of Nelson Mandela. Notwithstanding the challenges and the shortfall of the past 20 years of democracy, the majority of South Africans endorsed the African National Congress (ANC) election manifesto.

This was also an affirmation of the maturity of our hard won democracy as we move South Africa forward hence we are here today, with humility, been assigned the responsibility as the fifth Administration to lead for yet another five years. We are also inspired by our people's resolve to embrace the National Development Plan (NDP) which gives them hope for the future.

South Africans expect from this Administration decisive leadership that can assert authority across government, communities and private sector to bring about radical socio-economic transformation.

For us to bring about this radical socio-economic transformation in real terms, we have to deal with matters in a manner that demonstrates:

- Effectiveness;
- Efficiency;
- Accountability;
- Accessibility, and
- Co-operation amongst all of us.

"As part of the drive towards radical socio-economic transformation, we need to ensure that solutions to water and sanitation challenges must be about opening the sector to those that have been dis-enfranchised."

Therefore, it is on this basis, that we found it befitting to host this summit as a platform to deal with key areas that require game changers in a radical way. And these are:

- Meeting the service delivery challenges;
- Water and sanitation challenges;
- Water research, technology and innovation;
- State of South Africa water resource;
- The role of the private sector; and
- Community participation.

Transformation and de-racialisation of South Africa through the provision of water and sanitation should be fast-tracked. For us to contribute meaningfully to the realisation of the NDP objectives and the electoral mandate, we have to do things differently. In finding solutions to the current challenges, this calls for our collective wisdom in changing the lives of women.

In places like Kwa-Mhlaba Uyalingana, for an example, women should no longer share water with animals or walk bare-foot and pregnant to fetch water in the river whil there is the Jozini dam next to their village.

As part of the drive towards radical socio-economic transformation, we need to ensure that solutions to water and sanitation challenges must be about opening the sector to those that have been dis-enfranchised. This will have to done by providing skills development, economic empowerment as well access to quality water and dignified sanitation.

The game changers will firstly have to be about revisiting the water ownership patterns and water use rights in our country. Secondly, it is about educating and creating awareness amongst our communities on conservation, preservation and security of our scarce resource as well as innovation.

Furthermore, the game changers will have to harmonise the roles and responsibilities of institutions and all spheres of government in the best interest of the end-user both individually and collectively. We can achieve this, only if we put communities first in what we do and demonstrate that it is business unusual.

As stated by His Excellency President Jacob Zuma, this department has a national obligation to ensure that we infuse

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Minister of Water and Sanitation, Nomvula Mokonyane

life in the provision of quality water and restore the dignity of our people through sanitation.

We are here for the next two days to consolidate the work done in the last 20 years to bring about radical socio-economic transformation in service delivery. It is that partnership that is essential in moving South Africa forward. We all look forward to a sustainable relationship beyond these two days.

As we move South Africa forward let us remember the words of the founding father of our democracy, Nelson Mandela, in a document titled "Why Advocate for water, sanitation and hygiene?" where he said: "Sanitation is more important than independence."

Our preoccupation should be bringing to reality our motto, which is 'Water is life and sanitation is dignity'. ❑

NATIONAL WATER SUMMIT DECLARATION

PREAMBLE

We the delegates congregated at this National Water and Sanitation Summit on 1 and 2 August 2014, in the province of Gauteng; represented by over 400 participants from all nine provinces, key stakeholder groups including civil society, academia, the private sector, all spheres of government, State-owned enterprises and agencies, labour, as well as parliamentary portfolio committees;:

- Recognising the crucial importance of water security and the integrity of the water resources;
- Recognising that access to water and sanitation is a basic human right, are determined to address water and sanitation challenges collectively and decisively;
- Recognising the primary challenges facing water and sanitation in South Africa, and acknowledging the need for innovative solutions that will enable us to take a great leap forward as we collaboratively develop a long-term national vision for water and sanitation;
- Convinced that we need to bring about radical socio-economic transformation in service delivery;
- Acknowledging the importance of doing things differently through communication and partnerships focusing on people-centred solutions;
- Fully conscious of the need to realise solutions in the identified deliberation areas of: meeting the service delivery challenge, enabling water and sanitation policy, developing and implementing research, technology and innovation choices, enhancing the state of South Africa's water resources, understanding and defining the role of the private sector;
- Therefore resolve to chart a pathway toward national water security and sustainable universal access to water and sanitation services within the longer-term National Development Plan (NDP) timeframe of 2030.

PRINCIPLES

Our actions will be guided by the following principles:

- Our efforts shall have the net effect of strengthening the developmental state;
- Our decisions shall be informed by both the best available science, research and technology, as well as real-life, local experiences;
- Our strategies shall be geared toward the development of a South African water and sanitation industry that is globally competitive and locally relevant.

We therefore commit to:

- Effectively utilising the knowledge and information before us to its full maximum for the use of our resources in a diligent and effective manner.
- Create an enabling environment for those who have been isolated, excluded and marginalised from education, skills development and ownership.
- The repositioning of the function of government through a one-stop centre based in the Department of Water and Sanitation.
- Develop the Water and Sanitation 10-Year Plan (2015-2025) as the water and sanitation pillar of the NDP. The Water and Sanitation 10-Year Plan shall have the following cornerstones:
  - The development of an inclusive, empowering and integrated water and sanitation policy, legislative, and institutional environment.
  - An innovative and inclusive service delivery model driven by research and technology especially with regards to alternative solutions to ensure universal coverage.
  - The third National Water Resources Strategy that will ensure South Africa's long term sustainable water security in the wake of climate change and our expanded development needs.
  - A novel public-private sector partnership that will ensure optimum service delivery for all as well as developing a competitive South African Water Industry.

We would like to express our sincere gratitude to all those that have participated in the process thus far, and invite the broader South African public to join the water family in this journey.

National Water Summit: TOWARDS A TEN-YEAR PLAN FOR WATER

In her first budget speech as the Minister of Water and Sanitation (DWS) earlier this year, Nomvula Mokonyane called upon stakeholders in the South African water sector to come together through a National Water Summit to engage around the sector's challenges and opportunities and collectively discuss ways of moving the sector forward as the country's enters its 21st year of democracy. Article by Lani van Vuuren.

The National Water Summit, held on 1 and 2 August in Boksburg, attracted more than 400 delegates from all nine provinces, representing various roleplayers in the sector. Especially heartening was the presence of the complete Parliamentary Portfolio Committee on Water and Sanitation, members of the Portfolio Committee on Human Settlements, as well as members from the Select Committee on Social Services. Two premiers, Senzu Mchunu of KwaZulu-Natal and Supra Mahumapelo of North West were also in attendance.

Considered by many to be the start of a new conversation around South Africa's water, the Summit offered a rare opportunity for deep multi-stakeholder engagement to critically examine our water and sanitation challenges and well as our responses to these over the past 20 years. Invited participants engaged on topics related to meeting the service delivery challenge; the water and sanitation policy environment; water research, development and innovation choices; the state of South Africa's water resources and the role of the private sector.

Indeed, as pointed out by Water Research Commission (WRC) Vice Chair, Dora Ndaba, the summit provided not only the newly-appointed water minister the opportunity to meet stakeholders in the water sector, but to hear first-hand the greatest challenges experienced by the sector, notably sustainably servicing those who are still without safe water and sanitation.

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Minister of Water and Sanitation, Nomvula Mokonyane with Elizabeth Moroaswi from Strydkraal B Village in Limpopo, who provided a community perspective on the need for water for productive purposes.

HIGH LEVEL OF PARTICIPATION

According to Water Research Commission WRC CEO, Dhesigen Naidoo, the high levels of participation in terms of numbers and seniority of delegates alluded to the keenness of people from various parts of the sector to contribute meaningfully to developing a water successful future for South Africa. "Certainly the presence of Minister of Cooperative Governance and Traditional Affairs (CoGTA), Pravin Gordhan, made it clear that water presents an important opportunity to get the right kind of model in place for improved service delivery across all spheres in South Africa."

[The Summit] sent out the very positive message that the DWS is open for business and that the new minister is serious about getting things done with urgency, notes Dr Chris Herold of the South African Institution of Civil Engineering (SAICE) . He expressed the hope that those roleplayers who were unable to attend the event would be given an opportunity going forward to make their contribution towards this ongoing dialogue.

DWS Acting Director-General Trevor Balzer made it clear that the Summit would only be the start of the conversation, with more discussions planned with various individual stakeholders. Chair of the Portfolio Committee on Water and Sanitation, Mlungisi Johnson, expressed the hope that this conversation would also extend to the communities of South Africa.

"The ten-year plan is a critical next-step that must include broad-based conversion to become the gluing mechanism between water and sanitation roleplayers towards collective implementation."

The opening speeches by the ministers of DWS and CoGTA set the tone for what was by many considered an honest, 'no holds barred' discussion. Minister Mokonyane made it clear that this was a water and sanitation summit and not a departmental summit, and that successful water and sanitation service delivery and management in South Africa was dependent on the entire water family working together.

"Transformation and de-racialisation of South Africa through the provision of water and sanitation should be fast-tracked," she noted. "For us to contribute meaningfully to the realisation of the National Development Plan objectives and the electoral mandate, we have to do things differently. In finding solutions to the current challenges, this calls for our collective wisdom."

National, provincial and municipal cooperation needed to take a leap forward to realise an improved level of service delivery including quality and cost-effectiveness, noted minister Gordhan during his address. He introduced the 'back to basics' approach for municipalities, which entails a responsibility by CoGTA to build a system of local governance, which was a long-term project, as well as dealing with immediate operational difficulties within local government.

"The back to basics approach is about setting clear benchmarks of performance in our efforts to ensure that all municipalities perform their basic responsibilities, every day, without fail. We are saying, forget about the fancy stuff, just make sure you do the basics right," noted Gordhan. This would include focusing on the delivery of a basket of services, such as water, sanitation and electricity; ensuring proper governance of local government as well as sound administration and financial management while considering the view of constituents through substantive community participation and engagements.

A significant announcement by the two ministers was that municipalities will henceforth have to allocated a minimum of 7% of their annual budgets to infrastructure maintenance. Five-year planning budgets will also be extended to ten years.

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The team from the WRC and DWS putting the final touches on the Summit declaration.

NEED FOR A NEW CONVERSATION

The need for a renewed conversation around water has never more pertinent judging by the state of the country's water resources as presented by DWS during the summit. As a result of the country's nature climatic variability and general water scarcity, South Africa's water engineers have become extremely adept at moving water from surplus areas to where it is needed, and the country's boasts one of the most complex and sophisticated water supply networks in the world.

To carry the country through long periods of drought hundreds of large dams have been constructed. Maintaining this infrastructure while enhancing service delivery is crucial. "The development and management of South Africa's water resources is fundamental to the provision of acceptable and adequate water and sanitation services," notes Dr Paul Roberts of the South African National Committee on Large Dams (SANCOLD).

"Maintenance of existing infrastructure, working more effectively with existing resources and the development of new resources are keystones to keeping taps running. Both quantity and quality of the resource are of importance. We are aware that many of our river systems have reached full development and this will require increasing and more complex water resource initiatives than those in the past."

In his keynote address, premier Mahumapelo outlined the challenge of municipal revenue and the need for improved monitoring to ensure that there is compliance and adherence to the law by the mining industry, in particular. He listed several recommendations for the way forward. This included the possibility of centralising water and sanitation functions, the need for better communication channels between communities and government, particularly local authorities and their constituents, as well as the need for more partnership between government and the private sector, among others.

POLICY ENVIRONMENT

During his keynote address on 'radically transforming water and sanitation policy', Anil Singh, Deputy Director-General of DWS emphasised that South Africa's water policies take into account both national and international policies, such as the United National Millennium Development Goals, but that development must increase freedom. "The marginalised and vulnerable must benefit from policies, instead of having policies that just affirm the affluence of the rich."

This echoed the DWS minister's sentiments that "it cannot be right for a Ma-Dlamini or Rra-Mokgothu to continue to battle the elements in order to satisfy the basic needs of any human being, these being access to safe and sustainable water and dignified sanitation."

Singh also reiterated that the national water policy review was complete, and that in order to shape game changers to enable us to achieve the National Development Plan 2030 vision and goals, we need to redress imbalances in the form of ownership and user rights through water allocation reform.

SKILLS AND CAPACITY BUILDING

Top of the list to overcoming South Africa's water challenges is the critical need for especially technical capacity in the government sector, according to organisations such as SAICE and SANCOLD.

Dr Herold proposes various initiatives to achieve this, including encouraging mentorship of young engineers and addressing funding gaps, among others. "Survival over the next decade or two requires that we concentrate our limited technical expertise on doing the essentials."

For Naidoo, accelerating capacity building is but one of the 'game changers' required to move the sector forward. "Firstly, we require a much stronger injection of research, science, technology and innovation to support interventions. Secondly, we need a different kind of approach to community participation throughout the value chain from decision-making through to implementation and, most importantly,

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The breakaway session on municipal service delivery was particularly well attended.

aftercare and stewardship around interventions to make these sustainable."

He agrees that novel and innovative mechanisms will have to be found to fund both service delivery and infrastructure development.

ROLE OF THE PRIVATE SECTOR

What is the role of the private sector in overcoming these challenges? There was general consensus during the summit breakaway discussions that the private sector can perform various roles in the water and sanitation sector, ranging from water use, to water and sanitation service provision to finalisation, as well as in all phases of the infrastructure lifecycle.

While capacity certainly exists within the private sector to aid government in meeting water service delivery requirements, there is the question of how the sector is to be compensated, notes TCTA's Richard Holden, a topic he feels was not discussed adequately at the summit. The dependency of especially local government on, for example, consultants, also requires critical debate, in his opinion.

In addition to the participation of the private sector, CSIR Natural Resources and the Environment Executive Director, May Hermanus, also sees a clear role for science and research. "[Organisations such as] the CSIR, are well placed to address the research and development aspects of water challenges, and provide the information communication technology and other platforms or facilities to address large-scale problems," she told *the Water Wheel*. "I think more could be done to transfer research outcomes which have implications for practice to service providers. This would entail more collaboration (which is resourced) between science councils and the institutions which train service providers."

NOT FORGETTING SANITATION

Sanitation, which has prominently been added to the DWS portfolio also requires attention. For Prof Chris Buckley, head of the Pollution Research Group at the University of KwaZulu-Natal, the delays in administrative procedures are an area for concern, especially considering the large number (and concentrations) of people currently unserved.

"The circular interaction between water resource development, water supply, sanitation (and treatment) and back to the resource is critical. Human excreta needs to be seen as a resource to be exploited, not as an embarrassment to be discreetly hidden, treated and discharged. This requires a new way of thinking, political engagement and leadership, technical expertise and implementation."

Prof Buckley notes that the sanitation ladder has an aspirational driver. "Thus, more attention needs to be placed on the target of the aspiration – the icons of fashion in film, television and glossy magazines. Until upper class homes have, for example, well serviced and functioning porcelain urine diversion toilet pedestals, such modern sanitation systems will only be seen as a temporary measure for marginalised people. Thus there needs to be more leadership by example."

TEN-YEAR PLAN

The National Water Summit declaration has at its core the development of a water and sanitation ten-year plan. According to Naidoo, this is a crucial instrument in taking the conversation forward. "The ten-year plan is a critical next-step that must include broad-based conversion to become the gluing mechanism between water and sanitation roleplayers towards collective implementation."

The WRC CEO sees a clear role for the Commission in developing out the plan. "The WRC must convene and bring to bear the contribution of the science and technology community in producing the catalytic effects that we want in order to generate the desired progress within the sector, such as the diversity of sanitation solutions, improved on-site treatment solutions and other innovations."

Naidoo has a special word of thanks for minister Mokonyane who, together with DWS Deputy Minister, Pamela Tshwete, provided the space for this conversation around South Africa's water to happen. "Not only was the minister's drive and desire for a better water sector very contagious, but her ability to enthuse a whole new investment in South Africa's water future cannot be underestimated."

It is hoped that the Summit is the start of long and fruit collaboration by all in the sector ensure a water-successful future for South Africa. ❑

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Department of Water and Sanitation Acting Director-General, Trevor Balzer, with COGTA Minister, Pravin Gordhan.

SA hotels now 'aquasmart' thanks to new tool

The Water Research Commission (WRC) has developed a tool to help hotels and other hospitality accommodation establishments reduce their water consumption. Sue Matthews reports.

When the small coastal town of Hermanus was gripped by drought a few years ago, permanent residents eyed the perilously low level of the De Bos Dam with a growing sense of unease, and frequently bemoaned the view that visitors to the area were not committed to saving water. The town's population increases fourfold during the peak summer season, and although this is partly due to the abundance of holiday homes, there are numerous guesthouses and B&B's, as well as a few hotels.

It was perhaps fitting, then, that a workshop to test-run a tool designed to assist these accommodation establishments to be more 'water wise' was held in Hermanus recently. The AquaSmart Hotels tool was developed by engineering and environmental consulting firm, Jeffares & Green, as part of a WRC-funded project that aimed to increase awareness for water conservation within the hospitality industry.

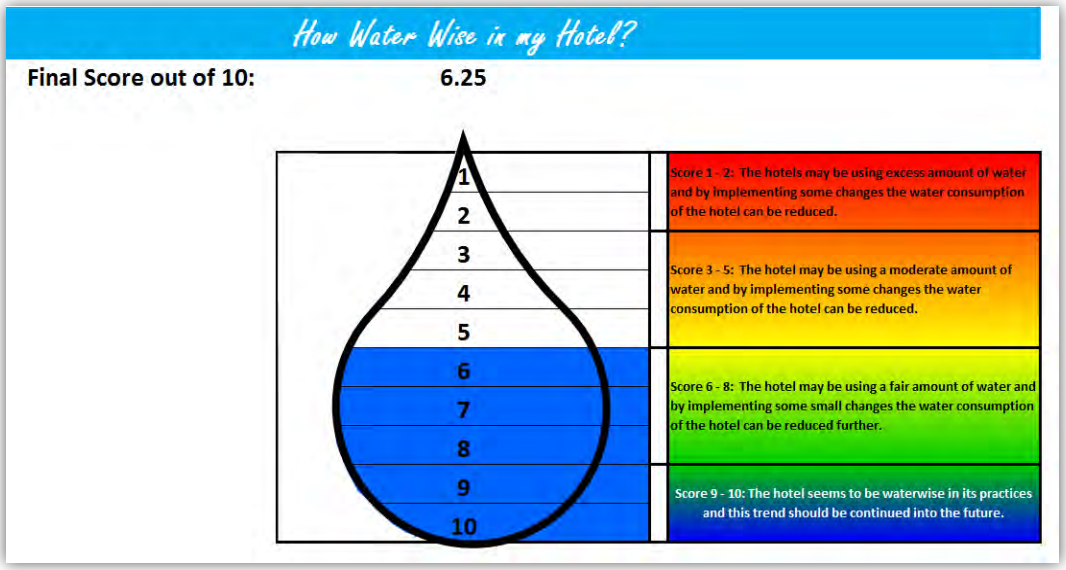
"It's been found in other studies that guests in hotels are likely to use more water than they would at home," explained project leader Melissa Wade. "And according to research in Australia, the average medium to large hotel uses about 300 litres of water per room, which equates to 29 Olympic-size swimming pools in a year."

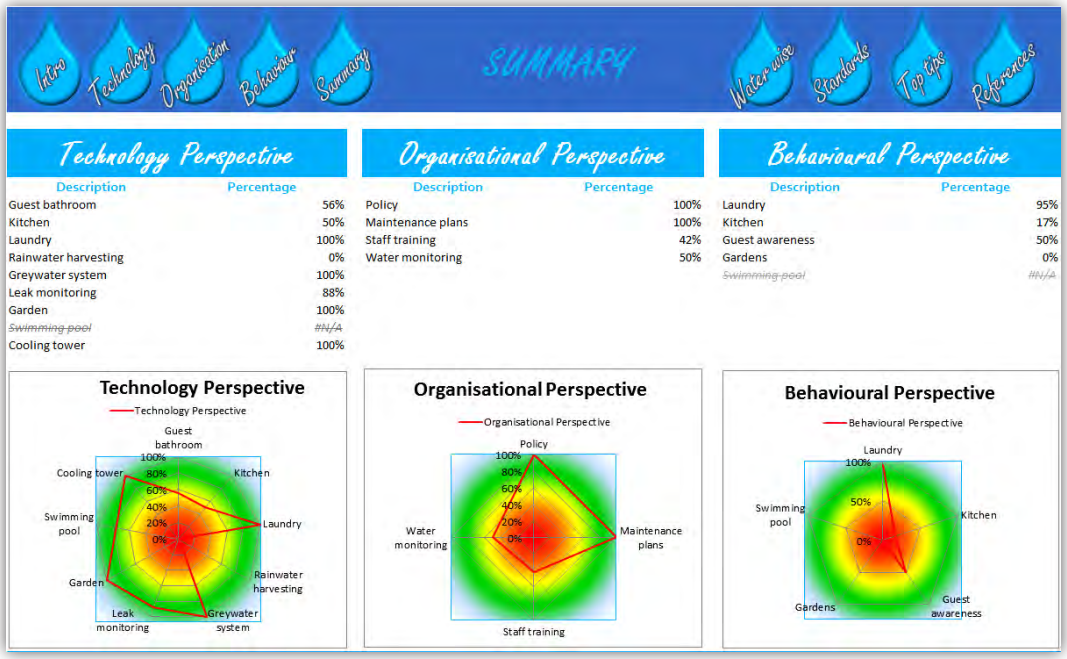
Surprisingly, showers have been found to account for the major share of this water use, so just replacing standard showerheads with low-flow aerated ones can result in a 65% saving per shower. 'Friendly reminder' signs in bathrooms asking guests to save water and take shorter showers are quite common nowadays, and – since the laundry is another significant water guzzler – many hotels have introduced a 'no change' policy, with towels and bed linen only washed after check-out, or every few days for long-stay guests.

These are examples of the three kinds of interventions required for a successful water-conservation programme, likely to achieve substantial savings in water usage:

- **Technological changes**: The installation of water-saving equipment and devices to improve water efficiency
- **Organisational changes**: A review of the policies and procedures that need to be in place in order to help reduce utility costs
- **Behavioural changes**: The efficiency of water use within the establishment is dependent on the habits of guests and employees.

The first section of the user guide accompanying the AquaSmart Hotels tool provides water-conservation tips incorporating these three aspects for guest rooms, laundries, kitchens, gardens, swimming pools and cooling towers for air-conditioning systems, as well as some information on rainwater harvesting





***Top:** The AquaSmart Hotels tool gives a final 'water wise' score out of 10.*

***Bottom:** The Summary worksheet contains the percentage scores from the various divisions in the Technological, Organisational and Behavioural Perspective worksheets, and spider diagrams as graphic representations of the results. The closer the red line to the centre of the diagram, the worse the score.*

and greywater recycling. The importance of training and incentivising staff to conserve water is highlighted – for example, short-stay guests may not report leaking pipes, dripping taps and running toilets to reception, so house-keeping staff need to bring such problems to the attention of management for prompt repairs.

The second section of the user guide covers the tool itself.

"The tool is divided into two Excel workbooks," explained Melissa. "One is the actual tool, which is like a scorecard – it's trying to determine how well the hotel is doing with regards to water usage and to highlight where more could perhaps be done. The second is a database where the water consumption information can be stored."

Once users of the tool have answered the questions listed in three worksheets covering technological, organisational and behavioural aspects, a Summary Worksheet containing the water wise score and more detailed results is generated. The results highlight areas needing attention, after which the Example and Information Worksheets can be used to identify ways in which water consumption can be reduced, and awareness and water management improved. More specifically, the Example Worksheet allows the user to input the cost of a water wise utility or product, and the tool will determine the payback period in months based on the amount of water that will be saved. These figures are only estimates, however, so users should research the costs and savings of such products themselves before making a purchase.

The database allows monthly information such as the water tariff, water consumption and occupancy rate to be recorded, and then 'number-crunched' to determine the monthly cost of water used. Results are displayed in four different graphs, namely:

- Water consumption vs occupancy rate
- Total cost vs occupancy rate
- Water consumption vs total cost.

Average water consumption per guest per day.

There are two case studies in the user guide, one of them being Zoete Inval Traveller's Lodge in Hermanus. Owner Marilyn van der Velden attended the Hermanus workshop, and her answers to questions in the worksheets yielded a water wise score of 6.92 out of 10. While low-flow showerheads have been installed in all the bathrooms, and rainwater harvesting and limited greywater recycling are used to water the lodge's garden, other technological, organisational and behavioural changes could be considered to reduce water consumption further. One of the other hotels represented at the workshop, the three-star Windsor Hotel, has recently installed a water recycling system in the laundry, and is looking forward to the busy summer season to see how this reflects on operating costs.

Internationally, most reasonably up-market hotels have implemented water-saving initiatives of some kind, often as part of a broader environmental policy. For those belonging to large hotel groups, this may be driven by requirements for annual sustainability or corporate social responsibility reporting to shareholders, but even small hotels must meet the expectations of a growing sector of their clientele who are well-informed about responsible tourism practices.

There are also concerted efforts at awareness-raising from within the industry. For example, the International Tourism Partnership – set up under the International Business Leaders Forum by the major hotel groups in the wake of the Rio Earth Summit in 1992 – publishes the *Green Hotelier* magazine, an environmental management manual for hotels, and the Going Green guide on minimum standards for sustainable hotels.

There are a variety of environmental certification schemes for hotels, while the InterContinental Hotel Group, which owns the InterContinental, Holiday Inn and Crowne Plaza brands, has its own online sustainability management system. Called Green Engage, it allows member hotels to input their water, waste and energy data, and they immediately receive an automatically generated report with 'green solutions' to reduce their impacts – tailor-made for the particular climatic location – and an energy benchmark so that they can compare their performance to other hotels. Worldwide, more than 2 600 hotels are now enrolled in the system, and the Group has set a

Sue Mattwes

Improving water conservation in the hospitality industry is crucial for water-scarce holiday towns, such as Hermanus.

target for the period 2013-2017 to reduce water use per occupied room in water-stressed areas by 12%.

Closer to home, the City of Cape Town published a guideline for the hospitality industry on water use and management as part of its Green Goal Campaign for the 2010 FIFA World Cup, while the eThekwini Municipality conducted a Responsible Accommodation Campaign coinciding with the UN Convention on Climate Change COP17 in Durban in 2011. The Tourism Grading Council of South Africa has included responsible environmental and business practices in its grading criteria, although the maximum score that can be earned for water management is only 12 out of a total 1 000 points for hotels and lodges, or 22 out of 1 004 points for guesthouses and B&B's. In addition, the Federated Hospitality Association of Southern Africa (FEDHASA) has a water management category as part of its annual Imvelo awards for responsible tourism.

However, few hotels have gone as far down the greening road as the Hotel Verde at Cape Town International Airport. Having only opened in August 2013, the hotel won the Enviropedia/SABC 3 Eco-Logic Award for Water Conservation a month later. Its most significant water-saving initiative is the grey-water recycling system incorporated into the design of the hotel. Water from showers and baths is piped to a treatment plant where it is biologically filtered and UV-sterilised before being reticulated throughout the hotel and used for the flushing of toilets.

The hotel's basement houses a 40 000 ℓ tank that stores captured rainwater and any subsoil drainage water seeping into the basement. This water is used for drip irrigation of the waterwise indigenous gardens, as well as car washing and cleaning of paved areas.

Only eight of the hotel's rooms have baths, the taps and showers have low-flow, aerated fittings, the toilets are dual-flush and the urinals are the waterless variety. The washing machines in the laundry use water from the final rinse cycle for the pre-wash cycle of the next load. And a comprehensive metering system allows monitoring of water use in the various parts of the hotel.

Of course, that's just the technological initiatives for saving water – there are as many on the energy front. Management seems to have all the right organisational policies and practices in place, judging from the environmental vision statement on the hotel's website, but what of the behavioural aspects? The hotel encourages guests to have an environmentally friendly stay by rewarding those who re-use towels and linen, recycle waste and don't use air-conditioning with 'Verdinos', redeemable at the hotel's deli or bar.

The hotel has set a high standard, but as a newly constructed building – seemingly with no expense spared – it had the benefit of working 'from the ground up'. Indeed, the hotel is the first in Africa to be given a Platinum rating under the LEED green building rating system in the building design and construction category.

Existing hotels, and smaller guesthouses and B&B's on a tighter budget, can make a range of changes that significantly reduce their water usage though, and this is where the AquaSmart Hotels tool comes into its own.

"We want the sector to be more proactive in contributing to water efficiency," says Jay Bhagwan, the WRC's Executive Manager for Water Use and Wastewater Management. "So the WRC will ensure that we get copies of the AquaSmart Hotels tool to all the South African hospitality industry associations and indicate to them that it is available, free of charge, and will help many of the small emerging hotel and B&B establishments to contribute to improving their water efficiency and use. If there's follow-up capacity building that is required, we can facilitate that in partnership with those associations."

"The tool is a first in South Africa, and it's not the Rolls Royce model, but it's a start. Based on demand and use, we foresee that we will in future be able to improve the tool and the platform for web-based bench-marking so that hospitality establishments can compare how they are doing and learn from others." ❑

To obtain a copy of the *Aquasmart Hotels User Guide* (**WRC Report No. TT 606/14**) contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565, Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.

An architectural visualisation of Hotel Verde at Cape Town International Airport, winner of the 2013 Eco-Logic Award for Water Conservation.

Every drop counts in Kruger's BIG GREEN WASTEWATER SCHEMES

Courtesy WIN-SA

The world-renowned Kruger National Park (KNP) is famed for its fauna and flora but, in some circles at least, it is now also grabbing attention for something that is far from the thoughts and peering eyes of tourists – wastewater treatment. Article by Petro Kotzé.

Considered by many to be Africa's most iconic game receive, the KNP has received accolades for its green treatment of some of what's left behind by the thousands of people that streams through the park gates every year – sewage. While they missed out on the Department of Water Affairs' esteemed Green Drop certification during the last round of assessments, the park is being upheld as a best-practice example in terms of its wastewater treatment methods.

According to Dr Marlene van der Merwe Botha, specialist of wastewater management for Water Group Holdings, who manages the Green Drop project, "the KNP will probably be the first oxidation pond system that will attain Green Drop status."

Though it is something that few spare a second thought to, the topic is one that the park's general manager of technical services, Blake Schraader, feels quite passionate about. The park operates a total of 13 wastewater treatment plants with a design capacity of approximately 365 million litres per year, to cater for the roundabout 1.5 million tourists that enter the park per year (about 4 000 per day) and the 2200 permanent staff members. The Skukuza system alone treats between 240 000 and 320 000 litres of sewage per day.

KRUGER'S GREEN TECHNOLOGIES

In line with the area that they operate in, Schraader and his team are serious about choosing technologies that have the least amount of impact on the environment, and curb the negative impact of people on the environment. "It is very important for us to promote the use of sustainable green and natural systems," he says.

While municipalities in cities often use activated sludge systems, requiring lots of energy the Kruger

technical management believes in natural systems and try to use as little as possible energy. All the systems here comprise of a combination of three processes, explains Schraader, anaerobic digesters, oxidation ponds and artificial wetlands. They run treatment plants of various sizes, catering for places as large as Skukuza to picnic sites such as Tshokwane and far-flung ranger posts.

Depending on the size, plants range from simple septic tanks with soak-aways, to systems that entail anaerobic digesters, oxidation ponds and artificial wetlands or different combinations of the three processes. The systems are configured differently depending on needs, but they all mostly rely on Mother Nature to do the job.

In the anaerobic digester, organic material is broken down by bacteria in the absence of air, while the wastewater is further treated in an oxidation pond through the interaction of sunlight, oxygen and bacteria. Water is then polished further as it flows through the artificial wetland or so-called reed beds.

The ponds only need to be desludged every seven to ten years, says Schraader. The removed sludge is dried and mixed with soil to rehabilitate gravel pits with. Alternatively, the sludge is buried, but they make sure that there is no possibility of any contamination of groundwater aquifers.

Water for human consumption is abstracted from the park's rivers, and that's exactly where it goes back to afterwards. "All our systems are licensed," says Schraader, "and that means we need to adhere to a certain quality of the outflow."

While they need to comply with the general limit as set by the Department of Water and Sanitation, and always meet it, they strive to meet the special limit, a benchmark of more stringent quality parameters. Except for the legal requirements they have to adhere to, an ecological disaster would also have international repercussions in a place like Kruger.

"The system has been fine-tuned through the years and every year we continue monitoring the system performance and plan for upgrades where required," says Schraader. They stringently monitor the quality of effluent before and after every stage of the process, so they know where to tweak if there are problems. Integral to this success is knowing each element of your system, and its capacity, inside and out.

"Keep on refining," advises Schraader. "You have to implement, monitor, measure the quality of the outcome, and then make certain adjustments." At the Shingwedzi rest camp, for example, the system entailed a septic tank and a reed bed, but one of the reed beds will now be converted into an oxidation pond before the last reed bed. In Skukuza they only have an oxidation pond and reed beds, but they are planning to add a anaerobic digester before the oxidation pond. "When your quality gets close to your limit, look at where your system is under pressure, and make changes."

AIMING FOR THE GREEN DROP

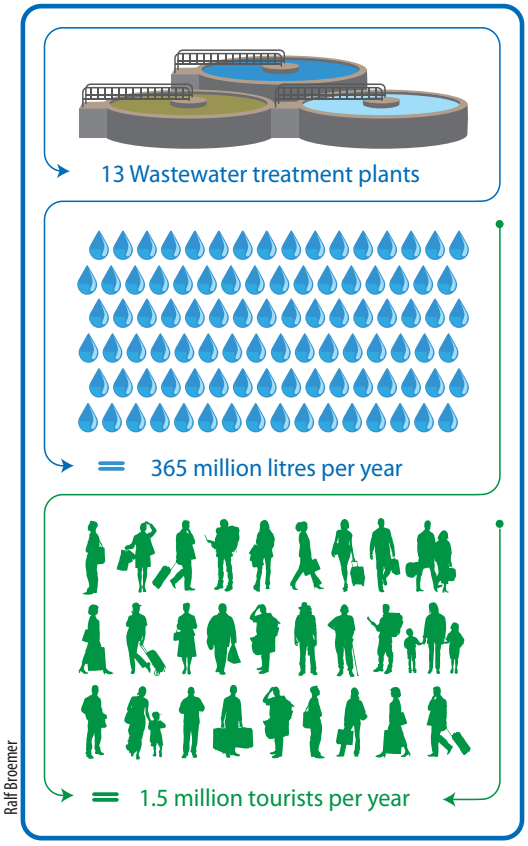
In 2010, the team started working towards Green Drop certification. The programme evaluates the best practice management, compliance and performance of wastewater systems and rewards excellence according to a set of criteria.

The 2013 Green Drop report is still to be published, but the park has already been informed of the results. While the Kruger systems and final effluent quality are of exceptional standard, they could not meet all the criteria, mostly due to their unique circumstances that include the remoteness of waste-water plants, the wastewater treatment processes applied and relative small scale of the plants. For a small sewage plant in Tshokwane for example, explains Schraader, they cannot have a ring-fenced budget or a dedicated operator on site. "When the Green Drop criteria were designed they had larger municipal water treatment plants in mind," he says. "We don't need to comply to all those criteria because our plants are relatively small and are natural systems that do not require direct process control."

Blake Schraader, General Manager Technical Services of the Kruger National Park.

Courtesy WIN-SA

However, their innovative work was recognised when they were selected to present their methods, as 'best-practice' in small wastewater treatment plants, at the recent Water Institute of Southern Africa conference. The park is also the topic of a recent WIN-SA lesson series, which aims to capture the innovative work of people tackling service delivery challenges on the road



Ralf Broemer

to Green Drop status. The series focuses on "sparks of excellence" in South Africa, as identified by the Water Research Commission and the Water Information Network of South Africa (WIN-SA).

According to van der Merwe Botha, what makes Kruger unique is that their systems are incredibly well designed, making use of anaerobic systems and reed bed systems to attain effluent of a very high standard.

There is a general perception that you cannot reach Green Drop status with oxidation ponds, she says. "This is a perception that we need to manage because, even though oxidation ponds are not technologically advanced, it is possible to attain effluent of a high standard with them." However, they are disregarded because they are often not managed right, and then the perception is created that they do not do a sufficient job, she says. People overlook the benefits such as low maintenance and operational costs.

But, all is not lost for Kruger National Park's road to Green Drop certification. According to van der Merwe Botha, they are adding bigger initiative for oxidation systems in the next round of Green Drop assessment, as well as slight relief of effluent quality standards for green systems. These changes will enable Kruger, and other Small Wastewater Treatment Plants that use oxidation ponds to attain Green Drop certification.

TAKING THE GREEN BEYOND KRUGER

There is not just the hope, but huge potential for small municipalities to implement systems similar to Kruger's, says van der Merwe Botha. In particularly smaller municipalities that have space available to construct the ponds. Kruger set a benchmark that can be attained by other as well, she says.

She says they would broadly have to keep three things in mind. Firstly, the oxidation system's design needs to be very good. Secondly, you must not allow your system to sludge up. Thirdly, they must understand that an oxidation pond is not just a waste pond, but a system that must be properly managed, monitored and maintained.

However, it will not necessarily be clear sailing ahead. "Technical skills are a challenge," she says

Petro Kotze

The reedbed at Punda Maria.

and adds that it is integral that the correct people are appointed. You must appoint the right people, she stresses, and if you don't have them, you must put your existing staff in contact with people like Schraader. "You need to have committed staff and somebody who is dedicated to make it work," adds Schraader. A sewage treatment works is something that most people don't want to visit so you need to have the right, passionate and knowledgeable person to manage it.

While many may have the theoretical knowledge to job, they short in practical know-how. "So, maybe we have to look at stationing them on sites like Kruger's for a month or two to learn," says van der Merwe Botha. Schraader agrees that it is "definitely possible" for systems similar to theirs to be implemented in other places beyond the boundaries of Kruger. But using "appropriate technology" is integral, he stresses.

"We have some form of control over the quality of the discharge that we treat, and it's very different than what you find in Johannesburg," he notes. "Discharge from all operators in Kruger, like restaurants, has to adhere to certain standards. Up to 99% of all of the effluent that they treat is domestic. The systems that we use are natural, and in our environment it works very well. I would not say that the same system would work as well for a place like Johannesburg with heavy industries.

However, Schraader adds that it can be an alternative to conventional purification plants for small wastewater treatment plants with a capacity of less than two mega litres.

GREEN DROP AND BEYOND

It is little surprise that Schraader reports that they will "definitely" tackle the challenge again during the next Green Drop assessment, which starts in September. "One of our aspirations is to get the Green Drop certification, and we will get it." This will also make them the first South African National Park to carry the coveted status. But their future objectives do not stop there.

In the next ten years, the number of visitors to Kruger may double, particularly since two safari lodges are planned for the park. The technical management team must thus provide for increased volumes of wastewater per day.

NO PLACE LIKE KRUGER

Managing wastewater plants in the Kruger National Park brings about challenges that many local municipalities would never have to deal with. When the park started closing artificial waterholes as part of an attempt to reinstate natural migration patterns, the elephants did not initially change their ways at a similar pace. They broke through the fences around the water and wastewater plants to get to the ponds and wetlands, causing millions of rands of damage. Crocodiles and hippos followed. In Punda Maria, the elephants broke through the fence and fed on the reeds in the artificial wetland, completely destroying the reed bed and damaging the oxidation ponds.

Other challenges include duck weed that grow on the surface of ponds and depleted oxygen, which operators remove manually, and floods. A number of existing rest camps are situation on the banks of major rivers.

Source: *Water Information Network Lesson series – Kruger National Park chooses green technology to achieve a Green Drop.*

Drinie van Rensburg

Furthermore, they want to take in interns and work with education institutions to research pond systems and alternative technologies that cater for green options, re-use and value adding. They also want to continue to reach out and share knowledge and experience with private game reserves, municipalities and mines.

The Kruger technical management team is also upping the benchmark for another area that falls under their broad range of responsibilities – drinking water. While they are waiting for the next round of Green Drop assessments to starts, they have applied for Blue Drop status. This process is currently on the go. ❑

New ways to deal with Cape Town's flooded communities

Addressing life's challenges in Cape Town's flooded shacks calls for communities and the municipality to work together, research from the African Centre for Cities has found. Gina Ziervogel and Leonie Joubert.

When floods sweep through informal settlements it destroys food, furniture, clothing and bedding.

Courtesy African Centre for Cities/University of Cape Town

The Cape Flats is a low-lying coastal zone outside Cape Town, South Africa. While the state used to force people of colour to settle there under the apartheid regime, the area now attracts migrants from both South Africa and further afield. Tens of thousands live in cramped conditions, in low-cost formally registered houses or rickety squatter camps.

During the dry summer months, many places here look perfect for settlement. People buy a shack on the informal housing market, or build on an open piece of land. But when the winter rains come to this natural wetland, the high water table seeps up, pooling in and around houses where it will stagnate for days. Even in the formally housed areas, where the wetland has been tarred over and cemented in, stormwater drains back up: debris and household waste then flood the streets and nearby homes and businesses.

FLOODING AN ONGOING CHALLENGE

For business owner Christina Mtandana in the informal settlement of Philippi, regular flooding means that water pools in the kitchen of her small restaurant. "I have even been shocked from the deep fryer I'm using, because we are standing in water," she says. She wears rubber boots and thick socks to keep dry, warm, and safe.

Others, like Bomkazi Sokhaya, live with sewage-tainted water seeping into their homes. The municipality's portable toilets aren't emptied regularly, leaving many residents to use buckets as toilets, which they empty into the standing water near Sokhaya's home.

The Cape Flats' challenges won't simply go away. Climate change is leading to more severe and heavier rains that increase the risk of floods. At the same time, budget constraints have slowed construction of new state-supplied housing, and the provision of sanitation and waste removal services. Vandalism of existing services sets progress back further. Many city efforts to upgrade the infrastructure – such as public toilets and improved sanitation and stormwater drains – have failed because communities weren't consultated or involved in the efforts.

We have a good idea about why people settle in flood-prone areas on the Cape Flats. The implications for people living here are also well documented. What isn't well understood, though, is how

governance aids or hinders management of and responses to flooding in these communities.

The University of Cape Town's (UCT) African Centre for Cities and partner departments studied the governance of flood risk on the Cape Flats. This included exploring how local government departments in the metropole view and respond to flood risk differently as well as how communities and the municipality can work together to address flooding.

The project was funded by Canada's International Development Research Centre and the UK Department for International Development through the Climate Change Adaptation in Africa programme. A number of Honours, Masters and PhD students worked on the project.

COMMUNITY MEMBERS UNDER PRESSURE

The research showed that there needs to be better collaboration between different sectors. That includes the different local government departments, civil society organisations – which may help with food and blanket distribution during a flood event – and volunteer leaders from within the communities themselves.

The work of one of the PhD students, from UCT's Centre of Criminology, highlights the difficulties of community-level governance. Communities are often represented by committees, whose members are drawn from voluntary activists. Their role is to address issues such as safety and neighbourhood development, and to negotiate with external actors such as local government, ward councillors, and civil society organisations.

The expectations of these volunteer committee members can be unrealistically high, she says. Their community expects them to sway local authorities' decision-making processes. Meanwhile local authorities expect them to rally the community together at workshops and meetings. In many cases, these community leaders don't wield nearly as much influence as they're expected to.

BUILDING BRIDGES TO BETTER GOVERNANCE

Often, when municipalities respond to converging threats and stresses, such as those discussed here, they tend to do so by seeking out highly engineered technical solutions, or through policy response. But, as our research points out, if the governance context that acknowledges different interests and ways of operating is ignored, those other solutions will fail.

One of the key findings at the end of the project is the need for strengthened cooperation between local communities, civil society organisations, and the municipality. Significant progress has been made in Cape Town through the establishment of the Flood and Storms task team that coordinates government departments in preparing for and responding to flood risk. But this government-led task team does not provide space for the representation of groups from outside government.

The last phase of the project focused on bringing together these different stakeholder groups through facilitated dialogue. What emerged is that there are many groups who could benefit from collaborating more but it is a tricky field to negotiate. In cities like Cape Town, where informality is high and many people are disempowered in decision-making processes, it is essential to create a bridge between the formal and informal parts of the city's governance system. This is easier said that done. But aiming for collaborative governance is an important starting point, one that most stakeholders are willing to give a try.

One of the recommendations researchers gave to guide the city's work with communities, was to ensure transparency and report back to communities to avoid suspicions that could lead to conflict.

Results to date are promising. The municipality has indicated it is willing to foster collaboration across its departments, and to work with communities and civil society organisations. It is looking for solutions to flood risk and carrying on education campaigns. It's also trying to buy privately-owned land so it can develop new housing areas. And it's prioritising at-risk areas for appropriate flood risk reduction measures. ❑

Courtesy African Centre for Cities/University of Cape Town

Living in wet conditions are particularly hard on elederly, the infirm and on children.

Courtesy African Centre for Cities/University of Cape Town

This drain is part of a stormwater management system, put there to siphon off the water that fetches up in a 'detention pond', a manmade wetland built to hold water temporarily after heavy downpours. But, since the pond stands dry during summer, desperate people set up their homes on what seemed like suitable open ground, often not knowing what the winter months would bring.

TEACHING THROUGH PLAY:
New game educates rural communities on risk

Courtesy of Umvoto Africa

Earth sciences consultancy Umvoto Africa has developed a game, called Riskopoly, as a facilitation tool to discuss risk and preparation for climate change in rural communities. It can be adapted for use in any community dealing with natural hazards, and is particularly useful where literacy levels are low, as it is experiential. Article by Paula Hay and Rowena Hay.

The southern African region is considered one of the most vulnerable in Africa to climate variability. Temperature records in Southern Africa reveal that over the last decades the region has experienced a warming trend. In part this is due to the region's high social vulnerability and low adaptive capacity. In South Africa, the most common natural hazards are floods, storms, wildfires and drought. South Africa has an average rainfall of less than 500 mm per annum, which is comparatively lower than the world average of 860 mm. As this rainfall is unevenly distributed, 65% of the country receives less than 500 mm of rain annually. This is considered the minimum for successful dry-land farming.

At the national level in South Africa, a number of legislative and policy measures have been developed which stipulate that water is to be managed equitably, sustainably and efficiently. Further to this, the National Water Resource Strategy 2 (NWRS 2) also recognises the increased threats posed by climate variability and advocates the implementation of disaster risk reduction (DRR) and climate change adaptation (CCA) strategies. At the local level, there is also an urgent need for good governance and a participatory approach to managing water resources and undertaking DRR and CCA initiatives.

Earth sciences consultancy, Umvoto Africa, was commissioned by the Water Research Commission (WRC) to undertake a study on community CCA planning. The purpose of the study was to gain an in-depth understanding of the rural challenges of adapting to climate change, to understand the role of community-based organisations (CBOs) and community-level coping strategies, and how to cohere and optimise these with local and district municipal resources and initiatives and sustainable water services.

From 2012-2013, the Umvoto study team engaged with the rural Eastern Cape community of Tsengiwe in conducting a local level risk assessment and undertaking planning for CCA. This took place during three community workshops held within this two-year period.

Tsengiwe is located within the Sakhisizwe Local Municipality (LM), a water services provider within the Chris Hani District Municipality (CHDM) in the Eastern Cape. At the district municipal level, the CHDM Water Services Authority (WSA) is tasked with implementing water supply schemes. It has been declared a drought-affected region, and the need to tackle the issue of climate change through an adaption and DRR programme in the area has been recognised.

As elsewhere in the Eastern Cape, Tsengiwe suffers from limited long-term disaster planning and coordination between water services and disaster management at the local municipal level. In villages such as Tsengiwe, this lack of planning compounds the exposure risk of communities.

It was the view of Umvoto that grassroots or community involvement in climate change adaptation planning and implementation would be critical, coupled with the need for effective service delivery.

The study identified the need for the development of a common vision and purpose from village to DM level to improve assurance of water supply, particularly developing resilience at village and household level through efficient use of water and sustainable use of land. In order to achieve this it was necessary to map the community's water sources, reticulation, storage and the municipal service delivery process. Study outcomes included:

- Creating plans to undertake disaster risk assessment at a community level;
- Catalyse community-led CCA and other DRR measures;
- Strengthen partnerships between the community and LM, District Municipality (DM) and provincial and national stakeholders, and local mentors;
- Monitor study progress and evaluate the impacts of community CCA initiatives; and
- Produce video documentation of the study.

The study was informed by theories around Participatory Action Research (PAR). This involves a spiral of self-reflective cycles of planning a change, acting and observing the consequences of the change, and reflecting and re-planning. The adaptive process of PAR was applied throughout the study through specific techniques such as Participatory Rural Appraisal (PRA), Constructive Dialogue, and Participatory Mapping.

Undertaking a risk assessment at a community level involved gathering information from the community on the hazards and risks they face and how these have changed over time. The fundamental idea of action-reflection learning is to bring people together to learn from each other's experiences. There is emphasis on "studying one's own situation, clarifying what the organisation is trying to achieve and working to remove obstacles".

In Tsengiwe the first task was to

"The Riskopoly game highlighted the importance of doing risk management and the consequences of not doing so."

(courtesy of Umvoto Africa)

The Rolypoly playing cards.

determine which hazards would be the focus of the study. Through PRA techniques, the community ranked the hazards they faced. The research team then shared information on risk and hazards with the community. Together, they and the community defined the hazards that would be the focus of the study and looked at the potential benefits and pitfalls of different activities and how to deal with political sensitivities around various issues.

A disaster risk assessment undertaken by Africon in 2009 for Chris Hani District Municipality used local municipalities as the unit of assessment. This influenced the hazard types identified for the assessment as well as the vulnerability and coping capacity, and hence risk assessment. This scale of risk assessment informs the perception of risk at DM and LM level, and will also inform prioritisation and roll-out of risk reduction activities by local government.

"Grassroots or community involvement in climate change adaptation planning and implementation is critical, coupled with the need for effective service delivery."

Buy-in to risk reduction activities requires that, so far as possible, risk perception and risk assessment are aligned and agreed upon (during and/ or after due process) between government levels (traditional and local) and the rural population. Community hazard rankings and specialist hazard assessment formed the springboard for discussions around actions that could be carried out by local municipality and community members. Discussions were also centred on those actions that were necessary but would need the support of external agents; be this through planning, direct government intervention, or funding.

The community level risk assessment was challenging, due to the community's fusion of hazard and risk. For example, drought was perceived as one of the worst risks by the community. However, they considered risk on the basis of the hazard they experience as the worst, as opposed to that which occurs most often or most severely.

However, land degradation, ineffective governance by local and regional leaders, and limited service delivery also contribute to exacerbate drought and the problems experienced by the community. In this instance mitigation measures related to actual temperature and rainfall changes might not be effective if the causes of the increased impact of drought were not addressed.

The question of scale was also important to address, in order to prioritise climate change planning and strategising. The CHDM highlights snow and strong winds as priority hazards for Ward 4 of the Sakhisizwe LM in which Tsengiwe is situated. It is likely that these are both significant hazards at the ward level, but the community of Tsengiwe does not consider snow and strong winds to be as pressing because of the more urgent need on a local level to address issues of drought and water and food insecurity.

RISKOPOLY GAME

In line with the PAR approach, a game was designed by the Umvoto study team in order to provide an experiential basis from which to discuss risk. The game, called Riskopoly, was used as a facilitation tool with the Tsengiwe community to highlight the need to prepare simultaneously for several different unpredictable hydro-meteorological hazards. In the context of PAR, games are valuable tools for applying insights as they will have a different outcome each time they are played.

Riskopoly provided a real-life and experiential basis from which to discuss risk and unpack issues of scale and of defining hazard and risk. The process highlighted the role of games in increasing community understanding of slow onset disasters and how to prepare for multiple hazards simultaneously in order to reduce compound risk.

The game requires players to strategise investments and spending. It developed the community's insights into the difference between a risk and a hazard and the value of risk reduction. Players in Tsengiwe were divided into four teams of four to six players. Each team elected a team leader to do the buying and selling of products.

Players clearly understood the rules and after the second round, when the implications of not having a particular item that provided hazard protection were felt, the excitement grew. It was apparent, for example, that a water storage tank is an essential item and three out of four groups purchased one in the second round. The other items became relevant as the game progressed and different hazards occurred.

Players were also able to earn money by having a water tank: by the end of the game it was understood to be an important investment, as the returns extended beyond drought scenarios. With the loss of certain protective measures, which some teams had invested in (as game penalties) the competitive spirit grew. It also became harder after each round to regain losses, particularly without the correct products to protect against hazards such as drought, flood or frost. Adaptation in the event of a hazard was also important and informed the inclusion of a buying and selling round which enabled players to re-evaluate their decisions.

The Riskopoly game highlighted the importance of doing risk management and the consequences of not doing so. The process of playing the game and feedback from the participants highlighted the necessity of cooperative team work.

The feedback from the game indicated that players had gained insight into key elements of risk reduction. Feedback included:

- Have back up – hazardous events will occur;
- Prioritise what you want to buy and invest in;
- Work together; and
- Spend wisely and select important items.

It was interesting that teams in the Tsengiwe pilot game did not partner up with each other. This option illustrates the importance of cooperation and the potential benefits of pooling resources. However, the competitive spirit of the game served to heighten excitement. Throughout the workshop the game and insights gained by players and the study team continued to serve as a touchstone for real life examples. Playing together as a community can also serve to restore a sense of solidarity and joy and perhaps the most important conclusion, voiced by game players, was that cooperation and working together was essential in mitigating risk.

Games serve to expand the range of possibilities with which people can act by creating an alternative world of imagination, based on real life but freeing players up to consider new possibilities that may have been dormant within everyday awareness.

It is argued that it is precisely because humans have the capacity to imagine their world in multiple ways that they feel hopeless when they are blocked from doing so. One of the roles of the catalyst or change agent is to restore people's sense of their own resources and capacity to respond to the world in which they find themselves.

Change agents should first strive to understand the world in which people live and then see possibilities of responding to that reality. It was in light of this understanding and a drive to move away from linear patterns of thinking that the research team used Riskopoly to stimulate imagination and insight, as well as introduce the energy of fun and possibility. Games facilitate entry into an alternative world of imagination. The imaginary world of play, however, always happens within the world in which people live their daily lives. As games happen within the world of the players they have the capacity to affect them in reality. Rather than just mirroring reality, games imply that something new can arise, wherein lies their power. Games can thus help players discover something new within a known context.

The game can be adapted to different circumstances and hazards but, given its success, is recommended for adoption as a participatory tool. In combination with other participatory tools, the game facilitated the interaction between scientific and local knowledge and brought about new insights for both the Umvoto team and Tsengiwe community.

Coupled with the game, the Umvoto team facilitated communication between Tsengiwe and the Sakhisizwe municipality, the DWA, DRDAR, Department of Environmental Affairs and other officials in order to gain their support with and input into the climate change adaptation processes initiated within and by the Tsengiwe community. The team further facilitated links between Tsengiwe and nearby school greening projects, Mbewula and Three Crowns.

These measures all served to catalyse an evaluation of risk reduction measures that could be undertaken at the community level, culminating in community CCA Plans, each led by a committee and a committee leader. The community progressed from expectations of receiving and moved towards aspirations and documented ideas on what they can do. References available on request. ❑

Courtesy of Umvoto Africa

Members of the Tsengiwe community playing the game.

AQUALIBRIUM – Taking the art of learning to international heights

SAICE

Aqualibrium, the water network game first introduced by the South African Institution of Civil Engineering (SAICE) as a schools competition, is gaining international respect as an educational tool aimed at raising awareness around the role and challenges of civil engineering. Lani van Vuuren talked to the game's creator, Prof Kobus van Zyl of the University of Cape Town (UCT), about the game's growing popularity.

Three high school learners are gathered closely around a table. Heads together, they hardly notice the commotion around them as they anxiously watch the thin stream of water move from its bucket 'reservoir' through their constructed network of plastic pipes and connectors. Will this be the day they take first prize? This is the typical experience of a finalist in the SAICE Aqualibrium Schools Water Competition.

When Prof van Zyl developed the game with his students from the then University of Johannesburg (UJ) for the debut of the water competition he never imagined that 11 years later it would have attracted international interest. "In 2003 SAICE and Rand Water expressed the desire to use an interactive schools water competition as a platform for their combined centenary celebrations," explains Prof van Zyl. The idea behind the competition is to raise awareness of the importance of water supply, the complexity of water supply networks, the role civil engineers play in the process, the application of physics and mathematical concepts as well as the importance of preserving water resources.

The objective of the competition is to distribute three litres of water equally between three reservoirs (containers) placed randomly on a grid of 16 points. Participants build a pipe network between a water source and the three reservoirs using plastic pipes of different diameters. Teams are judged on how well they can achieve this task within a set period of time. To determine the winner the volume of water in each reservoir is measured and penalty points are calculated (teams are penalised for supplying less than or more than a litre per container).

The group with the lowest number of penalty points wins the competition. Competition rules test the creativity of the teams, for example, the main supply pipe has to be connected at point 1 on the competition

sheet; pipes must align with the grid on the sheet, and where two or more pipes meet at a junction they must all be connected to each other. A maximum of eight lines on the sheet grid may be left without a pipe.

SAICE organised regional competitions through their branches across the country, and the regional winners were flown up to the first national finals held at the Pretoria Show. Following the success of the first event, the Aqualibrium competition has become an annual event on the institution's calendar. Prof van Zyl notes that it is largely through the enthusiasm and dedication of event organisers such as Marie Ashpole of SAICE and Lourens Human of Rand Water that the competition got established.

A penalty score below 100 is considered excellent. Interestingly the minimum number of penalty points (and therefore the highest score) ever achieved was 30. This has been achieved twice in the national finals – the first time in 2008 by Brackenfell High School from Cape Town and the second time in 2012 by Port Rex Technical High School from East London.

The 2014 winners, again from Brackenfell High School, achieved a top score of 35 penalty points. The team from Winnie Mandela Secondary School in Tembisa achieved second place, while Dendron Secondary School from Limpopo came third. The three winning teams and their educators shared prize money of just over R17 000. Rand Water again came on board as the main sponsor following an absence of a few years.

Learners experience the competition as great fun and a valuable learning activity. A simple and fun activity, it doesn't matter what your age or level of learning. However, while the competition is simple to understand and fun to do, the underlying problem is highly complex: the three small reservoirs can be placed in more than 3 000 combinations, and potentially there are 280 billion possible pipe networks for each one of these combinations.

Conceptually, the Aqualibrium problem is the same as finding the optimal combination of pipe diameters in the design of a water distribution system. "This is an extraordinarily difficult problem to solve due to the large number of possible solutions, non-linear hydraulic behaviour and discreteness of the available pipe diameters," explains Prof van Zyl.

For this reason, Prof van Zyl introduced Aqualibrium to his third-year civil engineering students at UCT in 2010. The game proved so popular with the students that it has become a standard feature in the course.

Students run the competition under the same rules as the schools competition, however, it is done in a way that integrates closely with course work on water networks. This includes network hydraulics, design and network modelling. "Students are given the opportunity to design the network in advance using hydraulic modelling software, and are expected to calibrate their hydraulic models after building and testing them," Prof van Zyl explains.

A number of final year investigations have also been based on the Aqualibrium competition, including the development of new components, determining the hydraulic properties of components through direct measurement or calibration, and developing optimisation software for the competition problem. Finally, several students have become involved in community outreach as a result of the exercise, taking the competition to schools in their local communities.

Prof van Zyl travels up every year to take part in the national finals, which usually take place at the Sci Bono Discovery Centre, in Johannesburg. "I love the

Kobus van Zyl

Kobus van Zyl

Lani van Vuuren

***Top left:** Consulting engineering firm Gibb has used the Aqualibrium game as part of their job shadowing initiative.*

***Middle left:** Delegates of the 16th International Water Distribution Systems Analysis Conference in Bari, Italy, get a closer look at the Aqualibrium competition.*

***Bottom left:** Prof Kobus van Zyl explains the rules of the game during the SAICE Aqualibrium school finals.*

The Aqualibrium game is enjoyed just as much by girls as boys.

SAICE

competition because it brings so many complex issues together in such an elegant and accessible way. Aqualibrium deals with our water resources and how we take care of these resources, what civil engineers do and how water gets to people. It also shows learners the practical application of mathematics and science and why they are such important subjects."

More importantly, he has seen the positive impact the competition has had on learners, students, engineering and the general public. As a result of the competition three students are currently studying civil engineering.

"An important fact to me is that it is not only the privileged schools that can win the competition, but that everybody stands a chance. About one third of our national competitions over the years have been won by very underprivileged schools." The competition has also seen an increasing number of entries by mixed and all-girl teams – an indication perhaps that engineering is no longer seen as an exclusively male career choice.

"About one third of our national competitions over the years have been won by very underprivileged schools."

The game has gone through several transformations through the years, and Prof van Zyl is always on the lookout to improve its look and feel. The original equipment was designed with common materials so that schools can build their own sets from parts purchased at hardware stores and aquariums. "Originally, the buckets hung under the competition and this required a special board and frame, making it bulky and expensive. Getting air out of the pipes was a big problem," he explains.

One of the first changes to the system was to have the buckets stand on top of the background, allowing participants to remove the air in the pipes before doing their final run. The next major improvement was the development of an informative, technically correct background for the competition. This was done with the assistance of the UJ graphics department.

Finally, the developers realised the need for more consistent materials to take the competition to the next level. This led to the development of the current equipment using rigid pipes and special connector pieces. During the 2014 competition, take-away Aqualibrium kits were also introduced. These kits come with foldable, material backgrounds and all the network connections neatly fitted into a nifty carry case.

The game has achieved national recognition, having been chosen as a finalist twice in the National Science and Technology Forum and BHP Billiton Awards in the science communication category.

Aqualibrium has also been introduced successfully overseas. It was first introduced to the 14th International Conference on Water Distribution Systems Analysis, held in September 2012 in Adelaide, Australia. This series of conferences brings together the top global experts on water distribution, and is held under the auspices of the American Society of Civil Engineers.

"There was huge interest in the competition at the Australian conference and conference delegates participated with enthusiasm," reports Prof van Zyl. Some experts used their latest software to try and optimise the system, and in the end a delegate from Belgium won.

Since then the competition has been run at two further international conferences in Italy. Various people have expressed interest in taking the competition to their own countries, and Aqualibrium is already played in Italy, Austria, the USA and Australia.

Prof van Zyl's dream is to see Aqualibrium as a true international event. "Our national winners should compete against winners from other countries in an Aqualibrium World Championship that brings together learners to meet, share and spread the message of caring for our water resources."

To become part of the Aqualibrium movement, visit www.aqualibriumcompetition.net or follow their Facebook page 'aqualibriumcompetition.' ❑

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Duncan Hay, Charles Breen and Bimo Nkhata look at the wicked problem of achieving water security and the difficulty of unravelling its complexity.

Standing in the centre of the city of Missoula, Montana USA, waste deep in the waters of the Clark Fork River, one can cast a fly-line at very wild trout; you can also drink the water you are standing in. A city and clean water – for many South Africans this is a revelation. Only later do we learn what securing this clean water cost – hundreds of millions of dollars in upstream mine waste rehabilitation. It seems almost inevitable – mix people and water and what do we get – a mess! This, in turn, appears bizarre. On an ongoing and escalating basis we compromise the quality and quantity of a resource upon which we are entirely dependent. People are not stupid so why do we appear to be getting it so wrong and what might we do about it?

Through the research of Nobel Prize winner, the late Eleanor Ostrom, and many others we are beginning to appreciate that the issues we are grappling with are not simple; they are complex and are particularly complex when they relate to water and aquatic systems. Water, in itself, is a complex resource – liquid, solid, vapour, flowing, falling, static, transporter, depositor – and society is equally complex with highly diverse values, needs and aspirations. Put the two together, give it a stir and the result is problems that appear intractable and are not amenable to simple or conventional solutions. This complexity is increasingly the focus of research effort funded by the Water Research Commission (www.wrc.org.za), the Lloyd's Register Foundation (www.watersecuritynetwork.org) and other agencies worldwide.

Not only has this research introduced us to new ideas but it has introduced us to a new language – the language of social-ecological systems; messy and wicked problems; common pool resources; property rights regimes; bundles of rights, collective identity, collective action and adaptive management. Let's unpack some of the ideas and their language and see where they take us.

If we are to become far-sighted and act together to find solutions we must find ways of living with this complexity; this mess full of wicked problems. At the same time we must act in ways that respect the diverse social and economic values the different groups attribute to water resources. But how might we do this?

Aquatic systems, particularly rivers, lakes and wetlands, provide a variety of ecosystem services that we use and from which we benefit. As we exercise our choice of which benefits to access and where and when to do so, so do complex patterns emerge. Just imagine drinking, bathing, washing clothes and watering cattle in or from the same pond. Our patterns of use mirror the ecological patterns we find in the pond – they are as complex and dynamic. Not only is the pond responding to physical, chemical and biological change, it is also being shaped by our changing preferences and demand. The ecological and social systems – people and the pond – are inextricably linked, each affecting the other. At the same time both are being influenced by common issues such as climate change. In complex social-ecological systems

of this nature where there are many pathways through which changes can occur, the relationship between cause and effect can be difficult to see and may take years to emerge.

How we choose to access water resource benefits can alter other peoples' options to the extent that we might compromise the opportunity others have to access benefits. Closing the sluice gates at a dam or reservoir might improve water security for downstream irrigation farmers who require a regular supply of water for their crops. At the same time it might compromise the water security for downstream subsistence fisherfolk who rely on annual flooding to replenish the shallow lakes where they fish. How risk is experienced and how it changes in both space and time is reflected in changes to linked social and ecological systems. As this happens it affects the choices we make, and the consequences of these choices are carried forward to emerge later, sometimes with quite unexpected and undesirable outcomes.

The system is never stable; it is constantly adjusting to what is happening now and what has happened in the past. So, for management to be effective it needs to take into account this complexity, messiness and uncertainty; the wicked nature of the problems that are thrown at us. Our management needs to be adaptive – acting, reflecting, learning, refining – rather than providing blue-print type definitive solutions that might be wrong today and will certainly be wrong tomorrow.

Moving on to what we are ultimately trying to achieve – water security. The term water security conveys a sense of being safe. It is an indication of how secure and free of risk we feel about accessing our share of the benefits of aquatic systems. To feel secure we need to know that others using the resource acknowledge our right of use. Because we are all connected and need to defend our rights to use and to sanction abuse, we need to understand and identify with the system as a whole – the resource and resource users – and not only the benefits that we derive from it. Collectively we need to commit to sustaining a pattern of risk that is socially and environmentally just. When this happens the resource can be thought of as being common to all, as a common pool resource. The collective identity built through the processes of identifying with the system and developing commitment provides a foundation for collective action that is necessary for managing the use of common pool resources.

However, developing commitment to collective action is not enough – we require rules to direct this energy.

Conventionally we think of rules in terms of legislation, regulations and byelaws. These are underpinned and/or complemented by a system of rights – a property rights regime – most simply defined as a system that determines who has access to what under what conditions. This regime provides the means for social coordination and ordered rule in the delivery of benefits from aquatic resources. It provides direction, guiding our energy and initiative towards a common good. It provides the means for negotiating, constructing and ultimately defining the common good which the state must then secure. It also provides the means of resolving trade-offs in order to establish the common good. Clearly defined property rights are used by society to guide the relationships among users, managers and policymakers as they go about securing their interests, meeting their social obligations, and mediating their differences.

But how do we establish an effective property rights regime for common pool resources? Each will be context specific but Ostrom and her colleagues established seven general principles to guide us:

- The boundaries of the system (linked social and ecological system) should be clearly defined – we need to be able to define the resource and who has (or should have) access to it.
- There should be proportional equivalence between benefits and costs associated with ecosystem services – we must internalise the costs and it must be worthwhile investing in sustainable use.
- Those affected by the rules that regulate use should be included in the process of establishing the rules – governance should be inclusive and participatory.
- Those who monitor use and its consequences should be accountable to the users – those

Managing the use of common pool resources requires that we, the resource users, all understand, agree to and support the allocation of rights to access and use ecosystem services.

Bundles of Rights Associated with Positions (extracted from Schlager and Ostrom and Schlager, 1992)

Rights	Owner	Proprietor	Claimant	Authorised user	Authorised entrant
Access	X	X	X	X	X
Withdrawal	X	X	X	X	
Management	X	X	X	X	
Exclusion	X	X			
Alienation	X				

monitoring might be government or the users themselves.
- Those who disobey the rules should be subject to sanction – there must be consequences for those who disobey the rules.
- There should be affordable access to dispute resolution – it needs to be convenient and efficient.
- Resource users should have the right to self-organise and devise their own institutions without external interference – let users get on with the business of management with minimal interference.

Within a property rights regime there are number of distinct rights related to a particular property. Taking a wetland as an example: subject to certain restrictions imposed by government, the 'owner' would have rights to possess, use, access, manage, sell, lease, donate or subdivide it while someone leasing a portion would only have some of these rights. A birdwatcher, with permission of the 'owner', would only have right of access and use. So, in this context, property rights are viewed as bundles of rights to use or transfer resources, including benefits – see the table above.

These bundles of rights can be added or subtracted, shared or divided in different ways resulting in changes in the amount of benefits, and associated costs, flowing from the property. So, by defining property rights in terms of bundles allows us to better understand how different allocation systems for those rights affect our incentives structures and, in doing so, how they give effect to collective action.

Managing the use of common pool resources requires that we, the resource users, all understand, agree to and support the allocation of rights to access and use ecosystem services. In other words, agencies have to implement a property rights regime in which users are granted rights and responsibilities that encourage self-regulation within the parameters set by government. It is government's responsibility to establish the formal institutional arrangements for governance, while the various user sectors are responsible for establishing the informal institutional arrangements necessary for self-regulation. The success of formal institutions such as national policy and regulation is strongly dependent on how effective informal institutions are in ensuring compliance.

So, where is this likely to play itself out in practical terms and where might we focus our attention? In South Africa legislation has made provision for Water User Associations. This is where negotiations on water resource allocation will happen at a local level. It is particularly at this scale that effective property rights regimes will be required to ensure equitable, efficient and sustainable use. And, we cannot legislate or regulate what precise forms these property rights regimes will take place – every context is different, every situation is unique. What we need to do is provide wisdom, guidance, advice and information to assist users in working it out for themselves. This is perhaps the only way we will achieve collective action that takes account of the diversity of linked social and ecological systems in which we find ourselves.

- The authors are supported through the International Water Security Network (www.watersecuritynetwork.org) by Lloyd's Register Foundation, a charitable foundation helping to protect life and property by supporting engineering-related education, public engagement and the application of research. For more information, see: www.lrfoundation.org.uk ❑

Papers delving further into concepts and ideas around water security

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Calls to protect Cape Flats aquifer and Philippi farming area

An irrigation water pond in Philippi.

Maryke Malan

Rapid urbanisation and the growing need for water is threatening the Cape Flats aquifer, key water supplier to the agricultural hub of Philippi, outside Cape Town. Recent PhD graduate, Maryke Malan, shares some insights following her recent study in the area, conducted under the auspices of the University of the Western Cape (UWC).

Cape Town's population is expanding and so also the need for food and fresh water. The Philippi farming area is key in meeting Cape Town's demand for food, but its future is uncertain as urban development swallows more of this agricultural area. The Cape Flats aquifer, a natural water reservoir underneath the greater Cape Town region, supplies irrigation water to the Philippi farmers but could potentially also supply fresh water for domestic use in Cape Town.

The protection of the Philippi farming area and the Cape Flats aquifer is thus extremely important and of great urgency. Earlier this year, a seminar arranged by the Philippi Horticultural Area for Food and Farming Campaign, the Environmental Monitoring Group and the Western Cape Water Caucus brought together community members, farmers, academics, government officials and non-governmental organisations to share their concerns and knowledge about the Cape flats aquifer and the Philippi farming area.

For more than a century vegetables have been grown in Philippi and today much of Cape Town's fresh produce still comes from Philippi. The Schaapkraal Civic and Environmental Association reported at the seminar that almost 70% of Cape Town's vegetables were produced in Philippi. This great demand for vegetables places much pressure on the Cape Flats aquifer from which most of Philippi's irrigation water is drawn.

The importance of protecting this aquifer was the main topic of discussion at the seminar, but many concerns were raised about the encroachment of urban developments on the Philippi farming area

as a whole. In the light of the fact that fresh water is a scarce resource in South Africa and that global warming will most likely lead to its increased scarcity, it is imperative that all stakeholders take note of the deteriorating water quality of the Cape Flats aquifer and contribute to its protection. This point was echoed by the Environmental Monitoring Group who spoke about the importance of water security in Philippi.

The Philippi farming area is partly situated on the Cape Flats aquifer and water is drawn from it through boreholes and then stored in ponds for later irrigation use. The groundwater table in Philippi is very shallow and various pollutants could easily seep into it. Several community members, government officials and academics mentioned their concerns in this regard.

Group discussions highlighted problems with dumping of waste along farm roads, oil leaks from vehicles, run-off from informal settlements, overflowing septic tanks and air pollution as burning issues. Some farmers felt that they were unfairly blamed for polluting the aquifer but, as discussions continued through the course of the seminar it became very clear that not only agricultural activities affected the quality of the aquifer.

Other threats to the aquifer included the situation of solid waste disposal sites and wastewater treatment works on the heart of the aquifer as well as various effluents from surrounding urban and industrial areas. In Philippi, expansion of the local sand mine, growing informal settlements and intruding residential and commercial areas were also mentioned.

Community members noted that one of the big problems was the removal of water from the area by storm water pipes. This water could have replenished the aquifer and diluted pollutants in irrigation water ponds and soils. Salinisation of water from several boreholes and irrigation water ponds was also mentioned by some farmers. Fortunately academics from UWC could confirm that seawater had not yet seeped into the aquifer and was not the cause of salty borehole water.

In some parts of Philippi, salinisation of borehole water is partly due to salts that are naturally present in the soils and rock formations, which have gradually washed into the water over time. Chloride, potassium and sodium salts seem to enter borehole water and ponds in this way. Fertilisers also contain salts, which can eventually end up in ponds and contribute to the salt content of the water, this can however be managed physically.

Philippi farmers and their workers preparing to harvest crops.

Maryke Malan

Nitrates, which are essential for plant growth, are salts that come from fertilisers and have been found in some ponds. During summer the salinity of irrigation water in ponds increases significantly due to the evaporation of water. Fortunately, winter rains dilute the concentration of salts in pond water and also replenish the aquifer.

Although several boreholes and ponds in Philippi have brackish water, there are boreholes and ponds with fresh water in the centre part of the Philippi farming area. In general, Philippi's irrigation water is still deemed suitable for irrigation purposes. Means of controlling salinity effectively needs to be investigated while salt tolerant crops could be selected for planting in the future.

Also shared at the seminar was research by UWC around the concentrations of heavy metals in crops, soils and irrigation waters from Philippi. Some salts, are classified as heavy metals. Some heavy metals are essential for human health while others are harmful.

This research suggested that Philippi soils seem to act as a filter that could, to some extent, protect the aquifer from chemical pollutants, like heavy metals. One farmer also pointed this out at the seminar. For example; although the concentrations of metals like copper and zinc were high in Philippi soils these metals were almost absent in irrigation waters.

The concentrations of beneficial as well as harmful heavy metals were determined in Philippi's irrigation waters and none of these metals exceed the limits set by South African regulations. A decrease over time in the concentrations of copper, lead and zinc was observed in Philippi soils.

There was also a decrease in the concentrations of cadmium and lead in crops which was great news since these metals are harmful. It was interesting to see that although copper concentrations were high in some soils, vegetables grown in this soil did not necessarily take up the copper and thus contained little copper. Although zinc concentrations in some crops were considered too high, this could be good since human diets are often zinc deficient and zinc is important for good human health. In terms of heavy metal concentrations, the water, soils and crops from Philippi are considered relatively clean. Although heavy metal pollution is not currently a problem it must still be monitored.

At the seminar the Department of Water and Sanitation indicated that groundwater from the Cape Flats aquifer was being monitored across Cape Town. Unfortunately since several monitored boreholes have been vandalised, monitoring was difficult. The City's municipality often experiences water shortages, which are inflated by the need for domestic water by the growing urban population.

These water shortages could be met by the Cape Flats aquifer, if it is properly protected, monitored and managed, as is the case in the Atlantis area. At the seminar a representative from the Schaapkraal Civic and Environmental Association mentioned that the aquifer could supply up to 30% of the City's water needs. A representative of the CSIR explained how groundwater from the same Cape Flats aquifer is successfully applied for domestic use in Atlantis.

Although it is disheartening to hear of continued urban and industrial developments that intrude on the Philippi farming area and other seemingly negative activities, there is still hope to protect the Cape Flats aquifer in this area if all stakeholders stand together.

The seminar held in Philippi was a positive step towards uniting people from all spheres of society in actively participating in research and other activities to protect our precious groundwater resources and farming areas.

The Cape Flats aquifer is still not fully understood nor appropriately valued and UWC invited interested parties to join them in finding out more about the aquifer so that it could be protecting and managing for the benefit of all. ❑

The illegal dumping of waste is an increasing problem around Philippi.

Maryke Malan

Excellence award for SPRING GROVE DAM

The water engineering excellence achieved during the design and construction of the Spring Grove Dam was recently recognised when Consulting Engineers South Africa (CESA) awarded AECOM with a CESA Aon Engineering Excellence Award for the project in the category 'Engineering Excellence with a value greater than R250 million.' The Water Wheel looks at some of the non-engineering factors that make this project unusual.

Situated on the Mooi River, Spring Grove Dam is the main component of Phase 2 of the Mooi-Mgeni Transfer Scheme. This is a much needed water resource development project to bring additional water to the ever expanding KwaZulu-Natal coastal metropolitan area.

Spring Grove is the fifth dam to be built in the Mooi-Mgeni system, which already comprises Midmar, Albert Falls, Nagle and Inanda dams. Together, these dams provide water to more than five million people and industries in Durban, Pietermaritzburg and surrounding towns. The new dam has augmented the yield of the system by 60 million m^3/year, taking the total system yield to 394 million m^3/year.

Throughout the design and construction phases of this dam, it was up to the design and construction teams to work closely with the client, TCTA, to ensure that all efforts were made to minimise the impacts on the social and natural environment wherever possible.

The dam is nestled in the KwaZulu-Natal Midlands, near the small town of Rosetta, a quiet, picturesque area. Land acquisition is always a sensitive issue, particularly when arable land, homesteads and sensitive natural habitats will be inundated. AECOM worked closely with TCTA using a phased approach to acquire the portions of properties that would be inundated by the dam, giving priority to properties with dwellings that lay below the purchase line and in the construction domain. Throughout this process, the team was careful to ensure that landowners were properly communicated with and that the process was fair and clear.

As some landowners would have to reduce their agricultural operations following the expropriation of portions of their land, employment opportunities would change and measures had to be devised to compensate and relocate those who would be affected. A Relocation Action Plan (RAP) was thus developed under the proviso that the relocation process needed to be completed before impoundment of the dam.

The Spring Grove dam wall during construction.

Courtesy AECOM

Because the circumstances, history and 'relationship to the land' of the people affected by land acquisition differed so greatly, the RAP could not apply standard principles and procedures. The international standards and procedures for the relocation and compensation also did not apply because there was no homogenous community in the area (only individuals and families) and because the affected properties were all privately owned.

While the relocation of people was a major part of the project, the project team also had to ensure that historical, archaeological, social and natural fauna and flora aspects were also sensitively addressed. This area is noted not only for its beauty, but also for its role in South Africa's history.

While the relocation of people was a major part of the project, the project team also had to ensure that historical, archaeological, social and natural fauna and flora aspects were also sensitively addressed.

The KwaZulu-Natal Midlands has both tangible and intangible cultural and heritage importance, and the project documented the 'sense of place' in and around the dam's basin. Interestingly, the dam's basin was formally occupied by settlers of English decent in the late 1800s and was primarily used as farming land. The dam basin also included part of the wagon trail that led to the interior of the country and was part of historical events such as the Langalibalele rebellion, the Anglo-Zulu war, the Anglo-Boer war and the Bambatha rebellion.

The presence of San inhabitants was also evident in the dam basin. Three rock paintings just below Inchbrakie Falls, known as the Vaalekop Rock Art Site, would be inundated. The artwork was carefully removed by a team of archaeological experts and was taken to the Natal Museum for preservation.

In addition, 157 graves were reported as affected and were investigated for exhumation at the identified locations, 109 graves were found with remains or evidence of existence of a grave, and 42 sites were excavated and no remains were found or showed any existence of a grave.

During construction, the R103 became a major travel route for vehicles hauling construction materials to site.

Courtesy AECOM

An environmental aspect of the project that was unique was the construction of a fish barrier structure upstream of the Spring Grove reservoir to mimic the function of the Inchbrakie Falls, which served as a natural a barrier between smallmouth bass populations downstream of the falls and trout upstream. At full supply the Inchbrakie Falls would be inundated. During construction, the R103 became a major travel route for vehicles hauling construction materials to site, and much time was spent in consultation with local residents of Nottingham Road and Rosetta to find a solution that suited everyone.

The conditions of approval of the Traffic Management Plan stipulated that all vehicles hauling processed rock be fitted with GPS devices to track, among others, speed, and that the construction trucks had to follow a loop system so that no trucks passed each other on their way to/from site.

The D146 road from the R103 to the dam construction site was upgraded and maintained during construction so that it could accommodate the extra traffic burden. The construction of Spring Grove Dam holds short- and long-term benefits for the region, especially the nearby towns of Mooi River, Rosetta and Nottingham Road.

Guesthouses, restaurants, entertainment facilities and suppliers in the towns benefited from the influx of site staff and various sub-contractors. The project also generated employment opportunities for the local communities, and specific performance targets were included in the contract to ensure that socio-economic objectives were achieved.

In March 2013, impoundment of Spring Grove Dam started and the Taking-Over Certificate was issued on 25 October 2013 marking the end of construction. The dam was officially opened by President Jacob Zuma on 19 November 2013, who said "South Africans should remember that the country is one of the driest on earth. Not a drop must be wasted, not a drop must be polluted, and all infrastructure developed must be cared for. Water is life. Let us conserve it, respect it and enjoy it."

With good rain over the past few months, the dam reservoir's level has increased from 10% in November 2013 to 85% as at April 2014. ❑

Courtesy AECOM

The Inchbrakie falls, which are inundated during full supply.

INDIGENOUS CROPS – A market ripe for the picking

Maize, wheat, rice, potatoes. The globalisation of our food systems has made us dangerously over-reliant on a handful of food sources. Growing and preserving our knowledge of traditional South African crops is an important step towards preserving food crop biodiversity while enhancing food security and reducing malnutrition. Lani van Vuuren reports on the Symposium on Water Use and Nutritional Value of Indigenous Crops hosted by the Water Research Commission (WRC) earlier this year.

According to the Food and Agriculture Organisation of the United Nations (FAO), throughout history over 7 000 crops have been used for human consumption. Unfortunately, many of these so-called traditional, indigenous or indigenised crops have disappeared or have been neglected or abandoned in favour of westernised food.

Rising water scarcity, potential climate change and a growing population demand that we find innovative solutions to meeting our nation's growing food security needs. It has been recognised that previously neglected indigenous crops could play a role in this regard. However, this means propelling them from the peripheries of subsistence agriculture to the promise of commercial agriculture through scientific research.

In partnership with institutions such as the Department of Agriculture, Forestry and Fisheries (DAFF), the WRC has led the way in terms of enhancing knowledge about the agricultural production of indigenous crops. Several studies have been published in the last few years focusing specifically on the water use and nutritional value of indigenous crops, while the Commission also published the country's first production guide for African leafy vegetables.

As pointed out by WRC CEO Dhesigen Naidoo, many of these crops were not only shown to be extremely nutritious, but many also used less water than their conventional counterparts. "By expanding the production of indigenous crops we have the opportunity to develop completely new agricultural value chains," he told delegates at the symposium.

"South Africa has one of the greatest biodiversities in the world," added Thabo Ramashala, Director of Plant Production at DAFF. "These natural assets are often abundant in rural areas where poverty is most acute. It is in these rural areas where indigenous foods form an integral part of rural livelihoods."

According to Ramashala, the reliance of rural communities on indigenous foods to compliment diets and as a survival mechanism in times of hardship or drought had resulted in the creation of a large indigenous knowledge base in the use and processing of natural products. The challenge was now to capture and grow that knowledge in order to move the production of indigenous crops into the commercial farming domain.

"While South Africa has focused little on its indigenous crops the rest of the world have taken note of their potential. So, for instance, the kei apple is being cultivated in California while horned melons are produced commercially in New Zealand, France, Israel, and California."

DAFF has developed a National Strategy on Indigenous Food Crops to support research and technology development of these crops, while promoting their sustainable production and consumption, and improving productivity and profitability of these crops through market development.

Ramashala said that government, research institutions, training institutions and the private sector had to work together in order to develop a prosperous and sustainable indigenous food crop sector. "Through our indigenous crops we have an important opportunity to diversify our food basket and reduce our reliance on conventional staple foods. We must use the opportunities we have now to develop this sector."

The latest report on indigenous crops to be published by the WRC, *Water use and drought tolerance of selected traditional crops* (**Report No. 1771/1/13**) focused on identifying and characterising indigenous food crops with agronomic potential in South Africa. A series of trials were then undertaken on the selected crops, which included among others traditional maize, Bambara groundnut, cowpeas, amaranth, pearl millet and taro to understand the agronomy of these crops and determine whether or not they were drought tolerant.

The studies on crop water use were diverse and represented current trends in determination of yield response to water availability. These included water use efficiency and water productivity as distinct parameters indicating yield response to water availability.

While we now know much more about the agronomy of these indigenous crops thanks to this study, it also aimed to develop a crop model for indigenous crops. For the latter the FAO's AquaCrop model was tested for the first time on indigenous crops.

Research reports from the WRC focusing on indigenous crops

- Water use and drought tolerance of selected traditional crops (**Report No. 1771/1/13**)
- Nutritional value and water use of African leafy vegetables for improved livelihoods (**Report No. TT 535/12**)
- Production guidelines for African leafy vegetables (**Report No. TT 536/12**)
- Nutritional status of South Africans: Links to agriculture and water (**Report No. TT 362/P/08**)
- Screening of cowpea, bambara groundnut and *Amaranthus* germplasm for drought tolerance and testing of the selected plant material in participatation with targeted communities (**Report No. 944/1/04**)

To order any of these reports, contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.

"It is uplifting to see the growing number of researchers in the indigenous crop research field," noted Prof Albert Modi of the University of KwaZulu-Natal and project leader of the WRC study. "This growing field of research has not only brought more attention to the potential of these crops, but also allowed us to reach out to the communities who are the custodians of indigenous knowledge on the production of these crops."

The WRC's support to this subject matter has now been extended to a new research study focusing on water use of traditional and indigenous cereal and grain crops. The study is still in its early stages. ❑

Lani van Vuuren

WRC Executive Manager, Dr Gerhard Backeberg, DAFF's Thabo Ramashala and WRC CEO Dhesigen Naidoo and at the recent indigenous crops symposium.

Cream of SA's aquatic scientists gather in Free State

The Southern African Society of Aquatic Scientists held its annual conference at Thaba Nchu from 22 to 26 June. Around 100 delegates attended this year's conference, which provided a forum for discussion on aquatic science topics ranging from ecology and management to fisheries, parasitology, pollution and alien invasive species. True to its nature of being a student-friendly society, the conference offered an opportunity for many students to present their research work – many for the first time. The quality of papers were of an exceptional standard, bringing the hope that, while the sector remains small, South Africa's aquatic scientists are among the best in the world.

Dr Kele Malepe and Dr Tumi Motsisi-Mehlape of the Department of Agriculture, Forestry & Fisheries, Mary Mkhonto of the University of Johannesburg and Millicent Kekana of the University of Limpopo.

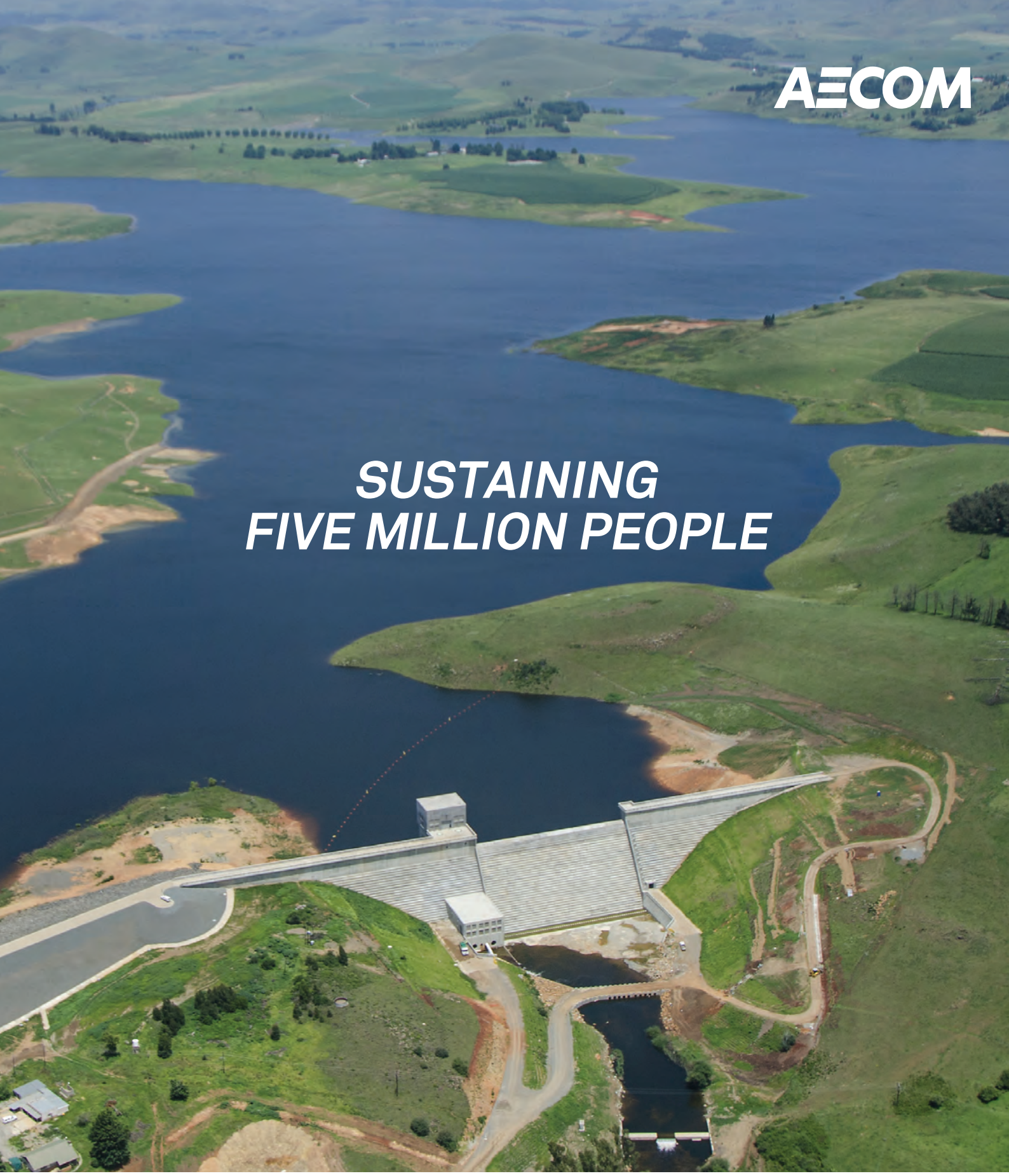
Hendrik Sithole of SanParks and Mpho Ramoejane of the South African Institute of Aquatic Biodiversity.

Martin Ferreira of Jeffares + Green, Dr Gordon o'Brien of Rhodes University and Prof Nico Smit of North West University.

Dr Vic Wepener of North West University, Prof Paul Fouché of the University of Venda and Prof Johan van Vuren of the University of Johannesburg.

Delegates pose for a group photograph.

Mia Otto, Pieter Swanepoel and Prof Linda Basson all of the University of the Free State.



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The Water Reasearch Commission not only endeavours to ensure that its commissioned research remains real and relevant to the country's water scene, but that the knowledge generated from this research contributes positively to uplifting South African communities, reducing inequality and growing our economy while safeguarding our natural resources. The WRC supports sustainable development through research funding, knowledge creation and dissemination.

The knowledge generated by the by the WRC generates new products and services for economic development, it informs policy and decision making, it provides sustainable development solutions, it contributes to transformation and redress, it empowers communities and it leads various dialogues in the water and science sectors.

The WRC Vision is to have highly informed water decision-making through science and technology at all levels, in all stakeholder groups, and innovative water solutions through research and development for South Africa, Africa and the world.

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