THE WATER WHEEL
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It's a race against time at Spring Grove

WATER RESEARCH COMMISSION

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Editorial offices:
Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa.
Tel (012) 330-0340. **Fax** (012) 331-2565.
WRC Internet address:
http://www.wrc.org.za
Editor: Lani van Vuuren,
E-mail: laniv@wrc.org.za;
Editorial Secretary: Mmatsie Masekoa,
E-mail: mmatsiem@wrc.org.za;
Layout: Drinie van Rensburg,
E-mail: driniev@wrc.org.za

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WRC Dialogues Series launch successful

Cover: *The Water Wheel pays a visit to the construction site of Spring Grove Dam in the KwaZulu-Natal Midlands. See story on page 14.*

The WRC Dialogues – let's get SA talking

The world's water challenges have become more intense with time. The reasons range from the Malthusian dictates related to the demands of a 7 billion person world to our choices of economic pathways. Mix the complexities of inequalities of development both between and within nations together with the adaptation and mitigation challenges associated with global climate change and it becomes easy to see that we are staring down the wrong end of a fiercely wicked problem.

The solutions need to be innovative and their implementation needs strong partnerships within a shared vision. In order to facilitate this for South Africa the WRC has launched the ***WRC Dialogues***. We want to create a series of platforms for partners from all spheres – academia, government at all levels, and civil society to come together to share their understanding and experiences of the challenges and problems as a stronger foundation for developing the solutions and interventions toward a better water scenario for South Africa and her development. Water is universally identifiable for its economic, social, environmental, aesthetic, cultural and religious attributes and values; and is therefore an ideal medium for the South African development discussion.

The WRC Dialogues will take three forms. The WAT Indabas are closed sessions operating on Chatham house rules designed to tease out particularly sensitive water conundrums. The Water Currents Seminars are public gatherings in a workshop format while the Khuluma Sizwe platform is an open lecture platform by global luminaries who will share their insights on water-related matters. The key characteristics of the WRC Dialogues are:

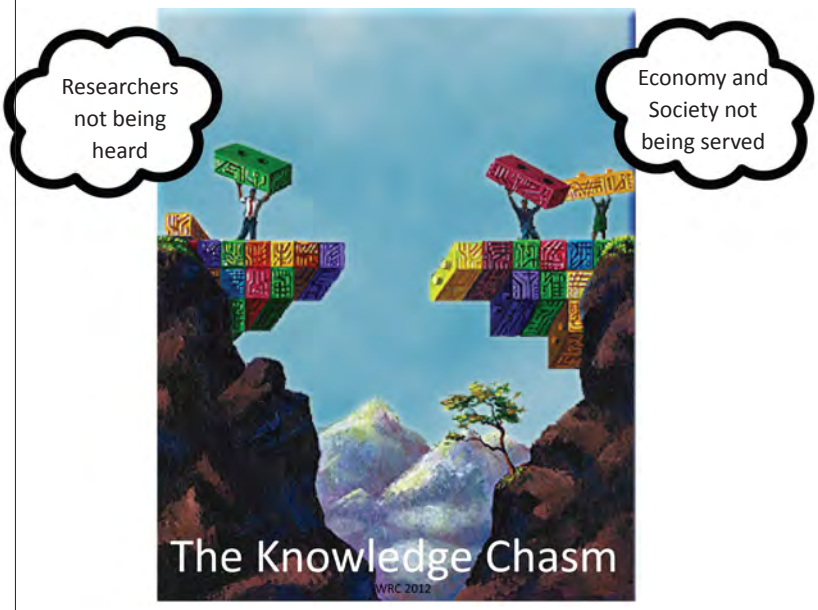
- **Inclusivity** (Government, communities, water practitioners and academia; local and international),
- **Research based** (decision making with the best information and with a longer term view),
- **Critical** (the more informed the problematique the better the chances for solutions that matter to emerge) and,
- **Candid** (The WRC Dialogues will provide a series of safe platforms to ensure that no punches are pulled – without being insensitive).

Another important objective of the dialogues is to bridge the *'knowledge chasm'* between the scientific community and broader society. This is a key mechanism to bridge the divide between the scientific community who are continuously frustrated that the solutions and knowledge developed through research are rarely used by decision-makers; and the self-same decision-makers feeling that in spite of large investments in research and development the economy is not sufficiently served by science.

The Dialogues were launched in August with a Water Currents Seminar on Job and Asset Creation in the Water Sector. The WRC partnered with the non-governmental organisation Trade & Industrial Policy Strategies (TIPS) and the Irrigation Water Management Institute (IWMI) in this event. The widely diverse delegates from all spheres of South African society engaged with the rich inputs of Dr Kate Phillip (TIPS), Shilp Verma (IMWI), Barbara van Koppen (WRC Board member) and many others. The conversation was frank and interrogative on one of the critical issues of our time – an issue that has ironically levelled the playing field between the developing and developed world on the back of the current global economic crisis. The convergence on mechanisms for community-based initiatives and the role of policy and regulation were emphasised.

The WRC has been explicit that its new five-year strategy will build further on an already significant portfolio of projects that emphasise job creation and entrepreneurship development. We will continuously seek the convergence pathway between good science and socio-economic development that both empowers communities and leads to sustainable livelihoods. In doing so we must carry with us the words from one of the most inspiring delegates at the seminar – one of South Africa's development icons – Mma Tshepo Khumbane who reminded us that while you might be able to examine and plan from the top down, you can only build from the bottom up. We are keen to go one better – we will seek to include in the water research and development portfolio a set of projects that will examine, problematize, develop and implement solutions both in partnership and with the wisdom of communities.

Duly inspired by a very successful start we look forward to continuing to engage South Africa in the water and development conversation in the WRC Dialogues.



The new WRC Dialogues series hopes to bridge the 'knowledge chasm' between the scientific community and broader society.

WRC projects making water work for communities

Exploring franchising partnerships for the operation and maintenance of water services infrastructure

WRC studies have found that franchising partnerships could alleviate and address many challenges in the management of water services. At the same time, franchising would support the development of local microenterprises and broad-based black economic empowerment. The latest study commissioned by the WRC focused on identifying the scope for franchising partnerships for the operation and maintenance of selected water services infrastructure, to establish the viability of franchising partnerships, and to make a case for outsourcing to franchises to be considered by water services institutions. Through this project two successful franchising partnerships were established in the Eastern Cape, which has seen the servicing of around 400 schools' water and sanitation facilities while providing valuable employment and income-generating opportunities.

Integrating community-based procurement in the operation and maintenance of basic services

As municipalities are coming to terms with the scale of the operation and maintenance requirements of basic services, more municipalities are considering integrating community-based procurement opportunities for the provision of operation and maintenance functions of basic water and sanitation services. While there is a willingness to integrate pro-poor strategies and improve operation and maintenance of basic services, the challenge in implementation is a guideline at local level to create an enabling environment for the integration, monitoring and support of community-based opportunities in operation and maintenance systems. A WRC study was initiated in response to this challenge as is in line with the ASGISA call for procurement and capacity building strategies for poverty alleviation in the context of basic infrastructure programmes.

Revitalising state aquaculture facilities

The WRC has done much to raise the profile of aquaculture in South Africa. In the latest project the revitalisation of selected existing provincial hatcheries were undertaken to act as development hubs for emerging farmers, from which to provide services such as advice, training and fingerlings. Technical support was provided not only in the training of staff at various provincial hatcheries, but also to develop strategic plans on the revitalisation and operation of these hatcheries in close cooperation with the provincial agriculture departments. The Turfloop hatchery near Polokwane, in Limpopo, for example, spawned catfish for the first time in ten years following intervention by the WRC-funded project team.

Empowering women in villages through water

A current WRC research project is exploring the multiple water use strategies of rural women in two different rural villages. The research is taking an explicit gender-oriented, pro-poor, bottom-up approach to policy formulation, within a framework of evidence-based policy and will produce qualitative knowledge and understanding of poverty and household dynamics, as well as the dynamics of the local government setting that determines whether and how water-related resources needed by women in rural villages are available or could be made available to them.

Rainwater harvesting – training the trainers

While many resource poor farmers and gardeners express an interest in learning rainwater harvesting and conservation practices, facilitators, such as extension officers, are not always equipped to provide the necessary training and support. To fulfil this need the WRC funded the compilation of a comprehensive rainwater harvesting learning materials package. During a pilot process lasting six months 14 learners received training in the completed training material, while 68 students benefited by providing illustrations for the course materials. The materials fit in squarely with government's Zero Hunger Campaign, aimed at eradicating hunger and food insecurity in South Africa.

Water Diary

HYDROLOGY
OCTOBER 1-3
The 16th SANCIAHS National Hydrology Symposium will be held at the University of Pretoria with the theme 'Hydrology in a Changing Environment – Science and Policy Interface'. *Enquiries: Mrs Zagry Scholtz; Email: zagrys@wrc.org.za; Tel: (012) 330-0340;*

DRINKING WATER
OCTOBER 9-11
The Water Institute of Southern Africa is hosting the International Conference: Water Reuse for Drinking Purposes at the Gateway Hotel in Umhlanga, KwaZulu-Natal. The conference is aimed at providing a training, education and discussion opportunity with participation by international specialists, local regulators and practitioners on the topic of potable reuse of water. *Enquiries: Melissa Wheal; Tel: (011) 805-3537; Email: admin@wisa.org.za; Visit: www.wisa.org.za/wruc/*

GROUNDWATER
OCTOBER 15-16
The Groundwater Division is hosting a groundwater symposium with the theme 'Groundwater to Tap Water - A Municipal Focus' at North West University. The symposium aims to share new knowledge on the topic of groundwater and municipalities as well as to allow for multi-stakeholder panel discussions mainly between researchers, groundwater practitioners and municipal officials. *Visit: www.gwd.org.za*

WETLANDS
OCTOBER 23-26
The National Wetlands Indaba will take place at the Klein Kariba Resort and Conference Centre in Bela-Bela (Warmbaths). This year's theme is 'The role of wetlands in a green economy'. *Enquiries: Adrienne Botha (Conference Secretariat); Tel: (014) 717-4014; Email: umklewulodge@gmail.com; Visit: http://www.wetlands.za.net/indaba2012/index.htm*

North West University to establish SA's first national water history archive

North West University's (NWU's) Vaal Campus in Vanderbijlpark has given its tacit support for a project to develop South Africa's first Water History Archival Repository.

The archive will be housed in the university's new multimillion Rand library, which is currently under construction. South Africa has a proud history of water management. In the twentieth century the Department of Water Affairs (DWA) was responsible for creating one of the most advanced national water infrastructure systems in the world in a region that has a long history of severe drought conditions. It is a heritage in which South Africans can justifiably take pride.

According to Prof Johann Tempelhoff of NWU's School of Basic Sciences, who is leading the project, a number of retired officials of the DWA as well as consulting engineers have collections of valuable historic material that need to be collected for posterity. "There is a notable shortage of primary source materials on South Africa's DWA – known between 1912 and 1956 as the Department of Irrigation. Many historians, especially those specialising in water history, have sorry tales to tell about the shortage of information on some of the department's most legendary projects, such as the Thukela-Vaal Transfer Scheme, the Orange River Development Project as well as the impressive irrigation works developed throughout the country in the twentieth century. The proposed repository should be in a position to partially address the existing shortage of historical information, especially in the pre-digital era."

The intention is to create a repository where hard copies of valuable primary documents are stored. However, at the same time, there is a need to digitalise this information, so that documentation that would otherwise be confined to dusty store rooms can be turned into functional electronic material, accessible for all to use.

It is expected that the repository will not only serve historians, but also other water sector stakeholders, such as engineers looking for information on the original design and materials used in water resource development projects up for refurbishment or enlargement.

Earlier this year the university received its first donation from Prof Will Alexander, Emeritus Professor of Civil and Biosystems Engineering at the University of Pretoria and a legendary former engineer and hydrologist at the Department of Water Affairs. The impressive collection includes construction notes and related information such as photographs and multimedia on, among others, the Orange-Fish Tunnel, Leeuw-Gamka Irrigation Works, Gamtoos canals, and Floriskraal Dam. Also included is Prof Alexander's impressive data on hydrology and climate-related subject matter.

In the photograph, accompanying this article (taken by Gustaf Tempelhoff), Prof Alexander is taking Prof Tempelhoff and *Water Wheel* Editor, Lani van Vuuren, through a part of his collection.

Collaboration is being sought with all individuals and institutions who have a passion for the country's impressive water heritage to be conserved for future generations. A workshop, to be hosted by NWU in collaboration with the Water Research Commission, is being planned for the first quarter of next year to bring stakeholders in the South African water sector together to discuss ways of developing the repository.

For more information about the repository Email: johann.tempelhoff@nwu.ac.za

Changing theoretical lenses broadens research space

Governance is the result of interactive socio-economic and political forms of governing that result in problem solving and opportunity creation. As such, governance has a complex character, reports Dr Richard Meissner, Senior Researcher with the CSIR's Water Resource Governance Systems Research Group.

"This implies that governance is not only the domain of state institutions, for instance Parliament, the judiciary, national government departments and local government. Because of this inherent complexity and the fact that governance encompasses different spheres of authority, governance can be explained and analysed through a variety of theoretical lenses, such as neorealism, neoliberal institutionalism, structuralism, complexity and resilience theory, risk society theory and social constructivism."

In 2011 the CSIR conducted a comprehensive survey of literature that had been conducted over the past 14 years on South Africa's water institutions — catchment management agencies (CMAs), water user associations (WUAs), irrigation boards (IBs) and international water management bodies (IWMBs). The research team reviewed publications that included newsletters, articles, doctoral theses, Water Research Commission reports as well as CSIR reports on the subject.

One of the conclusions of the review was that over 80% of the publications with a likely influence on policy processes (e.g. peer reviewed articles, reports, theses, etc.) were researched and written by researchers with a natural sciences background, while only 10% were from the economic and social sciences, and only as co-authors that produced the publications.

What the researchers also noted is that the major implicit theoretical underpinning of these studies was based on governing processes being driven by the government entities. This theory, called neoliberal institutionalism, with its roots in the political sciences, has a number of assumptions: state organs, such as parliament, the judiciary, cabinet, government departments as well as the leaders leading these institutions are paramount in the policy process.

"The theory also maintains that the policy process is a top-down process, where the states develop and implement policies from the top-down instead of bottom-up processes," explains Dr Meissner. "What's more, governments develop policies to grant them powers to regulate society. Everything that happens within the water discourse depends on what government does and through which policy instrument it is doing it. It is for this reason, we believe, that 86% of the research focussed on the role of CMAs in bringing about a more optimal utilisation of South Africa's water resources, since CMAs are defined within the National Water Act (No. 36 of 1998)."

Nevertheless, the CSIR argues that broadening the theoretical foundation of future research on water institutions will enlarge the research space beyond CMAs, WUAs, IBs and IWMBs. This will also include the role of non-state actors, such as large corporations (mining companies and financial institutions) and ordinary individuals that act from the bottom up with consequences at national, river basin and quaternary level. Governability (the capacity to govern) as well as the theory of agential power (the ability of an actor to determine and implement policy without constraints) is promising in widening the water governance and water politics research field.

Water law cuts mine discharge

Containing stormwater on mining property in line with the National Water Act (NWA) of 1998 has been an important way for South African mines to reduce their impact on the environment.

This is according to SRK Consulting's principal hydrologist, Peter Shepherd.

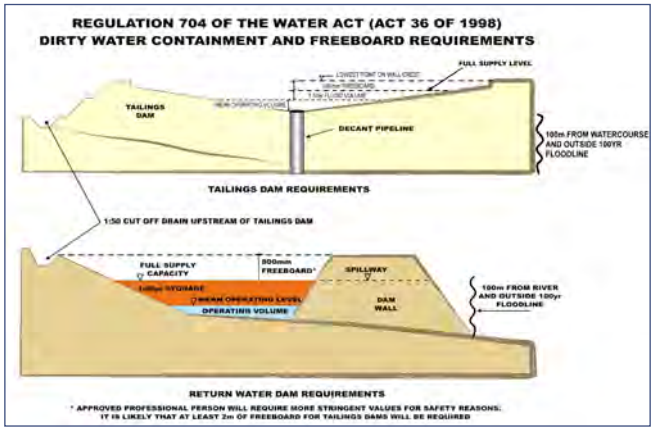
"The NWA highlights the need to conserve water, but it also lays down strict regulations on the discharge of contaminated water into the environment," said Shepherd. "For the mining sector, this has required more effective control of stormwater – one of the main catalysts of contaminated discharge from mining areas."

According to Shepherd, a key aspect of an effective stormwater control strategy is to isolate dirty water sources, such as workshop areas where oil may become mixed with surface water.

The NWA has also forced mines to focus on floodlines on or near their properties; in the context of climate change, mines also need to pro-actively anticipate more frequent flood occurrences – which may even exceed previous record levels.

"To comply with the law, mines' stormwater control strategies must also address the safety of others – such as surrounding communities or downstream areas," added Shepherd. "Flooding of tailings dams is a particular risk in this regard."

It is not only external stakeholders that benefit from improved stormwater control; better control mechanisms benefit the mines directly, as their own infrastructure is better protected.



Water partnership wins award

Sanlam and WWF have won two of the *Mail &Guardian*'s Greening the Future Awards in recognition of the partnership's freshwater work.

The annual Awards recognise and celebrate individuals and organisations that have contributed greatly to environmental sustainability. A first time entrant to the Awards, Sanlam and WWF won the second award in the Water Care and Management category against formidable co-finalists, Woolworths. Sanlam and WWF also became the first winners of the inaugural Sudley Adams Memorial Award. This Award has been introduced in honour of Sudley Adams, the *Mail & Guardian*'s Brand Manager and Convenor of the awards for the past decade who passed in May. According to the *Mail & Guardian*, the judges considered all the entries for this special Award and decided the one that best embodied Sudley's forward-thinking vision and team spirit was the WWF Sanlam Living Waters Partnership. Fiona Macleod, editor of the M&G Greening the Future supplement, said the partnership was an exemplary model for other conservation initiatives. "Sanlam's continued support for WWF SA's water programmes has been endorsed through the buy-in of other companies. The partnership presents win-win solutions for some of South Africa's most pressing natural resources problems, and as such is a deserving winner of Greening the Future's two top awards."

Source: WWF

New RO plant helps sweeten sugar refinery's water

Water and wastewater company Veolia Water Solutions & Technologies South Africa have designed, installed and commissioned a reverse osmosis (RO) plant for one of the country's largest sugar manufacturers.

The project formed part of an upgrade of the refinery's off crop refining capabilities.

Cane is milled for about nine months of the year, with most of the process water attained from the moisture in the cane. During off crop season, no cane is milled or raw sugar produced, but the refining process continues. Steam from the boiler is required for this process, and the additional water needed for this purpose thus has to be obtained from the onsite boreholes.

"There was a set of softeners in place to remove the hardness of the borehole water, but these were becoming obsolete and could not cope with the demand," explains Veolia Project Engineer Warrick Sanders. "Additionally, the client had to occasionally chemically clean the boiler at great cost as a result of the inadequate softener system."

The requirement was to design a new system in order to deliver sufficient quality and quantity of industrial water to feed the boiler.

The feed water for the plant is supplied from a borehole, which gets filtered through iron removal filters, before undergoing softening through the client's existing softeners. In the next treatment step, the water is passed through an ultrafiltration unit to reduce the SDI (silt density index) of the water.

From the ultrafiltration unit, the water is fed to the RO units, from which the good quality permeate water is fed into a holding tank, and the brine to a slave RO tank. Additional good quality permeate water is recovered from the slave RO which is fed by this tank. All RO permeate, at a capacity of 90 to 100 m^3/hour, is pumped to the client's tank.

Veolia supplied two iron removal filters, four holding tanks, two ultrafiltration trains installed on skids, three RO skids, various pumping equipment and in-line measuring instruments, as well as the Hydrex range of chemicals.

"The project posed a challenge due to the fixed deadline. Certain standard equipment was imported from our sister companies in Spain and Germany, to save on manufacturing time, but due to shipping delays, the timeline was very tight," notes Sanders.

Veolia provided most of the training and will be assisting with follow-up chemical supply and plant services in the future.

Municipalities can now keep water safe in Afrikaans

The opportunity now exists for municipalities to develop water safety plans in their own preferred language.

Owing to the great success and strong demand for the Water Research Commission's Web-based Water Safety Plan (WSP) tool, developed by Emanti Management, requests have arisen from municipalities to make the tool more accessible in the various official languages.

The first of these 'alternative' tools – in Afrikaans – is now available, Emanti reports.

The step-by-step assessment and risk management WSP tool deals with all aspects of risk, from where the water is taken from the catchment to where it is delivered to the consumer

Plans are afoot with the WRC to make the new Afrikaans tool Web-enabled, and then follow suit with tools in other languages such as iSiZulu and iSiXhosa as the need arises.

Source: Emanti Management

Singapore university's new loo turns poo into power

Scientists from Nanyang Technological University (NTU) have invented a toilet system that turns human waste into electricity and fertilisers while reducing the amount of water needed by up to 90%.

Dubbed the No-Mix Vacuum Toilet, it has two chambers that separate the liquid and solid wastes. Using vacuum suction technology, such as those used in aircraft lavatories, flushing liquids now takes only 0,2 ℓ of water while flushing solids require just one litre.

The existing conventional water closet uses about 4 to 6 litres of water per flush. If installed in a public restroom flushed 100 times a day, this next generation toilet system will save about 160 000 ℓ of water a year – enough to fill a small pool.

The NTU scientists are now looking to carry out trials by installing the toilet prototypes in two NTU restrooms. If all goes well, the world can expect to see and even sit on the new toilet in the next three years, said the university in a statement.

Associate Professor Wang Jing-Yuan, Director of the Residues and Resources Reclamation Centre at NTU who is leading the research project, said that their ultimate aim is not only for the new toilet system to save water, but to have a complete recovery of resources so that none will be wasted in resource-scarce Singapore. "Having the human waste separated at source and processed on-site would lower costs needed in recovering resources, as treating mixed waste is energy intensive and not cost-effective. With our toilet system, we can use simpler and cheaper methods of harvesting the useful chemicals and even produce fuel and energy from waste."

Aiming to convert all waste to resource, the new toilet system, which is part of a project that has received $10-million from Singapore's National Research Foundation's Competitive Research Programme, will be useful for new housing estates, hotels, resorts and especially communities not linked to the main sewerage system.

Mangroves can trap toxic heavy metals, researchers say

Researchers in New Caledonia have discovered that mangrove forests act as useful filters for toxic heavy metals, preventing these pollutants from contaminating the islands' waterways.

The researchers – from France's Institute of Development Research (IRD), working in collaboration with regional research partners – say that further destruction of the mangroves could therefore result in an increase in the discharge of heavy metals into waters that are incapable of filtering them out, with resultant contamination affecting local biodiversity and community water supplies.

High concentrations of heavy metals are found in New Caledonia's rivers and mangroves because of the archipelago's active mining industry – it is the third-largest nickel producer in the world. Cyril Marchand, an IRD scientist and the study's lead researcher, said that mangroves act as a heavy metal 'sink'. Over a long period, they can therefore prevent the spread of harmful metal sediments into waterways used by local communities.

The researchers found that concentrations of heavy metals were ten to 100 times higher in waters downstream of mining sites than in those unaffected by mining. Marchand explained that close to older mines – many of these are now abandoned – metal concentration is particularly high because proper sedimentation retention systems were never built.

The islands are home to an abundance of terrestrial and marine biodiversity, with numerous endemic bird and plant species, and the world's richest biodiversity per square kilometre. Communities in the region rely extensively on mangrove ecosystems for food and income generation.

Currently mangrove forests are prolific on New Caledonia's coastline, but they are gradually being destroyed by encroaching urbanisation and population growth. Researchers are concerned that this ongoing destruction could lead to the increasing discharge and dissemination of accumulated pollutants.

Water by numbers

1 million m³/day – The capacity of the latest desalination plant being developed in Japan. The plant, a government-funded project, will be the largest desalination plant in the world once completed.

35 – The number of houses which were flooded when a 600-mm diameter water outlet was damaged in Tshwane during construction work at a new water reservoir earlier this year.

60 – The number of North American freshwater species and subspecies that have gone extinct since 1898, according to the US Geological Survey.

R17,72-million – The estimated price of the feasibility study currently being undertaken by the Department of Water Affairs to find long-term solutions for acid mine drainage on the Witwatersrand, *Engineering News* reports. The study is expected to be completed by February next year.

2 – The number of contracts that have been awarded for the building of the second phase of the multibillion Rand Lesotho Highlands Water Project. According to *Engineering News*, the two contracts relate to the construction of a 3,8 km access road to the measuring weir downstream of Polihali Dam, while the second contract was for the construction of the measuring weir itself.

13 – The number of South African municipalities with clean audits for the last financial year. This represents 5% of the country's 343 municipalities. The municipalities with clean audits were in KwaZulu-Natal, Limpopo, Mpumalanga and the Western Cape.

9 – The number of provinces in which it snowed simultaneously in South Africa at the start of August, the first time in the country's recorded history.

New book on world's fountains delights

A new international publication on the delight and history of the world's water fountains is now available.

The book, *Water Fountains in the Worldscape*, is edited by Ari Hynynen, Petri Juuti and Tapio Katko. It is published by the International Water History Association (IWHA) and Kehrä Media.

Fountains have been used as public sources of water supply since antiquity. The first evidence of a water supply network emerged with cities of the first ancient civilisations (Egypt, Sumerian and other civilisations in the Middle East, Indus River and China). Ancient civilisations of the New World (e.g. Maya, Aztec and Inca) also developed sophisticated water systems, fountains being an important part of them.

The oldest remaining fountains, located in the antique Mesopotamian city of Tello, originate from 3000 BC. However, as former IWHA President, Prof Johann Tempelhoff, writes in the foreword, fountains are more than functional – they also transmit a sense of beauty, they are a symbol of "humankind transforming nature to create a special environment."

In an introductory chapter the editors explain their reasoning for the book: "public water supply systems and infrastructure are, to a large extent, parts of the so-called invisible city – something that is hidden or lies underground. Out of the systems we normally can recognise only two elements: water towers and water fountains."

The beautifully illustrated book takes the reader on a journey through 16 cities from across the world and all the continents where fountains have been or are an important part of the landscape. *Water Fountains* focuses on the historical, architectural, and technical dimensions of water fountains.

A total of 18 authors contributed to the writing of the book. "Working through the pages of the manuscript to write the foreword, I became aware of how many scholars, most of them well known and respected in the water history fraternity, shared the passion and the vision of the editors of this book project," notes Prof Tempelhoff. "Many hours of painstaking work has gone into each and every contribution. The illustrations that accompany the lively text are titillating to the senses. They transmit images of natural motion and fluidity."

One of only two African fountains covered in the book is the Sammy Marks Fountain of Pretoria. This 12 m-tall fountain, which today rests in a corner of the National Zoological Gardens, originally stood in Church Square. The structure features a small pond at its centre with water sprouting from different positions – from the entwined dolphins at the top as well as from a ring of spouts closer to ground level. The principal features of the fountain are the four figures at its four corners. These represent Commerce, Science, Art and Literature.

The story of this fountain, researched by Prof Johannes Haarhoff of the Department of Civil Engineering Science at the University of Johannesburg, is an interesting one. The entrepreneur, Sammy Marks, originally donated a statue of President Paul Kruger to the city, which was to be erected at Church Square. Unfortunately, the South African War broke out in 1899 while the statue was being created in Europe.

By the end of the war in May 1902, Pretoria had fallen under British rule, which would not allow the erection of the Kruger statue. The statue was remitted to a warehouse in Lourenço Marques (now Maputo) in Mozambique where it would remain for many years.

Marks, which had in the meantime befriended the new regime, commissioned a new project – a fountain. It was presented to Pretoria in 1905 and erected where the Kruger statue would have been. Here it served as a water supply point for the citizens of the city. The water was fed from a large artesian spring (the Fountains) a few kilometres away through a series of canals and pipelines.

From the Sammy Marks Fountain, the water was drained through a newly constructed system of storm water pipes to the nearby Apies River. The water to the fountained was turned on on 19 April 1906. The continuous drainage of precious fountain water to the Apies River was a wasteful practice – a fact that quickly dawned on the city fathers.

Four years after the fountain arrived at Church Square it was donated to the Transvaal Zoological Gardens as they were then called. The dismantling started toward the end of 1910 and by February 2011 the fountain was in its new position.

Water Fountains retails for €120 (postage excluded). For more information, or to order Email: petrisjuuti@gmail.com.

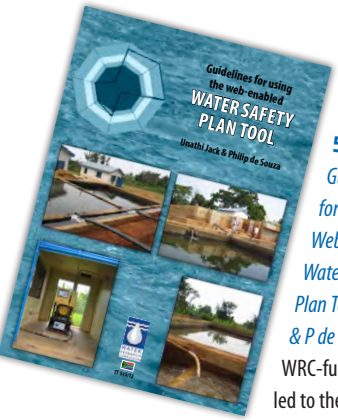
Courtesy Johannes Haarhoff

The fountain originally stood in Church Square.

Petri Juuti

The Sammy Marks Fountain in the Pretoria Zoological Gardens.

New from the WRC



Report No: TT 515/12

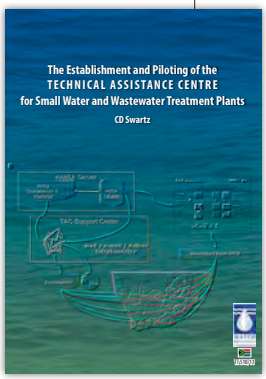
Guidelines for using the Web-enabled Water Safety Plan Tool (U Jack & P de Souza)

WRC-funding has led to the development of a Web-enabled Water Safety Plan Tool to help municipalities establish a methodology to identify and manage the risks of water services infrastructure, among others. This manual introduces water safety planning to the reader; highlights key steps to be considered when developing a water safety plan; and provides step-by-step guidance as to how to use the Water Safety Plan Tools currently hosted on the electronic Water Quality Management System.

Report No: TT 510/11

The establishment and piloting of the Technical Assistance Centre for small water and wastewater treatment plants (CD Swartz)

The Technical Assistance Centre (TAC) for small water and wastewater treatment plants was established to provide technical (and non-technical) support to water service providers (WSPs) experiencing challenges with their water and wastewater treatment plants. During the initial establishment stages of the TAC, it was decided that the establishment, piloting and roll-out of the centre be phased in over two years, during which time specific implementation tasks would be performed to ensure progress against milestone and planning budget. This report provides an overview of the establishment of the TAC, consisting of a description of the structure, mission, aims and activities of the TAC. It also provides feedback on piloting of the TAC that was performed in the Eastern and Western Cape provinces. Included is an overview of generic challenges common to many of the treatment plants in the provinces.



Report No: 1480/1/12

Agroforestry systems for improved productivity through the efficient use of water (CS Everson; SB Ghezehei; TM Everson and J Annandale)

Agroforestry systems have been reported to be potentially productive in degraded and marginal soils. However, in South Africa, the implementation of agroforestry systems has been relatively slow and may be attributed to lack of farmer knowledge on applicable crop and tree combinations. A major challenge is to build the capacity of small-scale farmers to implement agroforestry systems to increase production and food security. The aim of this project was to implement on-station agroforestry systems to determine their impact on water and plant production.

Report No: 1843/2/12

Handbook on adaptive management strategies and options for the water sector in South Africa under climate change (S Stuart-Hill; R Schulze and J Colvin)

Climate change has been identified as one of South Africa's threats on its path towards sustainable development and an equitable society. Climate change is not expected to have a uniform impact across the country, and is projected to be accompanied by increased variability in precipitation and temperature. Taking current knowledge to a new level, updating it and making it more relevant as well as usable for water managers in their decision making processes, was the major goal of a recent WRC project, of which this handbook forms one component. It is hoped that this handbook will create an awareness not only of potential impacts of climate change, but also of the role that each one of us plays in the water sector.

Report No: TT 491/11

Sustainable Use of South Africa's Inland Waters (J King & H Pienaar (Editors))

In 1998 South Africa passed a groundbreaking law that recognised water resources as living aquatic ecosystems and set out an approach for South Africa that supported their sustainable use and management. The National Water Act (NWA) recognises three Resource Directed Measures: the Classification system, the Reserve and Resource Quality Objectives, which together form the protection measures for the country's water resources. While the NWA, with its measures for protecting water resources is visionary and innovative, its implementation is neither quick nor easy. The country's community of water specialists have spent the last 20 years developing methods and tools to assess the Reserve. What comes next is a bigger challenge – making our new water vision work on the ground and giving effect to all three Resource Directed Measures. This book provides a poignant history of the NWA, sets out opportunities and challenges in relation to methods and implementation of the Reserve in South Africa while discussing issues with regards to the implementation of the NWA. It is an important situation assessment summarising what has been achieved and helping to guide thinking on the next phase.

Report No: KV 285/11

Physiological response of smallmouth yellowfish to angling (NJ Smit; R Gerber; G O'Brien; R Greenfield and G Howatson)

Freshwater angling activities have become an important recreational activity for people around the globe, bolstering both regional and national economies. A portion of the captured fish is sometimes kept by anglers, but many of them are released back into the environment. This practice of 'catch and release' fishing is growing as a proportion of total fishing in southern Africa and is widely promoted. Prior to this study no data on the effects of catch and release fishing on local species existed. The physiological responses of smallmouth yellowfish in the Vaal River system to catch and release were studied and recommendations made.

Report No. 1990/1/12

Ethnographic research methods to better understand household water practices (I van den Berg & S Slabbert)

A critical gap exists in South Africa regarding the status quo of water supply and use in rural communities, whether they are served by a local authority or not. Information surrounding challenges, availability, supply or lack of supply, water scarcity, management in times of drought and other water-related issues are largely absent. This lack of information leads imminently to an inability by the incumbent powers to address problems. The government remains incapacitated to deliver on its goal to provide basic water to all. Thus this project was funded by the WRC to, among others, gain a better understanding of the practices of water in rural South Africa; determine innovative management arrangements relating to water at family and neighbourhood level; and to produce a film report based on the outcomes of the ethnographic research. In search for an innovative methodology to meet the first objective, the function of the visual methodology of the research evolved to develop a tool that would improve

understanding of rural water practices by empowering a rural community to visually record and reflect on their own practices.

Report No. 1888/1/12

A risk-based methodology to assess social vulnerability in the context of water infrastructure (R Hay; P Hay; A Mlisa; D Blake; S Imrie & K Goldberg)

Through case study investigation in Cala, Kayamandi and Wonderfonteinspruit this study aims to develop methodology for analysis of social vulnerability and resilience to natural and man-made hazards in relation to potable water supply. Intensive efforts to mainstream disaster risk reduction into development have been underway internationally since 2005. The focus of this study is a meeting between water resource management and disaster risk reduction at the local level. The first aim of the study was to propose a straightforward methodology for understanding vulnerability and resilience to hazards that negatively impact the supply of potable water at the community level. The second aim was to identify opportunities to mainstream disaster risk reduction into aspects of water services, thereby improving the sustainability of all water service provision and increasing the resilience of communities to water-related hazards.

Report No. KV 294/11

State of the art: Fracking for shale gas exploration in South Africa and the impact on water resources (G Steyl; GL van Tonder & L Chevallier)

This document is intended to report on key issues regarding gas exploration and development through deep well drilling and hydraulic fracturing. These key issues are: the shale gas reservoir potential in the main Karoo basin and any other potential areas of interest; the location relative to and relationship between the shale gas reservoirs and the Karoo aquifer systems; potential impacts associated with hydraulic fracturing and associated processes. Among others, the report deals with the current state of knowledge of potential shale gas reservoirs in the Karoo Basin; shale gas development and hydraulic fracturing potential on South Africa's Karoo Basin and groundwater resources, including the natural and artificial hydraulically fractured systems; shale gas reservoir interactions with groundwater reserves; international case studies of shale gas development and hydraulic fracturing; and recommendations on the potential impacts of South Africa's water resources.

Report No. 1752/1/12

Influence of catchment development on peak urban runoff (SJ van Vuuren)

This research project reviewed catchment response due to urban development on the basis of comparative assessment. This required the identification of similar rainfall in the catchment during different development stages for which gauged flow rates were recorded. The hypothesis which was reviewed here relates to the statement that urban development which creates more impervious areas on the one hand also generated longer times of concentration due to the changes in the length of the flow path as well as more temporal storage capacity which could result in a higher groundwater recharge.

Report No. 1895/1/12

Field testing to determine the evaporation rate of brine solutions formed during the membrane treatment of mine-water (P Dama-Fakir; A Wurster & A Toerien)

Historically, mine-water was considered to be unavailable water, but it is now considered a valuable resource. In several mining impacted catchments, substantial water resources are stored in old or active mine workings. These mine-water bodies are typically continuously recharged by surface water. If not utilised, the mining voids fill up and the excess mine-water decants into rivers and streams, resulting in surface water contamination. Improvement in membrane processes has made it practical to treat mine-water to drinking water quality and supply it to municipalities. The brine or waste produced from these processes typically has high concentrations of metal ions, such as manganese, thus requiring a lined disposal facility. The aim of the study was to carry out field investigations to measure the evaporation rate of brine solutions and compare it against the evaporation rate of a potable water sample.

Report No: 1987/1/11

The provision of free basic water to backyard dwellers and/more than one household per stand (N Naidoo; C Longondjo, T Rawatlal & V Brueton)

The South African government has committed itself to providing basic quantity of free services to all. Unfortunately, the problem of access to water is multidimensional and includes issues like income poverty, infrastructure limitations, asset ownership and housing quality. Another critical challenge is the dramatically growing number of backyard dwellings in many urban areas. This study was commissioned to provide additional information of the extent of backyard dwellers and their access to basic services (or lack thereof) and to provide guidance on future policy direction.

Report No: TT 508/11

Biology and ecology of the Orange-Vaal Large and Smallmouth Yellowfish in the Vaal River (G O'Brien and P de Villiers)

This report documents the outcome of three WRC consultancy studies that were carried out between 2006 and 2010 by the University of Johannesburg and River of Life Aquatic Health Services. Among others, the consultancies assessed selected biology aspects of the two yellowfish species (*Labeobarbus kimberleyensis* and *L. aeneus*) from the Orange-Vaal system; investigated the effects of flow and temperature on spawning and recruitment of these yellowfish species; while studying selected biological features associated with the breeding biology of the two species. This report presents a broad review of the known biology and ecology of the Vaal yellowfishes, including a dedicated section on species identification, taxonomy and notes on the evolutionary and phylogenetic development of the species, as well as the taxonomic history of the yellowfishes. The study then addresses the approaches adopted and the outcomes of the three complementary reproduction, early development and growth studies of the Vaal River yellowfishes.

Report No: 1972/1/12

Can we manage our water better? Prospects and processes for the establishment of stakeholder-initiated catchment management agencies (M Muller; B Hollingworth & M Ndluli)

Many water resource management functions are best carried out at local level, often within the boundaries of river catchments themselves. This approach is supported by South Africa's National Water Act, which provides for the establishment of catchment management agencies (CMAs) to perform a range of water resource management activities. However, since the NWA was passed in 1998, only two of the proposed 19 CMAs have been established. The immediate objective of this study was to determine why water users and stakeholders have not taken advantage of the opportunity to lead the establishment of CMAs in the absence of action by government. To do this, the project sought to identify the concerns of a diverse group of water resource stakeholders about the benefits and disadvantages of establishing a CMA. The wider purpose was to understand better stakeholders' attitudes to institutions such as CMAs as interventions to improve water resource management in South Africa.

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WRC Board – Changing of the guard

Earlier this year, the Water Research Commission (WRC) inaugurated its new Board. Outgoing Chairperson, Prof Janine Adams, and incoming Chairperson, Barbara Schreiner, both shared a long relationship with the Commission prior to their election to the Board. They imparted some of their thoughts on how to keep the Commission real and relevant to the people of South Africa.

Prof Janine Adams

How do you see the role and value of the WRC to the water sector, and what have been highlights for you during your tenure as Board member and Chairperson?

The role of the WRC has become urgent as the pressure on water resources grows and the demand for knowledge to address daily challenges increases. Our biggest achievement over the last few years has been to address this through various communication channels such as policy briefs, technical briefs, and press days. The WRC now funds a broader range of disciplines, and encourages large multi-partner research teams. There is also an emphasis on including the end-users in the ongoing research. Importantly, nearly all research projects now include student training.

The 40-year celebration of the WRC in 2011 was definitely a highlight. This brought past and present staff and water sector stakeholders together. Past contributions of the WRC were celebrated and new research directions showcased. It also provided an opportunity to bid farewell to our former CEO of ten years Dr Rivka Kfir, and to celebrate her contributions. During my tenure as Board Chair I also had the opportunity to interact with three different Water Affairs Ministers. Parliamentary visits and the presentation of our annual reports were indeed memorable highlights. It has been rewarding to see the research portfolios grow, often with leverage funding. International achievements of our water researchers as well as the staff of the WRC were also highlights that confirmed the high quality of our water research. During my term of office the Fund Management System was implemented which has improved financial management and reporting at the WRC.

In your opinion, what are the greatest strengths of the WRC?

The fact that the WRC funds research across the water sector, issues relating to health, economy and the environment is certainly a strength. Research outputs make a difference in the lives of all people of South Africa. The research portfolio of the WRC is aligned with government's priorities and outcomes and it is thus geared to inform policy and decision-making. Collaborative partnerships with relevant stakeholders allows for effective dissemination of knowledge. Another great strength is the qualified staff. Research directors and managers are leaders in their specialist water areas, which allows for effective leadership and coordination of water research. Without their detailed knowledge and understanding this would not be possible.

What are the greatest challenges the WRC needs to face in years to come?

Adequate funding to address urgent research needs will remain a challenge. For this reason it is important to mainstream water, which is essential for economic growth and sustainable development and ensure protection of our fragile aquatic ecosystems that provide the goods and services that we depend on. Another challenge is to ensure that there are enough researchers producing high-quality research in all the water research disciplines. There is a need for consistent and long-term funding to develop research teams.

Is the WRC still as relevant today as it was 40 years ago?

Indeed the WRC is even more relevant today than it was 40 years ago. As new challenges arise (e.g. endocrine disrupting compounds, acid mine drainage, fracking) the WRC helps to ensure that we have knowledge to address these.

I would like to thank the staff and outgoing Board members of the WRC, my association with all of you has been a great privilege. Through my academic and research activities I will continue to be associated with the WRC. As the newly-elected President of the South African Society of Aquatic Sciences I look forward to growing the society together with input from the WRC. My employer, the Nelson Mandela Metropolitan University will also host a new South African Research Chair in Shallow Water Ecosystems, which will allow for collaboration on research and training. Best wishes to all and thanks so very much for the last six wonderful, rewarding years.

Barbara Schreiner

How has the role/meaningfulness of the WRC changed in the water sector since you first became involved with the Commission?

The WRC has played an important role in the water sector in South Africa since its inception, with 40 years of solid research supporting water management in the country. Obviously, however, with the changes in policy and legislation, and as the challenges facing the water sector and water users have become greater over the years, with increased pressure on our limited water resources, the research scope of the WRC and the nature of the research has had to adapt to address increasingly 'wicked' problems – ones without one simple solution. Equally, the challenges of inequity in South Africa, in access to water and in access to the benefits of the economy driven by water, mean that the WRC-funded research has had to engage with a range of complex and challenging social, developmental and institutional issues.

What do you see as some of the main impacts the WRC has had over the years?

The research funded by the WRC has provided a scientific basis for water management and regulation, and for addressing critical management, institutional, financial and ecological issues. The WRC funds a wide range of research, from the so-called hard sciences to the social sciences, a lot of which has informed decisions taken by the Department of Water Affairs in water management. The research has also informed the practice of water services authorities, and has impacted on water use in a number of sectors across the country. Having a solid, scientific research base has enabled South Africa to understand and address specific water-related challenges in the country from an informed base and to keep at the cutting edge of water resources management with solutions that are specific to the context and needs of South Africa.

In your opinion, what are the greatest strengths of the WRC?

The WRC has a number of strengths, of which 40 years of high-quality research is definitely one. There is strong institutional memory in the organisation, with a stable, experienced and committed team of research managers. The diversity of the WRC staff is also a great strength, in terms of race, gender, culture, and disciplinary background. The current CEO is an excellent leader, with new ideas and new energy to take the WRC forward into a new era.

What are the greatest challenges the WRC needs to face in years to come?

There are several challenges that the WRC will face in the years to come. One of these is increasing the funding base in order to be able to take on a greater suite of research programmes to address the increasing challenges in the water sector and amongst water users. Another challenge is ensuring that the research results are effectively disseminated and used – not just by other researchers, but by water managers and users – this, I believe, requires a greater up-front identification of possible impact pathways and stronger engagement throughout research projects with the potential users to ensure that the research serves their needs. Contributing to and building world-class water research capacity in South Africa remains an ongoing challenge to the WRC. Finally, I think there is a major challenge in the development of appropriate technology, and making the transition from technology development to market. I think there is a much greater role for the WRC to play in this area.

Are there any areas within the water sector that you feel the WRC should give more attention to?

One of the areas that I am particularly interested in is how one ensures that research makes a difference in the world, that it contributes to making a better world, for the poor and the marginalised in particular. As a research institution based in a developing country with high levels of poverty and major water challenges, we are in a strong position to provide cutting edge research to similar countries around the world and to learn from researchers in similar contexts.

How do you see the role of the WRC Board in achieving these goals?

Firstly, I think it is important to note that the goal of the WRC is to provide high-quality research to serve South Africa, not just the Department of Water Affairs. There are a number of government departments and agencies, and a vast range of water users, who can and should benefit from WRC funded research – across all water use sectors. While the Board clearly has a fiduciary responsibility in ensuring that the finances and resources of the WRC are used effectively and in line with legal requirements and international best practice, the Board also has a role in marketing the WRC and in making connections between the WRC and potential partners and research users. The Board also has a critical role to play in setting the strategic direction of the WRC and ensuring the performance of the WRC and of the CEO.

We are extremely fortunate to have an institution such as the WRC in South Africa, with a proud track record. The challenge now is to take it to greater heights, and to enable it to play an even stronger role in leading water research in South Africa, SADC and globally. ❑

"Research directors and managers are leaders in their specialist water areas, which allows for effective leadership and co-ordination of water research."

SPRING GROVE – A new dam rising in the KZN Midlands

Placement of rollcrete on the 260 m-long RCC section started in July. The intake tower is positioned on the upstream side of the dam to facilitate the placement of RCC continuously from the left bank to the right bank over the downstream part of the outlet section.

BKS

It is a race against time as the water requirements in the Umngeni Water area of supply push the construction of the Spring Grove Dam, outside Rosetta town in the KwaZulu-Natal midlands. Lani van Vuuren visited the site earlier this year.

Set amid the rolling hills of the KwaZulu-Natal midlands, activity is abuzz at the Spring Grove Dam construction site where the main structure and associated works are taking shape. It has been more than 18 months since the start of construction, and with the excavation and foundation work now complete, work is continuing at breakneck speed to meet the February 2013 deadline for impoundment.

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. The project was approved a few years ago following extensive studies by the Department of Water Affairs (DWA) into the future water requirements of the region.

The first phase of the Mooi-Mgeni Transfer Scheme, which comprised the construction of the Mearns Weir, was implemented in 1983 to transfer water to the Midmar Dam and to address the impact of prolonged droughts in the region. The original Mearns Weir had virtually no storage and the scheme was essentially a run-of-river scheme that could only transfer water when there was sufficient flow in the Mooi and Little Mooi rivers.

In 2003, the scheme was upgraded with a 5 m raising of Mearns Weir to create sufficient storage to allow for longer periods of abstraction by the existing 3,2 m^3/s pump station. Midmar Dam was also subsequently raised. The present system supplies water through a 13,3 km rising main to a break pressure tank at

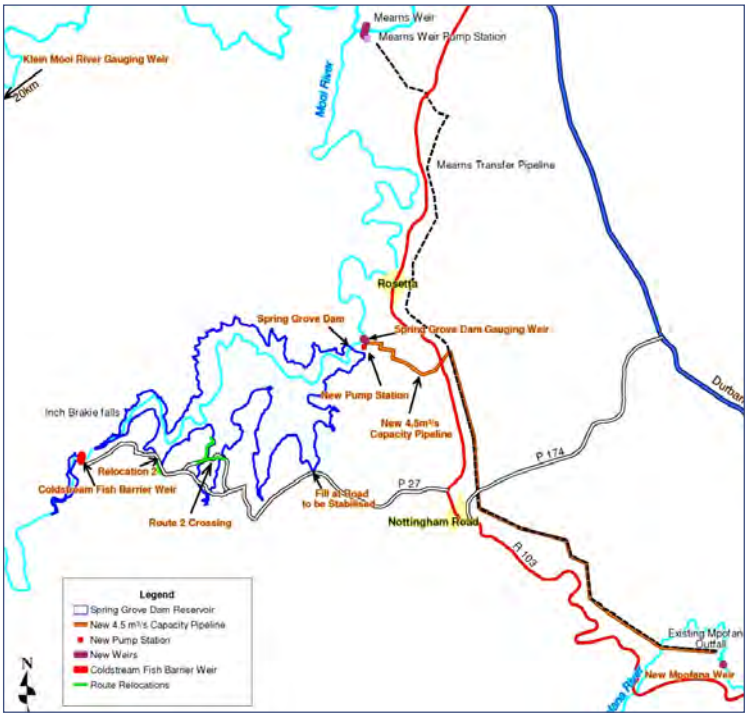
Nottingham Road. From there, it flows via an 8,3 km gravity main to an outfall works and is discharged into the Mpofana River and flows along the Lions and uMgeni rivers into Midmar Dam.

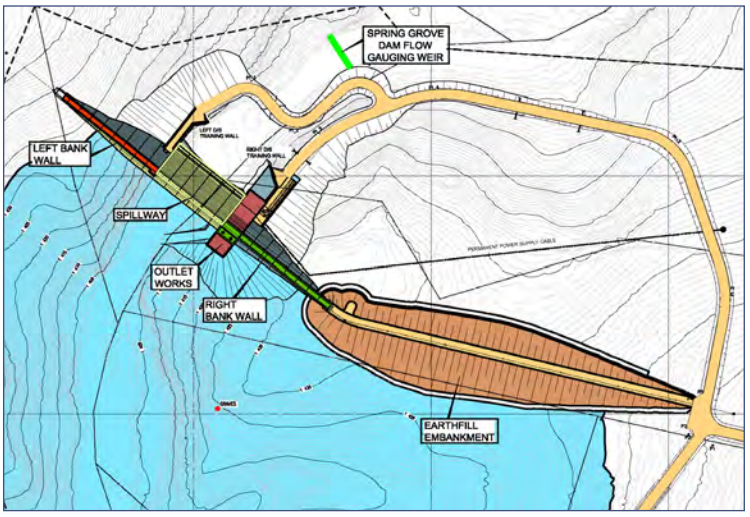
Water demand is again outstripping available supply, as is illustrated by the fact that assurance of supply periodically drops to less than 95% despite the implementation of water conservation and water demand measures. This has led to the fast-tracking of the Spring Grove Dam project.

During construction of the new dam and associated works, the Mooi-Mgeni Transfer Scheme Phase 1 infrastructure will remain operational and will be refurbished to prolong its life. In addition to the dam and additional water transfer scheme, three flow gauging structures will be constructed to monitor the system. Road realignment is also required to avoid the reservoir and flooding backwaters. (Construction of the new pump station and pipeline under Phase 2 has been postponed for the time being to allow for further environmental impact assessment after an appeal against the pipeline route was upheld by authorities).

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 will augment the yield of the system by 60 million m³/year, taking the total system yield to 394 million m³/year.

TCTA was appointed to implement the project on behalf of the Department of Water Affairs (DWA). BKS is the main consultant on the project, with Group 5-Pandev Joint Venture being the main contractor. Once complete, the dam and associated pipelines will be handed over to DWA to operate and maintain. The department will most likely engage Umgeni Water to operate the system as is currently the case on Phase 1. The project is being financed off-budget, and the long-term funding arrangements have been signed with several European development banks as well as the Development Bank of Southern Africa. Nedbank SA provided the bridging finance.





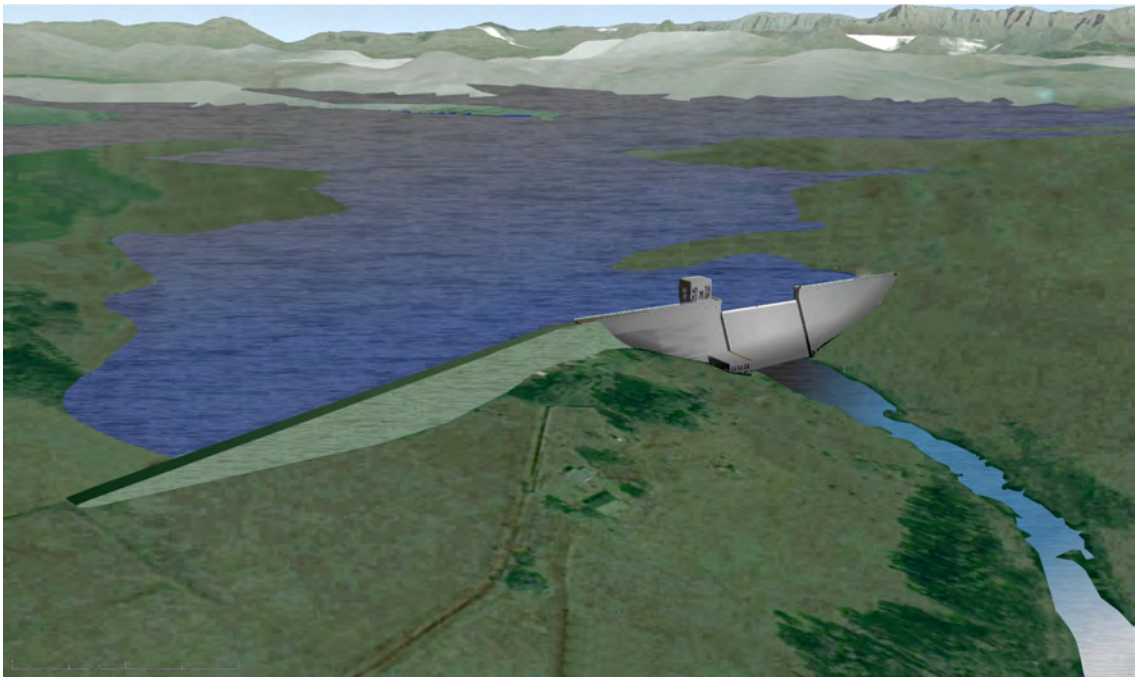
Top left: *The location of Spring Grove Dam and associated works.*

Bottom left: *The layout of the Spring Grove Dam wall.*

DESIGN AND CONSTRUCTION

Spring Grove Dam has been designed as a composite dam, with a roller-compacted concrete (RCC) gravity section and an earthfill embankment. It will have a maximum capacity of 139,5 million m³, and a wall height of 37,7 m. Due to its proximity to the town of Rosetta, it has a high hazard potential, and is therefore classified as a Category III dam.

The dam's main features comprise left and right non-overspill sections with a central spillway and an ogee crest as well as an outlet structure between the spillway and the right bank structures. The intake will be situated on the upstream side of the



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An artist's impression of what the completed Spring Grove Dam will look like.

dam, with a dam crossing located on the downstream side. River diversion culverts as well as upstream and downstream coffer walls were provided to accommodate river flows during construction.

Compared to De Hoop Dam – currently being completed on the Steelpoort River in Limpopo – Spring Grove is a small RCC dam, only requiring about 90 000 m^3 of rollcrete. Still, this has not prevented the project team from being innovative. A specially-developed high paste RCC (known as a wet paste RCC mix) is being used which, to date, is proving not only efficient, but cost-effective.

The high workability RCC has a number of advantages and offers the benefit of minimum segregation during placement. In addition, the RCC placement programme is such that it minimises the number of cold joints, where a complete stop of concrete placement and exposing of aggregates in the top of the receiving layer and green cutting thereof are required.

"From a logistical point of view, the high paste RCC is a substantial improvement as the same mix can be hauled with dumpers and conveyors, compacted with a 10 t vibratory roller in the body of the dam as well as compacted against formwork with 50 mm poker needle vibrators," says consultant Resident Engineer Peet Viljoen of BKS. "Placing is therefore much easier in confined areas and it is relatively easy to achieve a good finish on exposed areas."

Due to the speed of construction the placement time can be reduced, with significant savings in preliminary and general items. "The RCC mix used for Spring Grove Dam is saving us R85 per cubic metre of RCC compared to the mix used at De Hoop Dam (using Spring Grove Dam contract prices)," notes BKS Technical Director Danie Badenhorst.

To ensure the workability of the RCC mix, a full-scale (60 m-long by 12 m-wide by 6 m-high) trial section was constructed in the dam reservoir before RCC placement commenced in the dam. Laboratory tests confirmed that the mix should create an

Lani van Vuuren

Rip-rap being placed against the slopes of the earthfill embankment. The embankment will be 11 m high and 315 m long upon completion.

impermeable dam wall with acceptable concrete strengths (minimum 6,5 MPa at five days and 15 MPa at 365 days).

High paste RCC requires particular attention to the shape and grading of aggregates and fine tuning of the mix to ensure a fine balance between workability, cost of binder, shrinkage and strength, Viljoen explains. "In order to improve workability and to reduce segregation the maximum aggregate size of 38 mm with relatively high paste content is required. Visually, this mix tends towards conventional concrete, has the benefits of low cement content but is still dry enough to be placed with earthworks equipment."

Construction of the embankment and central spillway section is currently progressing, with RCC placement having started in July. Badenhorst says that placement is being undertaken on a continuous (day and night) basis, with fresh RCC compacted on the previous layer, which has not yet hardened. Instead of articulated dump trucks – which may contaminate fresh RCC with the dirt on their wheels – slew conveyors are used to discharge the rollcrete onto transfer trucks which remain on the RCC during placement. Around 200 workers are currently on site, with labour mostly sourced from the area. Many are women.

Construction of the earth embankment is also underway. This embankment was designed as a zoned embankment with a clay core and semi-pervious shells, as well as a chimney filter and blanket drain with strip drains and a toe drain. Slopes are protected by rip rap or gravel.

Special arrangements have been made at the concrete dam/embankment contact to prevent piping where soil was compacted on a sloped surface from 8 m below ground surface to the non-overspill crest. The provision of a thicker chimney drain and a pipe in the strip drain adds an additional safety measure to prevent possible piping failure, notes Badenhorst.

Lani van Vuuren

Above: *The Mooi River downstream from the Spring Grove Dam construction site.*

Below: *Slew conveyors are used to discharge the rollcrete onto transfer trucks which remain on the RCC during placement.*

ENVIRONMENTAL AND SOCIAL ASPECTS

As with any new infrastructure development in South Africa, the developers of Spring Grove Dam have to adhere to strict environmental and management plans as part of compliance with the Record of Decision. The public and other stakeholders have been widely consulted, and an Environmental Monitoring Committee – made up of independent persons – has been established to monitor environmental compliance of activities on site.

With Spring Grove sourcing its aggregate from a commercial supplier near Pietermaritzburg, local roads, particularly the R103, have now temporarily become major travel routes for vehicles hauling construction materials to site, and much time has been spent in consultation with local residents of Nottingham Road and Rosetta to find a solution that suits all.

Initially only 30 deliveries were allowed on the road per day between 08:00 and 17:00. This proved highly inhibitive to dam construction and the condition was later amended to

Lani van Vuuren

Top right: *In order to meet the February 2013 impoundment deadline, construction continues day and night.*

Bottom right: *The Spring Grove inlet tower with the Mooi River diversion on the foreground. The dam has been designed with outlet works capable of river releases that will meet the demands of downstream users and the aquatic environment.*

BKS

60 deliveries per day between 08:00 and 22:00. All vehicles have been fitted with GPS devices to track, among others, speed, and have to follow a loop system so that no trucks pass each other on their way to/from site. The D146 road from the R103 to the dam construction site has been upgraded and is being maintained during construction so that it can accommodate the extra traffic burden.

Lani van Vuuren

Several privately-owned properties are affected by the construction of the dam. In addition to the land owners who are compensated for loss of land and loss of economic income, there are several labourers resident on some of the properties. TCTA aims to not only find alternative suitable accommodation for these households, but preferably to give them full title over the new space, thus leaving a positive legacy, says TCTA environmental manager, Kogi Govender.

In addition, more than 180 graves have been identified to date, all of which require careful exhumation and reburial with consent from the affected families and permission from municipalities and provincial government. A key stumbling block at the time of writing, however, is the lack of cemetery space in Mpofana Local Municipality which most families have identified as their preferred reburial location. It is hoped that a workable solution will be found soon.

MAIN CHARACTERISTICS OF SPRING GROVE DAM

Dam type: RCC gravity dam with earthfill embankment
Catchment area: 339 km^2
Gross storage volume at full supply level (FSL): 139,5 million m^3
Water surface area at FSL: 1 021,8 ha
Total length of dam wall: 607 m
Maximum height (above river level): 37,7 m
Total length of concrete section: 274 m
Crest length of spillway: 70 m
Total freeboard: 5,7 m
Earthfill embankment crest length: 315 m
Earthfill embankment height: 11 m
Outlet works: Twin system with multi-level intkes
Outlet capacity: 29,5 m^3/s

Rock containing San paintings discovered just below Inchbrakie Falls on the Mooi River has been carefully removed and is now curated in the Natal Museum. Various rare plant species are also being removed and re-established out of harm's way.

Like all new dams in South Africa, Spring Grove has been designed with outlet works capable of river releases that will meet the demands of downstream users as well as the Ecological Reserve. Among others, the bottom two outlets are designed to jointly accommodate the in-stream flow requirement of 30 m^3/s peak for freshets as well as releasing 4,5 m^3/s for transfer to the uMgeni River catchment area. Normal instream flow requirements are accommodated with the smaller 600 mm-diameter sleeve valves provided as off-takes from the outlet's large bottom pipes.

FISH BARRIER

One of the more unusual environmental aspects of the project is the construction of a fish barrier structure in the Mooi River upstream of the Spring Grove reservoir. Environmental studies conducted during the initial stages of the project discovered that the Inchbrakie Falls forms a natural barrier between smallmouth bass downstream of the falls and trout upstream of the falls, the latter being an important money spinner for tourism in the midlands area.

The Inchbrakie Falls will be inundated once Spring Grove Dam reaches full supply level, and the possibility existed that the bass would find their way upstream where they would compete with trout for foraging and breeding habitats and nutrients in the river. Bass are fiercely protective of their chosen habitats and would likely exclude trout from those areas once they were established.

This prompted the decision to construct the fish barrier, which will mimic the effect of the falls in providing a barrier between the two fish species. The fish barrier will take the form of a concrete wall across the river that creates a step and resultant flow that exceeds the burst speed of the smallmouth bass. The barrier will have a storage volume of 450 000 m^3 and a maximum height of 9,4 m.

Lani van Vuuren

Top left: *The Spring Grove batch plant. Around eight days' worth of material is stored on site.*

Bottom left: *The formwork has been designed to hold fresh concrete and accommodate the placement of layers above.*

WATER FOR THE FUTURE

Unfortunately, the KwaZulu-Natal Coastal Metropolitan Area will continue to be under stress even when Phase 2 of the Mooi-uMgeni Transfer Scheme comes into operation, and additional water resources will need to be developed in conjunction with the need for ongoing water demand management. DWA, in close consultation with stakeholders and water user groups, is tending to opportunities for further development of the available water resources. This includes alternative water supply options, such as desalination of seawater, and re-use of effluent. One of the options currently being investigated is the development of the uMkhomazi River (Smithfield Dam).

In the meantime authorities will walk a thinly stretched tightrope between water supply and demand. It is up to all the water users of the cities and towns affected to treat their water with the utmost care and respect. ❑

Lani van Vuuren

Smart technology helps brings researchers closer to SA's aquatic life

South Africa might be water scarce but its rivers nevertheless support a vast array of wildlife both on the surface and underwater. A new locally developed biotelemetry system is helping us understand what is rolling in the deep. Lani van Vuuren reports.

Biotelemetry involves the use of transmitting devices to monitor the behaviour and physiology of animals in their natural environment. This monitoring technique is proving to be increasingly useful to researchers around the world. Biotelemetry devices allow researchers to document, for long uninterrupted periods, how undisturbed organisms interact with each other and their environment in real time.

For the last four years the Water Research Commission (WRC) has been funding a series of studies which have led to the development of a locally produced biotelemetry system to monitor the behaviour of aquatic organisms in South Africa. Through collaborative efforts between the Water Research Group at North West University (WRG-NWU), the Centre for Aquatic Research at the University of Johannesburg, Scientific Services at South African National Parks, E Oppenheimer and Son and biotelemetry system specialists Wireless Wildlife International, the technology has now been successfully developed and tested in the field.

Project leader Dr Gordon O'Brien, of the WRG-NWU, explains that biotelemetry methods are internationally recognised as one of the most effective ways of acquiring behavioural information of fishes and other aquatic animals over extended periods within their natural environments. "We are particularly interested in using the behaviour of these organisms to develop our understanding of their biology and ecology and then to evaluate the impact of changing environmental variables such as water quality, quantity or flows and habitat on their behaviour. This will allow us to establish management guidelines for these environmental variables which will contribute to the conservation of species."

REMOTE MONITORING

So how does it all work? The locally-produced biotelemetry system makes use of remote and manual tracking or monitoring systems as well as smart tags or transceivers. The latter is attached to the organism being monitored. Once tagged the animals (in the case of the study fish and crocodiles) are released to re-establish their normal behavioural patterns. With remote and manual monitoring systems researchers now monitor the continuous behaviour of the animal for at least a year.

The remote monitoring systems include the use of 'listening stations' or receivers that are deployed into the study area. These record and transmit information from the tags at a ten-minute interval to an Internet-based data management system. The researchers can log onto the data management system at any time from any computer with Internet access and download real-time behavioural data from the tagged animal. In turn, manual monitoring systems involve the use of directional antennae and hand-held receivers which are used to locate and download behavioural data from any tagged animal in the field.

"We have already had a few close encounters with crocodiles, hippopotami, pythons and pathogens."

Courtesy North West University

Monitoring South African wildlife can be a dangerous occupation.

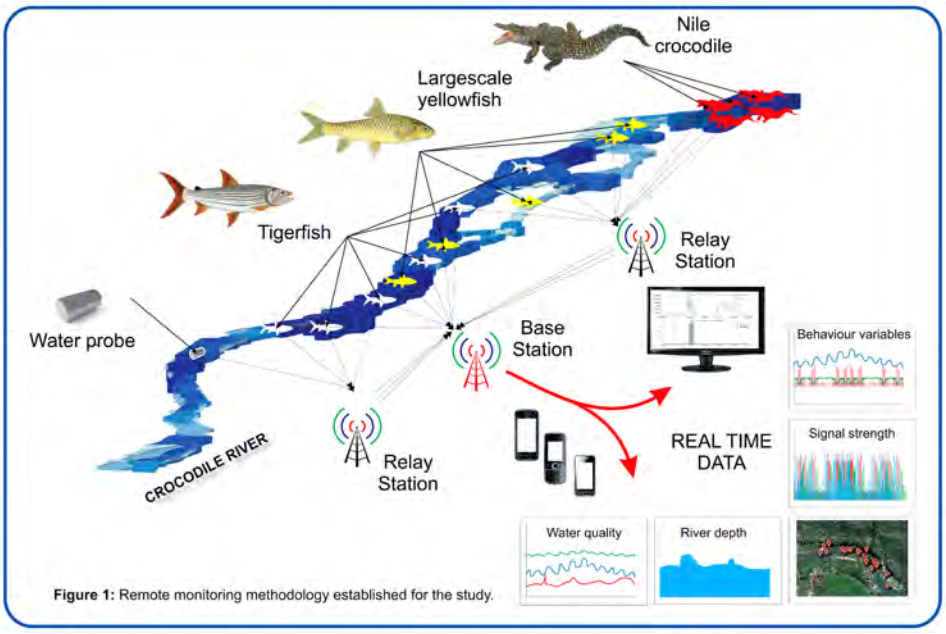


Figure 1: Remote monitoring methodology established for the study.

Courtesy North West University

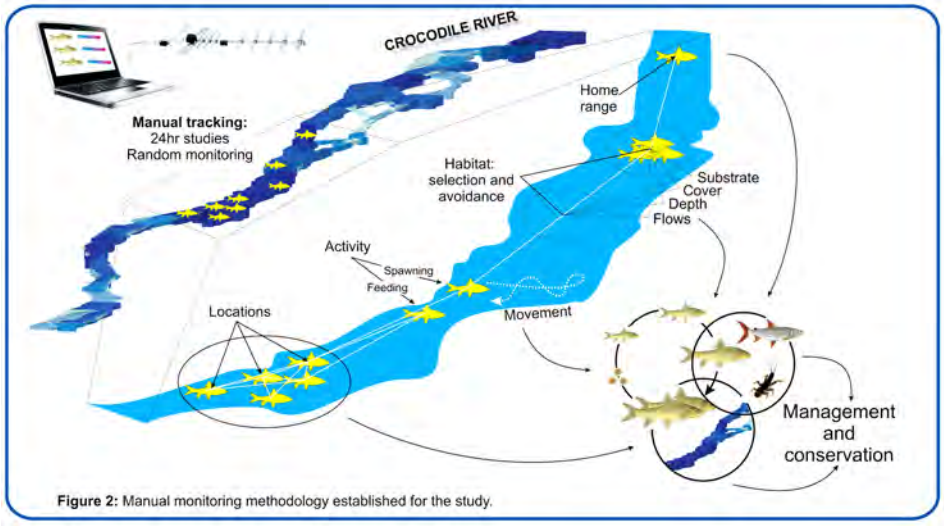


Figure 2: Manual monitoring methodology established for the study.

According to Dr O'Brien, the benefits of combining remote and manual monitoring methods are that scientists can manually monitor the behaviour of the tagged animals and important environmental variables whenever they choose, as well as get additional information from the remote systems when they are not in the field. "Fortunately although the approach we have developed is unique, biotelemetry methods are not, and we have access to a wide range of very useful data analyses methods that allow us to graphically and statistically analyse the behavioural data we collect."

The type of behavioural aspects of the aquatic organisms that can be monitored include the location of the animal, the movement and activity as well as some environmental variables, including the depth of the animal in the water, as well as the temperature in the water. In addition, by monitoring the location, movement and activity of the animal over extended periods of time, the team is able to evaluate the response of the animal to changing habitat variables, flows, water quality components and weather variables, such as atmospheric pressure.

Data collected on a monthly basis can miss the short-term water resource quality changes that can affect aquatic life, making real-time data monitoring all the more important, explains Bonani Madikizela, Research Manager at the WRC. "The kind of technology developed through this research allows authorities to react more quickly, not only protecting our biodiversity but also affording a greater chance to apprehend polluters."

Unfortunately the size of the tag is largely limited by the battery needed to power the tags. This means that the smallest tags that last one year are currently the size of an AA battery and weigh about 18 g. Due to the size of the tags the WRC studies have focused on adult aquatic animals that grow larger than 1 500 g. Smaller tags (10 g) are available for fish, however, they last only for three months. The smaller tags have been designed to address specific conservation or management questions for smaller fish species which can be answered with a limited amount of behavioural information.

TESTING THE WATERS

The Crocodile River, which forms the southern boundary of the Kruger National Park, was recently selected to carry out an experimental behavioural ecology study to test the locally manufactured biotelemetry equipment. Seven Lowveld large-scale yellowfish (*Labeobarbus marequensis*), twelve tigerfish (*Hydrocynus vittaus*) and one Nile crocodile (*Crocodylus niloticus*) were captured and tagged. The animals were then released and monitored for eight months between July 2011 and February 2012.

Behavioural data, including home range, habitat use, daily and seasonal movement patterns, daily activity patterns, as well as the response of the animals to changing environmental variables (flows, water quality and habitat availability) were described and statistically analysed.

Despite some early challenges with regards to the development of the local biotelemetry system, it has proven itself to work well in the field.

In addition to the KNP project, team members have already made noticeable contributions to the conservation of threatened or protected yellowfish in the Vaal River and tigerfish in man-made dams in southern Africa through the use of biotelemetry. "We are increasing our understanding of the behaviour of aquatic organisms in southern Africa and how to conserve and manage the systems they occur in," notes Dr O'Brien.

The findings of some of the studies the team has carried out to date have generated new, interesting and useful lifecycle biology and ecology information. Among others, the team has discovered how important refuge areas for Largemouth yellowfish are; how small the home range of Smallmouth yellowfishes can be (less than 500 m of the Vaal); how sensitive fish are to alternations in flows and water quality; how different species not only use different habitats but avoid habitat types; new predation strategies of tigerfish; the migration requirements of fish species; how often crocodiles feed in relation to the temperature of their gut; how the activity of crocodiles change when they guard nests, and how yellowfish and tigerfish use different parts of the water column in the same habitats.

The researchers are not deterred from working in South Africa's 'wild' environment. "While scientists from abroad refer to aquatic ecosystems as hostile environments because of the difficulty to see what is happening below the surface, we Africans base the hostilities of the system on the amount of animals that want to bite, eat or chase us," says Dr O'Brien. "We have already had a few close encounters with crocodiles, hippopotami, pythons and pathogens."

Wireless Wildlife together with the WRG-NWU now offers biotelemetry monitoring services using the locally-developed technology. Dr O'Brien sees a long and prosperous future ahead for biotelemetry in South Africa. "The use of the behaviour of aquatic organisms is not only going to help us improve our understanding of the biology and ecology of aquatic animals, but make better use of these indicator species to manage ecosystems."

"The WRC is excited about the outcomes and strongly believes that the results from the studies will find immediate uptake by water resource managers in many uses," adds Madikizela. "In the near future this approach is expected to allow ecosystem managers to make real-time management decisions based on the immediate response of organisms to changing environmental variables."

This means that when the behaviour of species indicates that environmental thresholds have been reached, for example, through reduced flows or a chemical spill into a river, managers will be able to respond accordingly. "We may even be able to use fish behaviour in real time to release ecological flows at the start of migration. This will all result in a better ability of decision-makers to manage and conserve our precious ecosystems," explains Dr O'Brien.

Further developments in remote and manual biotelemetry monitoring methods and analyses techniques are continuing. It is hoped that this technology will go a long way towards the conservation of South Africa's rich aquatic biodiversity. ❑

Courtesy North West University

Top left: *Water Research Group MSc student, Francois Jacobs, holding a tigerfish carrying a transmitter.*

Bottom left: Team member *Matthew Burnett with a yellowfish.*

Rainwater monitoring crucial to catchment management – DWA

In response to the article, 'Taking on the Challenge of Water Resources Assessment' (the Water Wheel May/June 2012), N Vermaak, H de Haast, P Havenga and G Steyl offer insight into the importance of rainfall measurement in managing South Africa's catchments sustainably.

Rain, for some reason creates confusing reactions from people. When you talk to a farmer, for example, he will usually complain that the rain was too early, too late, not enough, too much, or not at all. Nevertheless, it is clear that the farmer needs the rain even though it might not fall at the time or in the volumes required. For the city dweller, rain is usually an inconvenience – it ruins his schedule, his clothes, and creates discomfort, causing him to get wet.

We are, however, not here to discuss people's perceptions of rain, but the importance of rain in the hydrological cycle and the process of managing our water resources.

RAINFALL AND THE HYDROLOGICAL CYCLE

Every system has its inputs. Inputs are whatever enters the system, and this determines the outputs. The quality of inputs often determines the quality of the outputs. We humans have two kinds of inputs, the one being whatever enters the digestive system to provide us with energy to accomplish whatever we set out to do. The second input into the human system is, just like a computer, information. In our computer age, we should all be familiar with the saying: "Garbage in, garbage out".

Rainfall is the input into the hydrological 'system' and unlike the human body where we can control the inputs – whether it is what we eat and drink or the information we feed our brain – we cannot control the input into the hydrological cycle. We have probably all heard about seeding the clouds, in an attempt to cause the clouds to bring rain, and this has apparently met with varying rates of success – but it can only be done if there are clouds in the sky. Humans cannot control wind direction or the formation of clouds; we cannot control the weather, we can only predict it. It is the same for rain – we cannot control it, we can only predict it – not always successfully, we can measure it and we can contain the run off caused by rainfall in dams and impoundments.

How important is rain to the hydrological cycle? In the 1970s and early 1980s, there was a drought of almost 11 years in the interior of the country, where children had never seen rain in their life. In England, two weeks without rain would be considered a drought, with withered grass and worried farmers. Rain and other forms of precipitation are

extremely important, for without rain the whole hydrological cycle will come to a stand still – eventually. The streams and rivers may continue running for some time (often underground in the dry areas of our country and in Namibia); groundwater – the tortoise of the hydrological cycle – may still provide water for a couple of years afterward as it did when the southern Cape was experiencing their recent drought; but when this is gone, what is left?

RAINFALL AND CATCHMENT MANAGEMENT

We are mandated by the National Water Act of 1998 (Act 36 of 1998) to use Integrated Water Resource Management to manage the water resources of the country, and it therefore becomes the main responsibility of the Department of Water Affairs (DWA) and the Minister of Water Affairs, as the custodians of the water resources.

We have seen above how important rain and other precipitation are in the hydrological cycle. It is, however, the one part of our water resources that we cannot manage in the real sense of the word. We can only measure it, which may create some problems in the management process. Management has to do with volumes, reducing risks – risks of floods, risks of droughts, etc. We cannot reduce the risk of no rain, with its ensuing droughts, or the risk of floods, without planning. We cannot plan for eventualities such as droughts and floods without data – which comes from measurements. The measurements of precipitation will not predict a flood or a drought, but there seems to be a cyclical pattern to rainfall, as with most other weather-related phenomena. When long-term records are available, it can be used to predict possible patterns, with can be used to plan for floods, droughts and anything in-between. It can also help to predict climate change and assist managers in planning for the associated effects it may have on the availabilities of water resources.

"Humans cannot control wind direction or the formation of clouds; we cannot control the weather, we can only predict it. It is the same for rain."

MEASUREMENT OF RAINFALL

Measurements of rainfall can be done with a simple funnel-shaped gauge that is fairly easy to find. The readings have to be taken daily at the same time to ensure a consistent pattern. More complex rain gauges with electronic devises that take the pain out of taking daily readings is also available, but not quite so easy to find. Rain gauges can also be set up with weather stations, where the rainfall is measured but not collected.

A cumulative rain gauge was developed by Dr Eddie van Wyk of DWA in Pretoria. This rain gauge also collects samples that can be analysed chemically, especially for chloride values and certain isotopes. This data can then be used to determine the recharge to groundwater when it is compared with the quantities of chloride and isotopes in the groundwater.

A number of these cumulative rain gauges have been installed in South Africa, and are maintained by DWA. In the Western Cape, for example, a series of such rain gauges are currently managed by the Geohydrology Section of the department. Some of these rain gauges were installed in the Western Cape in 2000, with the latest ones installed in February this year as part of Table Mountain Group (TMG) investigations.

WHAT CAN WE LEARN FROM RAINFALL DATA?

Climate change is something we hear about frequently. Rainfall records can help us to understand the patterns of change, and also help us predict how things can possibly change in future. It can give us an indication of how much water we will have available as surface water and groundwater – and this can help us to manage our water resources better.

Zachariashoek was one of the experimental sites for the Mountain Catchment Studies in the winter rainfall areas. Measurements of

Courtesy of DWA

Top left: *This rain gauge and weather station is situated at Rocherpan on the West Coast, near Dwarskersbos.*

Bottom left: *Cumulative rain gauge TMG488 forms part of the TMG monitoring programme.*

Top right: *Water levels of the boreholes in Zachariashoek compared to the rainfall measure in the same catchment.*

Middle right: *Gauge plate readings at the weirs in Zachariashoek compared with the rainfall measured in the same catchment.*

Bottom right: *Graph showing the rainfall data for three of the rain gauges in the Beaufort West area.*

Figure 1

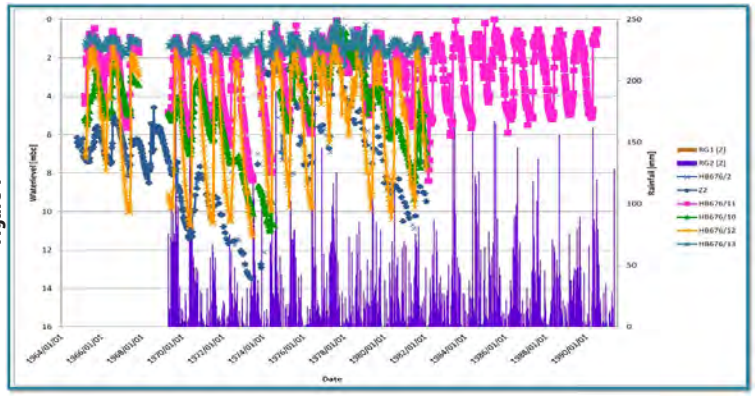


Figure 2

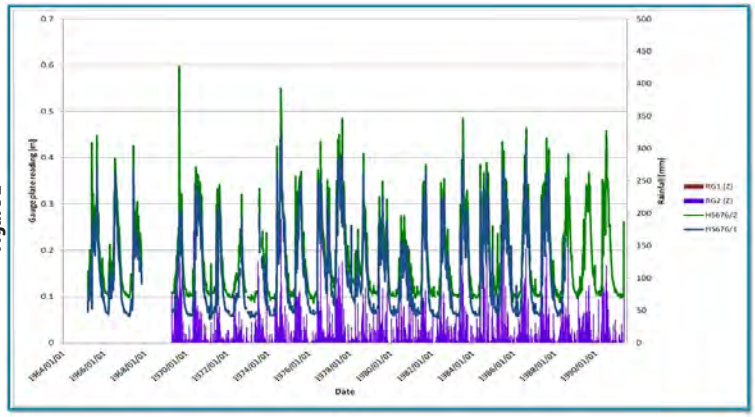
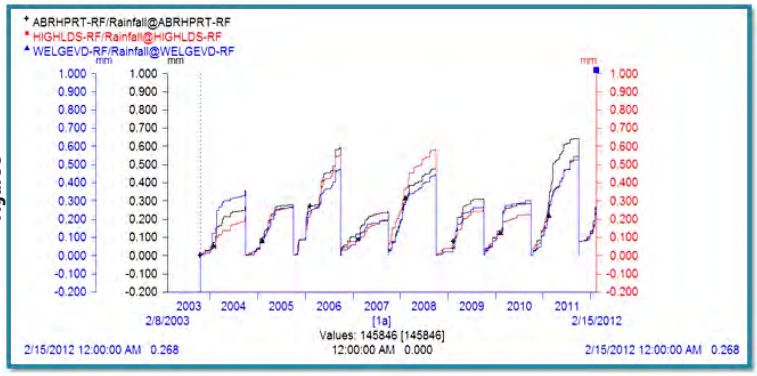


Figure 3



groundwater levels and surface water levels have been taken from around 1964. The record of rainfall measurements began in 1969. Figure 1 shows the groundwater levels in the Zachariashoek sub-catchment compared to rainfall, while Figure 2 shows the gauge plate readings taken at the two weirs in the Zachariashoek sub-catchments compared to rainfall.

It is very clear from this data that there is a definite correlation between rainfall and the groundwater levels and the surface flow. Figure 3 shows the rainfall record for three of the cumulative rain gauges in the Beaufort West area. It shows the lower rainfall of 2009 and 2010 that caused the water problems in the area, with the higher rainfall of 2011 that brought the relief.

Figure 4 shows the rainfall of four rain gauges in the Breede River area, with those of the KOO valley being far inland, while Cape Infanta is next to the coast at the Breede River mouth. The graph shows the decline in rainfall as one move inland. Figure 5 shows the data record of four rain gauges near the Nuweberg Dam, which is also located in the Breede River area.

These rain gauges are at different altitudes, and give an indication of the effect of altitude on rainfall. TMG489 is above 1000m above mean sea level, while TMG486 is right next to the Nuweberg Dam. TMG488 is somewhere in between. The record of TMG490 is too short yet to compare it with the rest, as it was only installed in February 2012.

Figure 6 shows the correlation of rainfall and groundwater levels for an unconfined porous aquifer in the Lower Berg River area. It can be seen how the rainfall events contributed to groundwater recharge.

The time lag between the rainfall event and the rise in groundwater levels can also give an indication of the transmissivity of the aquifer. Aquifers that respond quickly to rainfall events may have a higher transmissivity than aquifers that have a greater time gap. The response of an aquifer may also show whether the aquifer is unconfined or confined, as an unconfined aquifer will usually have a greater response to rainfall events than confined aquifers.

The unconfined aquifer will be recharged directly by the rainfall event, while the confined aquifer will mostly receive its recharge from a distance – giving it a greater time lag between the rainfall event and the response in waterlevels. Some confined aquifers may receive recharge slowly through a leaky aquitard, the layer that causes the confinement.

RAINFALL DATA PROCESSING

Raw rainfall data – the numbers – on their own do not mean very much. It is pictures that usually tell the story better than a list of numbers. Rainfall is usually plotted as a bar chart, where different time periods are used, such as the rainfall per day or per month. In the Western Cape the highest rainfall occurs between April and October, while in the rest of the country the highest rainfall usually occurs from September to March.

The cumulative rain gauges

record the data automatically, taking readings at set time intervals. This data adds up cumulatively, but can be edited to give daily readings as with the other rain gauges. The data is downloaded from the Thalimedes during monitoring of the areas, and edited. One of the programmes used in editing the data is Hydras3. The editing of the data is done in such a way that it gives the cumulative rainfall for a hydrological year, which begins on the 1st of October – unlike the financial year that begins on the 1st of April.

COMMENDATIONS

The *Water Wheel* article mentions the decline in streamflow and rainfall data for South Africa at the beginning of the WRC project WR2012. It is also stated that the number of useful rainfall gauges is seriously low, with roughly the same number of stations as in 1920. With this in mind it would almost seem as if we need to commend the people that still take the time to measure rainfall. This would include:

- South African Weather Service and its volunteers, who keep records without incentives or payment and then make it available to the public.
- Farmers, who realise how important it is for their own farm management to record rainfall.
- DWA who sometimes keep rain gauges (and weirs) going despite budget and staff constraints.

CONCLUSIONS

The *Water Wheel* article quotes Dr Pitman, where he states the following: "Rainfall is the primary input to hydrological computer models, not only to determine streamflow, but also irrigation requirements and net evaporation from reservoirs (an important factor in the determination of yield). On the other hand, information on streamflow is necessary to calibrate the hydrological models to ensure we get the most accurate determination of our water resources. Thus to undertake water resource assessment without rainfall and streamflow data is a bit like trying to plan for population growth without a proper census."

If rainfall is the primary input into hydrological computer models, it is definitely the primary input into the hydrological cycle and this absolutely necessary when it comes to managing our water resources. To put it very bluntly: Without rain, you have no water in the hydrological cycle. Without rainfall measurements, you have no integrated water resource management as you cannot manage what you cannot measure.

Figure 4

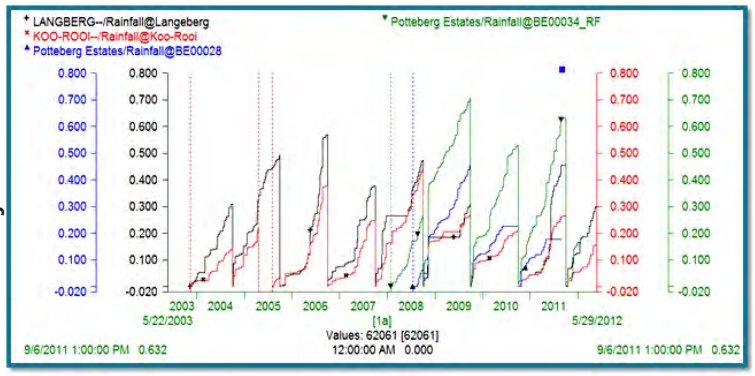


Figure 5

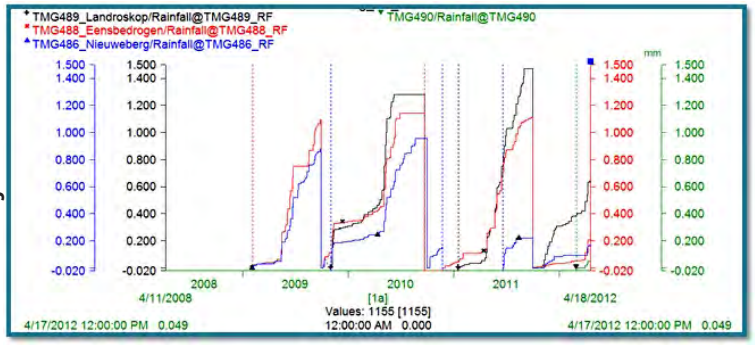
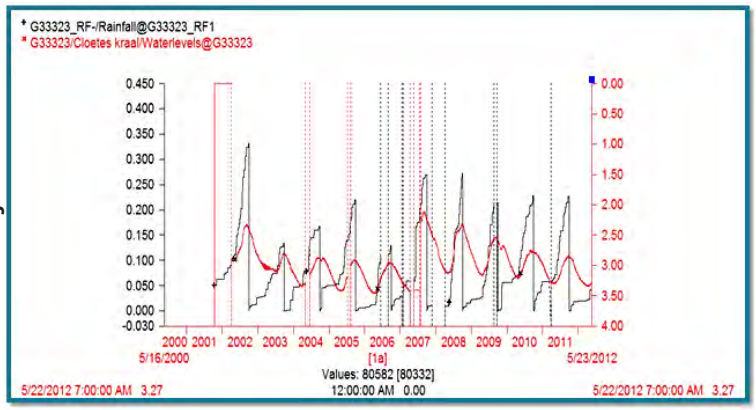


Figure 6



Top left: *Graph showing the rainfall data for the Breede river area. Two of the rain gauges are in the KOO valley while the other two are near Cape Infanta.*

Middle left: *Graph showing the rainfall data for the four rain gauges near Nuweberg dam.*

Bottom left: *Graph showing the rainfall from cumulative rain gauge G33323-RF and the waterlevels in borehole G33323.*

Below: *Cumulative rain gauge G46105-RF, near Langebaan Road, showing the Thalimedes used to record rainfall.*

Courtesy of DWA

DAM ENGINEERING – Now is Africa's time to lead

Dinnie van Rensburg

Director of the Institute for Water and Environmental Engineering at Stellenbosch University, Prof Gerrit Basson, has been elected to represent Africa as Vice President on the Board of the International Commission on Large Dams (ICOLD). Lani van Vuuren spoke to him about opportunities for water resource development in Africa.

South Africa has been extensively involved in the activities of ICOLD since it became a member of the organisation in 1965. A non-governmental organisation, ICOLD was originally founded in 1928. With 90 national committees and over 10 000 individual members, it is the leading international forum for knowledge and experience exchange on dam engineering. According to ICOLD's website, the organisation leads the profession in ensuring that dams are built safely, efficiently, economically, and without detrimental effects on the environment.

Prof Basson is the fourth South African to hold the Vice President position, following in the footsteps of Drs JP Kriel, Theo van Robbroeck, and Paul Roberts, all formerly of the Department of Water Affairs. Dr van Robbroeck went on to become President of the organisation. Prof Basson was nominated for the Vice Presidency by the Nigerian Committee on Large Dams. His nomination was uncontested.

Prof Basson has 25 years' experience, mainly in river hydraulics and sedimentation as well as the design of hydraulic structures. He has worked in 17 countries (excluding South Africa). He is a registered professional engineer. Prior to his election as Vice President, Prof Basson served as chair on the ICOLD Reservoir Sedimentation Committee, among others. He has been involved as editor or co-editor in a number of ICOLD Bulletins (state-of-the-art technical documents) related to reservoir sedimentation and authored several papers. He has also served as the ICOLD representative on the UNESCO-IHP-ISI International Sedimentation Task Force, while serving as Vice President of the World Association of Sedimentation and Erosion Research. The World Bank has also invited him on several occasions as specialist advisor on reservoir sedimentation on international projects.

Africa is experiencing a period of bloom at ICOLD. Newly-elected President Adama Nombre is from Burkina Faso and, according to Prof Basson the annual meetings, technical committees and conferences held by the organisation are generally well attended by members from Africa.

This is no wonder. Africa is currently experiencing high economic growth rates despite the global recession. The International Monetary Fund projected GDP growth for sub-Saharan Africa for 2012 is 5,4%. Some of the countries with high economic growth rates in 2012 are Zambia (7,7%) and Mozambique (8,1%). This is coupled with a growing demand for water and associated infrastructure. A need for especially hydropower dams has been identified.

The largest project in the southern African region at present is Phase 2 of the Lesotho Highlands Water Scheme, which includes the proposed Polihali Dam and transfer tunnel. Other southern African schemes include the 73 m-high Metolong Dam currently under construction in Lesotho, as well as proposed hydropower projects in Mozambique where the aim is to increase the current 2,4 GW capacity to 8,4 GW.

These and other proposed water resource development schemes make the present an exciting time to be part

of the field of dam engineering, notes Prof Basson. Of course, as he points out, these developments have to be undertaken sustainably. "As engineers we have a responsibility to make sure any new dam's benefits are optimised with consideration and measures to limit the environmental and social impacts of the dam on the surrounding environment."

South African dam engineers are playing no small part in water resource development projects on the continent, including in their own country and that of the country's neighbours. They bring expert knowledge in, among others, dam design technology and construction, assessment of the impacts of infrastructure on downstream ecosystem and Reserve determination, environmental and social impact assessments, dam surveillance and safety, hydraulic design and modelling of spillways, to name but a few.

Despite these advancements, Prof Basson sees greater scope for involvement of African countries in ICOLD. "Most countries on the continent have dams serving various needs, including hydropower, irrigation, flood mitigation and potable water supply. Many countries, however, are not ICOLD members due to lack of information or for financial reasons, for example." Prof Basson hopes to address some of these issues during his term of office to make it easier for African countries to become members.

At the same time, a need has been identified to update the ICOLD dam register for dams in Africa. ICOLD's World Register of Dams is recognised internationally as the best available database of dams in the world. Unfortunately data on Africa's large dams are often lacking and/or found to be inaccurate.

Key staff in National Committees of African member countries will be identified to check the accuracy of the existing register data, and to update available information. "For data from non-ICOLD member countries, a regional approach will be followed to obtain contact persons in these countries who would be willing to collaborate with ICOLD in providing the data," notes Prof Basson.

He also sees an important role for ICOLD to be played in regional water resource development and planning in Africa. "Due to political and social reasons, African countries have a poor track record of regional planning and sharing of the long-term benefits of water resources development. Apart from building technical expertise, ICOLD can play a role in regional planning and operation of dams and related schemes in Africa."

This could be achieved by regional workshops, which could also tie in with the annual Africa Regional Club symposium to be held in Africa. Regional clubs are formed by groups of national committees to facilitate interchange of knowledge and experience between countries with common interests and environments.

At such symposia, leading practice with regards to planning, funding, investigation, design, construction, operation, maintenance, safety review, environmental sustainability and social equity associated with dams are promoted. Exchange of information and experiences among African members on all aspects on dams will be encouraged.

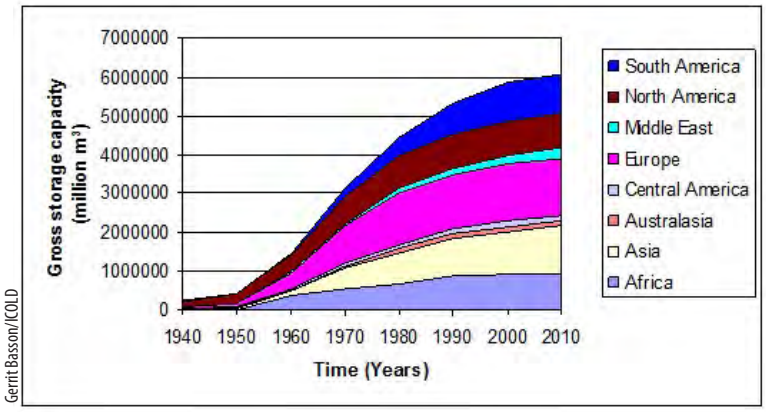
Regional planning could also benefit from independent reviews by experts in the field, maintains Prof Basson. "It is proposed that an African list of dam engineering experts be compiled with an indication of qualification, experience, speciality and so on. These experts will also be informed of the benefits to join international experts on ICOLD technical committees during annual meetings."

Prof Gerrit Basson, newly elected ICOLD Vice President for Africa.

To have a list of experts there needs to be experts, and building capacity in African dam engineering is close to Prof Basson's heart. "We need to encourage individuals, particularly younger people, with skills and interests in engineering, science and environmental matters associated with dams, to become active members of ICOLD and its regional organisations."

Earlier this year, ICOLD established a Young Engineers Forum for members under the age of 40, and it is hoped to build on this initiative locally and regionally. A good start is the fact that at the International Conference and Exhibition on Water Storage and Hydropower Development in Africa, to be held in Ethiopia in April next year, a session will be held specifically on the topic of capacity building.

The time has truly come for Africa to show that large dams can be developed for the benefit of all. ❑



Gerrit Basson/ICOLD

Historical growth in global reservoir storage capacity. Africa still has much scope for development.

New WRC guidelines helping dairy farmers to greener pastures

New irrigation guidelines for pasture production developed under the auspices of the Water Research Commission (WRC) are proving to farmers that with the efficient application of water and fertiliser the grass can be greener on their side of the fence. Article compiled by Lani van Vuuren.

According to the Milk Producers' Association, South Africa's dairy farmers are expected to produce 2 460 million litres of milk for 2012. As the human population increases and diets become more affluent, so the demand for animal protein (such as milk) increases. At the same time, farmers are under pressure to decrease their share of water and fertiliser usage.

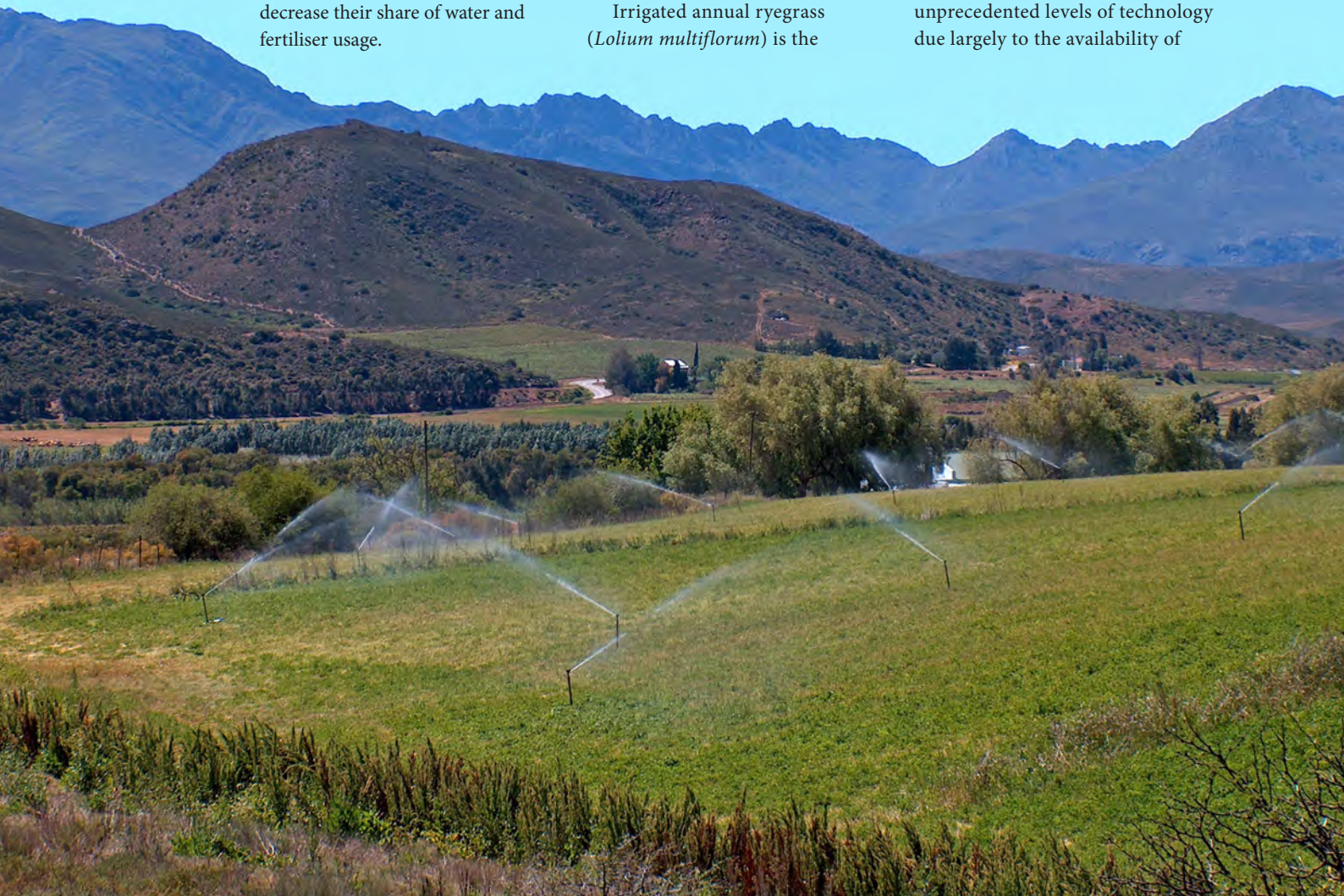
No wonder then that of all farming enterprises dairy farming places the highest demand on advanced technology. Expert knowledge is not only required for milking, but also to provide the milking cow with the kind of nutrition that will allow her to produce the optimum amount of quality milk.

THE NEED FOR PASTURES

As a result of South Africa's variable climate, general water scarcity, and often marginal soils, it is not unusual for dairy farmers to supplement their herds' feed with irrigated pastures. It is estimated that the total area utilised for irrigated pasture production is about 16% of the total area under irrigation in South Africa.

Irrigated annual ryegrass (*Lolium multiflorum*) is the primary sources of feed in the pasture-based dairy industry, and is mostly grown in the relatively higher rainfall areas, particularly the KwaZulu-Natal Midlands, Eastern Highveld, Eastern Cape and in the winter rainfall areas of South Africa. Annual ryegrass has high nutritional qualities, palatability, digestible energy, protein and mineral contents, playing an essential role in supplying good quality grazing between the winter and summer seasons. On the other hand, kikuyu (*Pennisetum clandestinum*) is the predominant summer grass pasture used for milk production along the east coast of South Africa.

Although management of dairy farming has now attained unprecedented levels of technology due largely to the availability of



practical equipment and methods for managing (specifically planning and monitoring) most facets of dairy farming, this does not apply to the irrigation of pastures. In spite of the increasing role of pastures in milk production, farmers still generally rely on experience and tradition even for managing the most important pasture production factors.

Irrigation water and nutrients are resources that can be optimised by selecting an appropriate irrigation type, scheduling technique and pasture type. For sustainable pasture production, the best possible fertiliser and water regimes are required in order to attain high biomass yield with minimum inputs, which maximises profit while minimising the impact on the environment. The most appropriate and cost-effective management strategy would therefore be to integrate irrigation and nutrient (especially nitrogen) inputs, since nitrogen and water cannot be managed independently.

Despite the latest fertiliser and irrigation application equipment and scientifically-based guidelines, knowledge gaps have been identified between research and farming practices. A number of experiments have been carried out throughout the country on the effect of nitrogen on yield and quality of grass pastures; however, there is a lack of reliable information and data pertaining to ryegrass water requirements to facilitate efficient irrigation management.

To fill some of these knowledge gaps the WRC funded a five-year solicited project to study the irrigation management of ryegrass and kikuyu pastures under different management conditions. The research was undertaken by the universities of KwaZulu-Natal (UKZN) and Pretoria (UP) along with the CSIR. The main objective was to study water use of these pastures, with field experiments undertaken over a period of two years at two agricultural research sites (in Pretoria and KwaZulu-Natal). This has led to the recent publication of water use and irrigation guidelines for the major pasture growing areas of South Africa.

FIELD TRIALS

At UP's Hatfield experimental farm and UKZN's Cedara research station experiments were conducted to determine the effects of different water levels in combination with different nitrogen fertiliser applications on the growth rate and dry matter production, quality, water use and water use efficiency of annual ryegrass for two seasons.

The experiments showed that irrigation and nitrogen fertiliser affected yield and leaf area significantly. Higher frequency of irrigation coupled with high fertiliser application greatly improved dry matter yield. Interestingly, there was no significant difference in yield between the treatments that were irrigated twice weekly and once weekly at the high nitrogen application. In fact, the decrease in the frequency of water application (and the resultant water stress) resulted in a generally superior end product. The highest water use efficiency was achieved by irrigating once every two weeks. The study concluded that by irrigating once a week and fertilising with high nitrogen application rate after each harvest, optimum yield can be achieved with better quality pasture and a better water use efficiency.

MODELLING COMPONENTS

During the WRC project the use of numerical models was investigated for achieving optimised growth of ryegrass through efficient use of water and nitrogen fertilisation. Several crop models were tested, and in the end the Soil Water Balance (SWB) model was used. This model is already being used extensively to simulate crop growth and soil water balance of several cereals, vegetables and tree crops. The model is available on the Web and can be downloaded free of charge.

Graeme Williams/Media Club South Africa

South Africa's semi-arid climate leaves farmers no choice but to supplement their livestock's feed.

Lani van Vuuren

Table 1: Summary of measured water use and yield of annual ryegrass at the research sites

Site	N rate	Year	Growth cycles	Forage yield (t/ha)	Water use (mm)
Hatfield	0	Year 1 and 2	4	4.8-5.4	320-342
	30			7.5-8.3	344-386
	60			9.4-10.2	378-423
Cedara	0	Year 1	8	8.2	701
	30			13.2	779
	60			15.6	816
Cedara	0	Year 2	7	5.9	493
	20			10	547
	40			13	564
	60			13.8	571
Cedara	60	Year 2	45 days	-	161

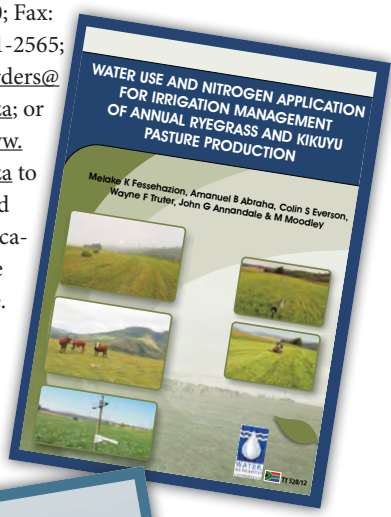
Source: WRC Report No TT 520/12

Pasture systems are highly temporally and spatially complex, as they involve interactions among crop growth, nutrient dynamics between soil, plant and animal and pasture management systems. Hence, it is difficult to evaluate the whole system with short-term monitoring experiments. Models, however, can be used to extrapolate research findings to pasture growing areas. This technology can also be useful in selecting the best management practices for specific sites and environmental conditions.

The SWB model was evaluated at two sites for different irrigation treatments in two ryegrass growing seasons. The simulated yield and leaf area index were in good agreement with the observed values. The simulated values of root zone soil water deficit and daily evapotranspiration were also in reasonable agreement with the measured values. The good agreement between observed and simulated data for different sites and irrigation regimes gives confidence that the SWB model can be used to predict long-term pasture growth and water use under different irrigation management scenarios.

In essence, the guidelines should prove a valuable addition to the dairy's farmers pasture management toolbox. ❑

- To order the reports, *Water use and nitrogen application for irrigation management of annual ryegrass and kikuyu pasture production* (**TT 520/12**) and *Irrigation guidelines for annual ryegrass pasture* (**TT 521/12**), contact WRC Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za; or Visit: www.wrc.org.za to download the publications free of charge.



Irrigated pastures are an inextricable part of livestock farming in many parts of South Africa.

Lani van Vuuren

SANCID 2012 Symposium

South African National Committee on Irrigation and Drainage

SANCID

GENERAL INFORMATION

Date 20-23 November 2012

Theme: IRRIGATION IN A CHANGING ENVIRONMENT

PROGRAMME AND KEYNOTE SPEAKERS

Local and international experts will be presenting their work on critical irrigation and drainage issues under the following sub-themes:

Sub-theme 1	Humans at the forefront of watershed management
Sub-theme 2	Climate change and irrigation: Adaptation and resilience
Sub-theme 3	Impact of irrigation on natural resources and ecology and impact of the natural environment on irrigation
Sub-theme 4	Design and management responses to economic challenges
Special Session	Coping with change: Farmers' perspectives

THE VENUE

The beautiful Alpine Heath Resort is tucked away in the majestic Northern Drakensberg, KwaZulu-Natal. A first class conference venue and luxury accommodation in a relaxing setting will provide the ideal platform to share knowledge, discuss ideas and network.

TECHNICAL TOUR

We will be visiting the Drakensberg Pumped Storage Scheme, a joint venture between Eskom and the Department of Water Affairs which transfers water from the Thukela River to the Sterkfontein Dam. Four reversible turbines situated 156 meters below ground level generate 1000 MW of electricity for the Eskom grid. Delegates will also learn about the functioning of different Eskom power stations.

ABSTRACT SUBMISSION

Submit your 600 word abstracts to SANCID@ufs.ac.za by 31 July 2012.

REGISTRATION FEES

Full registration
Early-bird registration fee R 5 500-00 (before 31 July 2012)
Late registration fee R 6 500-00 (before 1 November 2012)

For further information regarding the **Symposium programme** contact **Michael van der Laan**
(Chairman of the Organising Committee)
E-mail: michael.vanderlaan@sugar.org.za Tel: 076 793 3597

For any additional information regarding **Symposium arrangements (registration and accommodation)**
please contact **Lalique Smit** Tel: (051) 436 8145, Fax: (051) 086 275 2869
or E-mail: congress@internext.co.za

LEEUW-GAMKA DAM –

Most engineers will agree that constructing a dam is a challenging task even with the latest modern technology has to offer at your fingertips. But what if the only 'technology' at your disposal is the hoofed kind? The following letter from the Leeuw-Gamka Dam Resident Engineer to the Irrigation Department headquarters, dated 26 January, 1920, and preserved for many decades by renowned South African hydrologist, Prof Will Alexander, provides a poignant illustration of just what water engineers of old faced in their daily task to secure the nation's water supply.

Dear Sir,

The [Leeuw Gamka Irrigation Board] are unanimous that the proposal to run donkey wagons along the narrow crest of the dam, as suggested in my report, would be inpracticable and fraught with great danger of accident·

As they have all had a lifelong experience of capabilities of this class of animal, their opinion in the matter is to be respected, and I therefore consider it would be imprudent to insist upon a method or procedure which in their view is foredoomed to failure· So, if the draught animals and carts are to be used for the placing of the earth, a choice must be made between a horse, mule and ox· Consideration of the relative capabilities, cost of feeding, provision of stabling, harnesses etc· and general aptitude of each of these animals leads to the conclusion that by comparison the ox, is undoubtedly the safest animal for use in this work·

The cost of feeding at the present time is excessively high, but the board are in the possession of oxen, suitable courts, trek gear, kraals, etc·

Thus it appears that for animal drawn vehicles it would be advantageous and preferable to employ the ox for work on the embankment, but the pits from which suitable material is obtainable are situated abreast of the embankment and a considerable distance from therefrom, so far indeed, that it would be impolitic to run ox carts direct from the pits to the embankment·

This photograph, taken in 1919, shows the excavation for the stilling and weir chambers of the Leeuw-Gamka Dam. The excavation was very irregular owing to cleavage found in the shale beds.

Construction of the stone pitching of the upstream slope of the Leeuw-Gamka Dam in 1918. Assistant Engineer E Jacklin is standing at the toe with Resident Engineer JJ Swalwell on the slope.

A view of the first Leeuw-Gamka Dam during construction in 1919 taken from the right bank.

All photographs from Will Alexander Archive

a poignant time in history

It is therefore suggested that donkey wagons be employed to convey the earth from the pits to a dump at the end of the embankment and use ox carts for the actual placing of the earth in position. In this way it may be found advantageous to form a dump at each end of the embankment.

In no system of working by carts is it feasible to pass to and fro in the available space, nor to run a consolidating roller at the same time as the carts are at work.

In my opinion a satisfactory manner in which to carry out the work would be to acquire light track and cocopans; remove the top foot or so of gravel from the present finished bank and with this material form a roadway from the track along the uppermost part of the league 3-1 pitched slope. The material for a new embankment can be brought to the end of the track by donkey wagon and conveyed by the pans to the required position.

This method would allow of the soil being evenly spread and, by avoidance of any vehicles on the working area, promote the consolidating rollers being used to advantage.

Yours faithfully,

(sgd) JJ Swalwell
Resident Engineer

(No record could be found whether department headquarters actually complied with the request, however, on the photographs accompanying this article the use of oxen can clearly be seen - Editor)

ABOUT THE LEEUW-GAMKA DAM

The original Leeuw-Gamka Dam was an earthen structure situated on the Leeuw River, a tributary of the Gamka River on the farm *Stinkfontein* in the district of Prins Albert in the Karoo. The dam had a maximum height of 12,8 m above riverbed level and a gross storage capacity of 790 000 m^3. Originally, the dam water was used for the irrigation of lucerne for stock feeding.

The dam was constructed shortly after the First World War from 1917 to 1921 by the Leeuw Gamka Irrigation Board under the supervision of the Irrigation Department, with JJ Swalwell as Resident Engineer. The dam breached in 1923 after which it was repaired and raised by the department. This time DF Roberts acted as Resident Engineer.

Siltation caused the raised dam to lose much capacity in the ensuing decades, until, by the 1950s the average water depth was less than 3 m when the dam was full.

After various investigations it was decided to construct an alternative earthfill dam across the Leeuw River 3 km upstream of the old dam.

This dam, where Will Alexander was Resident Engineer, is 21 m high above lowest foundation and 1 204 m long. An area of around 600 ha is still irrigated from this dam, although it too has lost much capacity due to siltation.

View of the Leeuw-Gamka Dam showing the basin and the 'technology' used on the dam, namely oxen, resting in the foreground. Donkey wagons are at work in the background.

Dam from the left flank showing upstream slope and stone pitching in progress.

WATER Kidz

ALL GIRL TEAM takes top honours at water competition

SAICE

Manglin Pillay, CEO of SAICE with Domino Servite School's Bianca Coetzee, Dr Heidi Snyman, WRC Director: Water Centred Knowledge with Ntengo Memela in front of her, Zama Nyembe and Dr Martin van Veelen, President of SAICE. The all-girl team won the competition.

It was second time lucky for the all-girl team from Domino Servite School in Pietermaritzburg, KwaZulu-Natal, who took top honours at this year's AQUALIBRIUM, the Schools Water Competition hosted by the South African Institution of Civil Engineering (SAICE) and main sponsor the Water Research Commission (WRC).

Last year, the school achieved second place in the finals of this competition, held at the Sci-Bono Discovery Centre in Newtown. Team members Zama Nyende, Nntenga Memela and Bianca Coetzee, only conceded 160 penalty points to win first place.

In second place was the Steelcrest High School from Middelburg, Mpumalanga, with 180 penalty points. The team members were Hoteb Nkadimeng, Trinity Nkosi and Nokphiwa Mokoena. In the third spot was Hoërskool Grens from East London (Buffalo City) with 315 penalty points achieved by Niel Verwoerd, Justin Vorster and Tommie Terblanche. The teams all shared the prize-money of just over R17 000.

Winners of the regional competitions came to Johannesburg from as far as Bloemfontein, Cape Town, East London, Pietermaritzburg, Richards Bay, Port Elizabeth and Middelburg in Mpumalanga, to battle the local winners for top honours. Learners are flown to Johannesburg and accommodated in a good hotel – an experience that these young people and some of the educators will never forget. For most this is a first experience of the 'big city'.

In addition to the WRC, sponsors of the competition included Vela VKE, FIBERPIPE, Marley Pipe Systems, the Water Institute of Southern Africa, SSI Engineers & Environmental Consultants, ILISO Consulting and Rand Water. "It is only with the assistance of private sector

Lani van Vuuren

Dr Heidi Snyman, WRC Director: Water Centred Knowledge, took her task as adjudicator very seriously.

Lani van Vuuren

Prof Kobus van Zyl of the University of Cape Town explains the competition rules to the learners.

companies that SAICE can continue this valuable project through which three students have already been inspired to study civil engineering," notes main organiser SAICE Outreach Officer, Marie Ashpole.

This is the ninth year the AQUALIBRIUM competition was held. Teams are tasked to design a model water distribution network to distribute three litres of water equally between three points on a provided grid using two different diameter pipes and connection pieces. They are then judged on how well they execute the task – working on a penalty points system.

Teams have a period of about an hour in which to design, construct and operate their network. This competition exposes learners to the practical application of processes that influence their daily lives, which is how water gets to their homes. They are made aware of the intricacies involved in the design of water distribution networks and the actual water delivery to households.

As part of the competition the water cycle is explained to the learners. Issues such as why we have to pay for water, why we need dams, the distribution of water through water boards to municipalities and then to users, as well as the conservation of our water resources are discussed. In addition, this competition strengthens government initiatives aimed at encouraging learners to take Mathematics and Science at school and to follow a career as a science or civil engineering professional. ❑

Lani van Vuuren

Second-place winners Steelcrest High School's Trinity Nkosi, Hoteb Nkadimeng and Nokphiwa Mokoena building their water network.

Lani van Vuuren

Mondale High School, from Mitchell's Plain in the Western Cape, were represented by Keenan Soules, Ellen Bergman and Robyn Karlstroom.

WRC Dialogues Series launch successful

The South African government is currently deploying many efforts towards employment creation through massive infrastructure development projects. Employment creation also figures high in water programmes, such as the Working for Water and the River Health programme. However, these programmes are all rather top-down and very specialised. There is a growing realisation that there should be more community-driven projects in collaboration with local government. These challenges and possible solutions were highly debated during the launch of the WRC's *Water Currents Policy Series* on 14 August, at Leriba Lodge, Centurion. The launch which attracted over 150 delegates provided a unique opportunity to bridge the gap between scientists, water users, policy makers, senior programme managers and implementers, particularly on one of the most pertinent topics of today, namely job creation. Presenting the opening address WRC CEO, Dhesigen Naidoo said: "We intend the dialogues to be a solution-oriented discussion to address our challenges. We have a rich repository of smart people in our science and technology system, who need to be tapped into to apply their research capability beyond the laboratory." According to Kate Phillip, a leading expert on inequality and economic marginalisation in Trade & Industrial Policy Strategies (TIPS), a policy research NGO, the time has come for South Africa to use public employment to respond to water-related challenges at community level; raise awareness of the scope and opportunity to do so while also building partnerships. "The opportunity exists in South Africa to use labour to address social challenges at the local level. However, this requires a participatory process," she maintains. In summary, the dialogue revealed that much could be achieved through cross-sectoral collaboration and joint resource mobilisation for implementation and action research. It also indicated that public employment is not the silver bullet despite the advantages of employment guarantees – there is a desperate need to address the structural (social and economic) issues at play.

(All photographs by Hlengiwe Cele)

Dialogues participant, Vusi Montsho, CEO of Bantsho Management and Marketing Strategies.

The event attracted over 150 delegates who had a chance to browse through some of the WRC's community upliftment research projects.

Speaker, Dr Kate Phillip, of policy organisation TIPS.

Panellist, Arthur Ndlovu, Programme Manager for the Seriti Institute in the Community Work Programme.

Dr Kate Philip, Shilp Verma of the International Water Management Institute (IWMI) in India; and Dr Barbara van Koppen of the Southern African Regional Programme of IWMI were among the panellists.

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