THE WATER WHEEL
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FIRST SOUTH AFRICAN UF MEMBRANE PLANT OPENS

14th SANCIAHS SYMPOSIUM

"TOWARDS SUSTAINABLE WATER QUANTITY AND QUALITY MANAGEMENT: FOR HYDROLOGICAL SCIENCES"

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21 to 23 September 2009

University of KwaZulu-Natal, Pietermaritzburg

ABSTRACT DEADLINE: 18 MAY 2009

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SCHOOL OF BIORESOURCES ENGINEERING AND ENVIRONMENTAL HYDROLOGY

UNIVERSITY OF KWAZULU-NATAL

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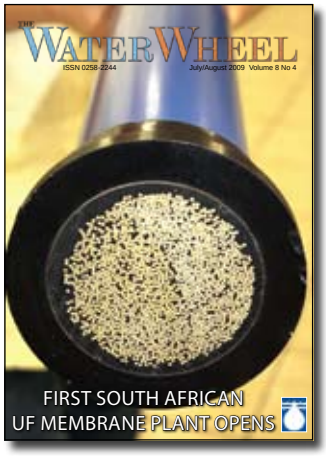
Alternatively details can be found at:
www.ru.ac.za/static/institutes/iwr/SANCIAHS/index.php



***Cover**: South Africa's first capillary ultrafiltration membrane production facility is now operational (See page 18).*

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LETTERS TO THE EDITOR

State stalling tactics killing SA's rivers

Your report in *the Water Wheel* of May/June 2009 on Environmental Water Allocation begs some form of response. The headline that "Government leaders are slow to reserve water for environment" is an understatement, as this issue goes further back than the 1998 Water Act. It was recognised within the South African DWAF more than 25 years ago that water was needed for ecological flow requirements – a preliminary, but rather arbitrary, figure of 15% of MAR was mooted. Scientists in South Africa spent many years prior to the New Water Act trying to provide a better scientific basis to this value. This was done despite a great deal of stalling from leadership within DWAF as they recognised that the concept conflicted with their main mission to impound and provide water for social and economic users.

It was therefore surprising when the concept of ecological reserve (environmental flow) actually got enshrined in the new Water Act of 1998 – because there was the feeling at the time that this was not implementable. Nevertheless DWAF have somehow soldiered on with this concept by developing and providing quantifiable figures, guidelines and procedures. They seem to have partially done this, and some values for reserve water assessments, albeit modelled, appear in inconsistent and varying forms in the Water Allocation Reform documents for water management areas in South Africa (see www.dwaf.gov.za/WAR/wateravail.asp).

From all of these analyses, it is not easy to get a clear picture of how DWAF really intends to implement the ecological reserve commitment as there are too many geographic, climatic and political ifs and buts. The situation is also further complicated by the higher priority political commitment to the Millennium Development Goals (MDG) of providing water and sanitation to the entire South African population – of which the resource, and impact, consequences are potentially enormous. The real problem is that we have a 'Jekyll and Hyde' paradox for South African decision-makers who have to resolve the conflict between providing water to the social and economic consumers as opposed to solving the requirements of the perceived wasteful sink known as the environment (which in DWAF's own words is a non-consumer). It is quite clear who is winning this conflict, and the winning approach will continue until the natural ecosystems, and the water resources they contain, are literally run down.

I heard Jackie King giving the same message more than 20 years ago – the government leaders are not only slow, but irresponsible as they preside over an insidious process which is non-sustainable for the water resources South Africa has. One only needs to look at the country-wide continuing trend in declining general water quality to get an idea of what the future holds – especially for the beneficiaries of the MDG who will be dependent on the natural environment for their water supply.

Danny Walmsley, Dartmouth

Mines still the major polluters

Thanks for an interesting article (Study Tests the Water for More Efficient Products, *Water Wheel November/December 2008*).

You covered various aspects but the major polluters of our waters, namely the mines. Research figures from the WRC places it at around 46% of all the polluters.

These people continues even under the present NEMA and Water Acts particularly on the West Rand, the Wonderfontein and Tweelopies Spruit, the areas around Pretoria, Bronneberg, Bapsfontein, the Sand Mining in the wetlands north of Roodeplaat Dam, and they do so with apparent impunity.

We do not hear or see court cases where these people are brought to book only that they ostensively create jobs (not employment) – in most cases they mechanise in any event.

In research reports originating from academics in the field, the Wonderfontein basin is a high-lying catchment area, the highly contaminated water can affect other rivers through the Vaal system right down to Alexander Bay. Add to this the contribution from the Free State rivers, and the effect on the agricultural products sold in open market, produced along the Gariep River.

Now these very people intend to interconnect the various basins from East to West under the guise that a central point can purify these waters to potable standard. It is a question of 'Nero fiddles while Rome burns'. This aspect needs a lot more attention. Also don't forget the radioactive dust, which is also found in our water. Local birdsong can no longer be heard – they cough us awake!

Eugene Viljoen Snr

If we only knew then what we know now

I enjoyed your article on the Buchuberg Dam (*the Water Wheel*, March/April 2009). I partially agree with AD Lewis' view that "The Orange River will never provide a solution to the problem of water conservation, because large storage facilities will be subjected to siltation."

In my view, the development of the Orange River's water resources should have started in the Highlands of Lesotho, at one or other of the sites such as the one where the Katse dam now stands. The basalt rock formations there are far less subject to erosion than the formations lower down. In addition, such dams would be located on the headwaters and would be capable to regulate the flow for the river's entire length. What a pity that narrow views on territorial jurisdiction and political factors would probably have prevented such sound development!

Theo van Robbroeck, PrEng

Praise for the Water Wheel

Dankie vir die lekker leesstof wat ek vandag uit die pos gekry het. Moes eintlik paar verslae doen vanaand maar kon nie die *Water Wheel* neersit nie! Ek het veral die artikels oor die Pongolapoort dam en die rivierreserwes geniet (Mei/Junie, 2009). Net genoeg kontroversie om nie onaangenaam te wees teenoor enige iemand nie!

Stephan Schoeman

Vervang uitheemse spesies met inheemse bome

Baie geluk met 'n uitstekende insiggewende tydskrif. Ons maatskappy (Enviro-Sculpt) bestaan uit 'n tuinboukundige (Naomi Esterhuyse) en 'n landskapargitek (Petra de Nobrega).

Ons spesialiseer in inheemse boomrehabilitasie op wildsplase, hospitale, skole, en residensies. Die artikel oor slyk-verwerking d.m.v. boomaanplantings is baie interessant en hierdie navorsing moet gekomplimenteer word (Are We Ready for a Sludge Revolution, *Water Wheel* May/June 2009).

Ons nuuskierigheid is egter geprikkel deur die feit dat hulle slegs uitheemse bome in die navorsing gebruik. Aangesien hierdie bome hoofsaaklik in die bosboubedryf gebruik word, is dit te verstane dat daar 'n nodigheid is om bekende bome te gebruik in die vergelykingsproses. Hierdie bome word nou egter in 'n area geplant waar die spesifieke bome van ontslae geraak moet word a.g.v. hulle indringende karaktereienskappe.

Ons wonder oor die feit dat hulle nie enige inheemse bome, wat terselfdertyd rehabiliterende en ondersteunende eienskappe het, oorweeg het nie. Daar bestaan geen twyfel oor die feit dat ontslyking d.m.v. boomaanplanting wel sal plaasvind nie. Dit sou egter interessant wees om ook vas te stel hoe dit 'n rehabilitasieproses sou versnel.

Sou dit dalk moontlik wees om ons meer agtergrond te verskaf in hierdie verband? Indien nie, sal ons dit waardeer indien julle ons in kontak kan bring met die hoof van hierdie navorsing.

Beste wense en sukses met die voortbestaan van hierdie tydskrif.

Naomi Esterhuyse

Editor's Note: In response to this letter, project leader David Still of Partners in Development says "We do plan to test some indigenous trees, and also some fruit trees (paw paw and citrus). However, it was because we need to get the forestry industry interested in what we are doing [and there are basically only three trees they grow (wattle, gum and pine)] that we had to start with the commercial exotics. Another factor is that it is relatively easy to get hold of plant stock for the forestry trees, whereas we find it quite a mission to get numbers of seedlings for the indigenous trees."

Those printer gremlins

Printer gremlins hit us twice in the article on Pongolapoort Dam in the *Water Wheel May/June 2009* (Pongolapoort Dam: Development Steeped in Controversy).

Where the gross capacity is given as 2 500 m^3 it should be 2 500 million m^3. And the combined capacity is 2 010 m^3/s and not 2 010 m^3 as indicated. Thanks to Stanley Southwood for pointing out those errors.

SA to host regional groundwater institute

The University of the Free State is to host southern Africa's first regional Groundwater Management Institute (GMI) to be operational by 2010.

At least 70% of the 250 million people in the Southern African Development Community (SADC) rely on groundwater. Groundwater water resources are increasingly threatened by overabstraction, pollution and drought and the need to enhance groundwater management in the region has been identified as critical. The GMI will work to raise the understanding of groundwater management through action-oriented research, knowledge management, awareness raising, coordination and capacity building.

Processes towards establishing the institute are being driven by the SADC project on Groundwater and Drought Management, which is supported with funding from the Global Environmental Facility Trust Fund, and SADC member states, with the World Bank as the implementing agency.

World mine-water specialists to gather in Pretoria

The world's foremost mine-water experts will gather in Pretoria in October for the 2009 International Mine Water Conference.

South Africa, together with the rest of Africa, represents a critical resource for a wide range of minerals to drive the world economy, notes Chair of the Conference Organising Committee William Pulles. "South Africa has a long history of mining and has limited natural water resources, leading to a situation where it also has a number of significant mine-water related challenges. With over 10 000 km^2 of hydraulically-interlinked coal mines and over 300 km of interlinked gold mines, mine-water challenges are not only at local mine level but at regional level too."

The International Mine Water Conference, being hosted by the Water Institute of Southern Africa's Mine Water Division and the International Mine Water Association, will enable persons around the world who have an interest in mine-water management to learn first-hand how these 21st century challenges are being tackled. The conference promises an outstanding technical programme covering various themes, including environmental best practice guidelines, mine closure, active and passive mine-water treatment, management of brines and rehabilitation of mine residues, water management issues in underground and open-pit mining and management of radioactivity in mine water.

At least 24 countries will be represented, with over 100 oral and 60 posters to be presented. A range of optional post-conference technical tours are also being planned.

For more information Visit: www.wisa.org.za/minewater2009.htm or E-mail: confplan@iafrica.com

Department redeploys water resources expert

Former Chief Director: Integrated Water Resources Planning Peter van Niekerk was been appointed Water Resources Engineering Expert in the (newly named) Department of Water and Environmental Affairs (DWEA).

In his new role he will act as specialist adviser, expert and mentor to the department and, in particular, the water resource planning component. He will be a technical resource for the department at strategic planning level and advisor and participant in international commissions on shared rivers as well as water research institutions. Van Niekerk's role will include enhancing the image of the DWEA's water resources component and assisting in activities aimed at shaping its direction.

Water woman named top Cape entrepreneur

Founder and MD of Cape Town earth sciences consultancy Umvoto Africa, Rowena Hay, has been name the Cape entrepreneur winner in the ninth annual Businesswomen's Association Regional Business Achievers Awards.

The Western Cape social entrepreneur winner was Karen Harrison of Indego Consulting, which offers support around economic and government development issues, while the emerging entrepreneur winner was Michelle Petersen of the Lofted B&B.

Finalists were judged on passion for their chosen field, whether they showed leadership, determination, patience and commitment and had a sustainable long-term business with a keen awareness of costs and pricing of products and services. "This is a great accolade for Umvoto," noted Hay, who attributed the win to her company's highly qualified and professional staff, pioneering use of technology and commitment to delivering work of the highest standard. "I am proud we have a strong national and international reputation and are helping to contribute to society through science."

Hay will now compete against eight other regional entrepreneur winners in the National Business Achiever Awards competition, which usually takes place early in the New Year.

Urgent moves to halt second wave of croc deaths

Almost exactly a year after the first crocodile carcass was discovered in the Olifants Gorge, in the Kruger National Park (KNP), new deaths have been reported.

Last year's incident, in which hundreds of crocodiles died as a result of pansteatitis, sparked outrage from environmentalists and the general public, leading to large-scale investigations into the prolonged pollution of the Olifants River system (see *Water Wheel*, January/February 2009). The exact trigger of the mass crocodile mortality remains elusive and research continues in this regard.

So far this year South African National Parks (SANParks) rangers and scientists have found 12 dead and many other sick crocodiles in the Olifants River Gorge near Olifants Rest Camp. Helicopter-borne surveys showed that there are now a total of only 385 crocodiles in the gorge and lower Letaba River. "Our research shows that these crocodile mortalities are now a recurrent problem that is likely to occur every winter. If mortalities continue at this rate, there will be very few crocodiles in the lower Olifants and Letaba rivers by 2010," said Danie Pienaar, KNP Head: Scientific Services.

To date researchers have analysed water, sediments, fish and crocodile tissue samples for potential toxins and chemical compounds at laboratories, both locally and around the world, and although many heavy metals, agricultural pesticides, fertilisers, organic waste and persistent organic pollutants were detected, none were found to be above levels where

adverse effects are expected and were therefore not individually responsible for poisoning the crocodiles.

Last year, the Consortium for the Restoration of the Olifants Catchment (CROC), which includes several government and non-government institutions, was established to determine a clear cause-effect relationship as it became increasingly clear that the crocodile mortalities were symptomatic of serious and growing environmental problems in the Olifants River system. CROC's research has found, among others, that invertebrate species numbers have halved compared to 20 years ago, that the river has changed from a free-flowing river with diverse habitats to a standing water body as a result of the back-flooding caused by the raised Massingir Dam wall in Mozambique, and that there are numerous pollutants present in the water and sediment.

In addition, the presence of toxic blue-green algae (*Microcystis* spp) and dinoflagellate (*Ceratium* spp) has been detected, while fish species such as barbell (*Clarias gariepinus*) were shown to have hyperplastic gills, and liver pathology. In addition, crocodiles in the Olifants River in general show lower levels of antioxidants than crocodiles in other water sources.

"We will continue to burn all crocodile carcasses that we find as this seems to limit the spread of disease and will also continue our monitoring of the crocodile populations which includes marking crocodiles with VHF download transmitters, colour-coded tags and both daytime aerial surveys and night spotlight counts," noted Pienaar. "Long-term water quality data, collected as part of the Department of Water & Environmental Affairs' national monitoring programmes, will be evaluated to facilitate a better understanding of the *status quo* of the Olifants River."

KNP researchers and rangers have called for more collaborative efforts to ensure that South African rivers are clear of pollution. "It is unlikely that management actions which are taken inside the park can solve this (crocodile mortality) problem," noted Pienaar. "One would need a much larger and overarching restoration programme for the entire Olifants River system, which should focus on issues such as acid mine drainage, agricultural pesticides and fertiliser use, sewerage treatment and industrial and household sources of pollution."

Study finds ways to predict toxic algal blooms

The CSIR has succeeded in formulating a method to predict toxic algal bloom events in freshwater blue-green algae.

These blooms of blue-green algae – known as cyanobacteria – pose potential health threats in water reservoirs. The ability to predict a potentially toxic bloom event is therefore an important goal of monitoring fresh water.

Blue-green algae blooms occur when the normally low populations of cyanobacteria increase dramatically as a result of nutrient enrichment, and form dense accumulations in the surface water of lakes and reservoirs.

CSIR senior researcher and limnologist Dr Paul Oberholster says that blooms of cyanobacteria disrupt the normal biological systems and functions of lakes and dams. "Also, when raw water containing blue-green algal populations are discharged or released from a dam they could have adverse effects on aquatic systems and water consumers downstream."

During a research study at Lake Krugersdrift in the Free State – funded by the National Research Foundation (NRF) and the Water Research Commission (WRC) - the research team developed a new assessment method that can be used as an 'early warning system' to warn of toxin-producing blue-green algal blooms in certain lakes and reservoirs. Oberholster reports predicting these kinds of bloom events can help water resource managers to select a water-withdrawal strategy that would minimise the health risk posed by algal toxins in irrigation water and drinking water.

"We used leeches as a bioindicator in Lake Krugersdrift – in contrast to other macro-invertebrates, leeches survive in water that contains toxic compounds released by cyanobacteria and their occurrence almost always indicates poor water quality. When leeches are also present during a dense cyanobacterial bloom, this indicates a strong likelihood that the bloom is toxic. However, despite being able to survive in poor quality water, leeches cannot indicate the levels of toxicity that may be present. We also employed genetic techniques to detect the presence of the cyanobacteria genes that synthesise the cyanotoxins. A sensitive enzyme-linked immunosorbent assay using anti-bodies helped us to identify toxin-producing strains and measure the toxin levels. The combination of these tests has never been used before," comments Oberholster.

Some of these scientific findings have been published by Springer in the January 2009 edition of the journal *Ecotoxicology*, while the NRF and WRC have also received a detailed report on the research results.

Source: CSIR

WISA's first young president elected

The Water Institute of Southern Africa (WISA) has elected its first Young Professional President.

Dr Jo Burgess, Research Manager at the Water Research Commission, took the helm at the inauguration of the Young Water Professionals Forum earlier this year. The initiative, first introduced by the International Water Association (IWA) aims to establish a national network for young water professionals who contribute to the sector through study, work or practice. A young water professional is defined as being younger than 35 years of age and working in the sector for less than five years.

"Fulfilling the present and future needs of the water and wastewater industries requires the continuous development of a workforce which is adequate in size, capable in skills and strong in leadership. Young professionals are the future of the sector and therefore the future of WISA," said Dr Burgess, herself a young water professional, in her inaugural address. "The primary aim of the first year is to put systems in place to enable the programme to be self-sustaining."

Much focus is initially being placed on creating effective communication networks to inform South African young water professionals of forthcoming activities and other news relevant to them. Among others, the first national Young Water Professionals Conference will be held in Gauteng in January 2010. The winner of the best paper at this conference will go on to present his/her paper at the IWA International Young Water Professional Conference in Sydney, Australia, 5-7 July 2010.

Other objectives of the forum include career development, sector support and programme development. "On the one hand the initiative hopes to attract and attain the skills of young professionals in the water and wastewater sectors and, on the other hand, it hopes to assist young people themselves to gain the necessary skills in order to advance their careers," Dr Burgess told *the Water Wheel*.

For more information regarding the forum contact Dr Jo Burgess at Tel: (012) 330-0340; E-mail: job@wrc.org.za; or Dr Tobias Barnard at Tel: (011) 406-2569. For more information regarding the conference, contact Cilla Taylor at Tel: (012) 667-3681 or E-mail: confplan@iafrica.com

Advances in 'sophisticated' systems brings hope to rural communities

Long considered a sophisticated and 'alternative' technology, membranes are set to play an increasingly important role in the quest to improve access to drinking water for rural communities.

Poor, far-flung populations are mostly the last on the list for improved water services as it is oftentimes nearly economically and technically impossible to set up a reliable water network in these areas. As a result, the focus is increasingly shifting to decentralised water supply for these communities.

Continuous progress in membrane design, leading to improved energy efficiency, robustness and reduced cost, has resulted in these systems being considered an ever more attractive alternative for decentralised water supply. "Membrane processes seem promising as they efficiently remove pathogens and offer a modular design that enables flexibility in terms of flow capacity reduction," reports Eric Hoa of the Berlin Centre of Competence for Water.

Speaking at the International Water Institute of Southern Africa Membrane Technology Conference, held in Stellenbosch in May, Hoa said in only a few years robust, low-cost and chemical independent systems are set to enter the global market. He is part of a European research group aiming to develop such a low-energy ultrafiltration unit for small drinking water applications.

A test unit (5 m^3/day) is already being set up in France and in South Africa. The system, which is based on a gravity-driven UF process, enables operation without crossflow, backflush, aeration of chemical cleaning.

The South African Water Research Commission (WRC) has focused on locally-produced membrane technology for rural communities for a number of years, and one of the latest developments in this regard is a gravity-fed microfiltration water treatment unit for specific use in small-scale, rural applications. Led by Prof Lingam Pillay of the Department of Chemical Engineering at the Durban Institute of Technology, the project, which is currently undergoing field testing, saw the production of a simple and robust microfiltration module and membrane pack based on locally-produced woven fibre polyester microfiltration fabric. The system is extremely simple to operate and clean, is transportable and potentially very inexpensive.

"Membrane technology is ideal for potable water production in underdeveloped, rural regions, particularly since the product quality is neither dependent on the skills of the operator nor raw water quality," noted Prof Pillay. "While current commercial membranes on the international market generally do not lend themselves to small water treatment systems that would be sustainable in rural areas, we believe the microfiltration water treatment unit we have developed could eventually have a significant impact on addressing the huge backlog in water provision to rural areas."

WATER DIARY

WATER HISTORY
AUGUST 4-8
The Biennual Conference of the International Water History Association will be held in Copenhagen, Denmark. The theme is 'Local Livelihoods and Global Challenges: Understanding Human Interaction with the Environment'.
Visit: http://wceh2009.org

CLIMATE CHANGE
AUGUST 12-14
A climate change summit, organised by the University of Ghana, will be held in Accra, Ghana. Enquiries: Tel: +233-(0)289550192; *E-mail: climpact2009@ug.edu.gh*

DESALINATION
SEPTEMBER 1-3
The 5th IWA Specialised Membrane Technology Conference for Water and Wastewater Treatment will take place in Beijing, China.
Visit: www.iwa-mtc2009.org

AQUACULTURE
SEPTEMBER 7-11
The 9th Conference of the Aquaculture Association of Southern Africa will take place in Swakopmund, Namibia. The theme for this year's conference is 'Africa in the Global Aquaculture Village'. *Enquiries: Natasha Marshall; E-mail: info@aasa-aqua.co.za*

WATER BY NUMBERS

R10-billion – The funds earmarked between now and 2012 for investment in significant bulk water infrastructure, according to the Department of Water & Environmental Affairs.

130 million m³ – The storage capacity of the newly-inaugurated Autshumato Dam (previously known a Berg River Dam). The dam adds almost 20% to the City of Cape Town's water supply.

135 – The number of environmental emergencies China's Ministry of Environmental Protection had to deal with in 2008, of which 46 posed a threat to drinking water.

85,3 km – The length of the world's longest water diversion tunnel, completed in north-east China's Liaoning province earlier this year. The tunnel has a diameter of 8 m. The previous record was held by Japan's Seikan tunnel, which is 53,86 km long.

>90% - The average percentage of global cholera cases stemming from Africa every year, according to the World Health Organisation. In 2007, Africa accounted for 93,6% of cases, compared to 99% in 2006.

86 000 – The number of blocked sewers cleared by the City of Cape Town in 2008. The municipality has announced that it is planning to start a R56-million sewer replacement programme from July. The City's sewer network consists of some 8 000 km of pipelines.

17% - The average percentage of child caretakers who wash their hands with soap after going to the toilet according to an international study. The study by the Hygiene Centre at the London School of Hygiene & Tropical Medicine, which looked at hygiene in 11 countries, found that hand-washing was still generally not taught at an early age, despite being one of the most cost-effective ways of preventing infection.

Academies of science urge governments to act on climate change

The presidents of the G8+5 Academies of Science, including the Academy of Science of South Africa (ASSAf), are agreed that climate change is an issue that can no longer be ignored by governments.
In a joint statement of climate change and the transformation of energy technologies for a low-carbon future submitted to the G8+5 meeting in July, scientists warned that urgent action is now essential.
In order to provide scientific data for evaluation and to suggest possible intervention strategies, members of the Academies of the G8+5 countries (Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, Russia, South Africa, the UK, the US, and Egypt as an observer) gathered in March at a meeting in Rome, hosted by the Accademia Nazionale dei Lincei.

According to the statement, crucial indicators of climate change have been progressively amplified recently. These include arctic sea ice melting at higher rates than predicted, the rise in sea levels, reduction in the salinity of oceans, desertification in the arid regions as well as the depletion of groundwater in the South of the Mediterranean.

The dire consequences of these climate changes threaten the economic and social development of developed countries and can seriously affect the future of developing countries. These changes, closely linked to the increased use of fossil fuels for energy production, require urgent measures from governments who must adopt new policies on worldwide energy production.

Fossil fuels, scholars note, remain the main source of energy supplying the increasing needs of developing countries. However, the fundamental goal of reducing the anthropogenic impact on climate changes needs to be considered. This result can be achieved by a continuous improvement in efficiency and emission standards in the production

and use of fossil fuels.

In the statement presented at the July summit, the academies suggest encouraging the increased adoption of renewable energy technologies, such as wind, geothermal, solar energy, biofuels, and wave power to move the global economy away from the heavy use of fossil fuels.

Greenhouse gas emissions remain a central issue to be addressed. A low-carbon economy will require integrated systems, global collaboration and concerted actions. International collaboration in scientific research on low carbon and climate resilient technologies is crucial. The document stresses the far-reaching, but as yet unrealised, opportunities for the creation of new solutions in construction, transportation, food conservation, urban and industrial communities, the safeguarding of protected areas, water saving practices in agriculture and industry; for the creation of new jobs; and for the stimulation of new and emerging markets.

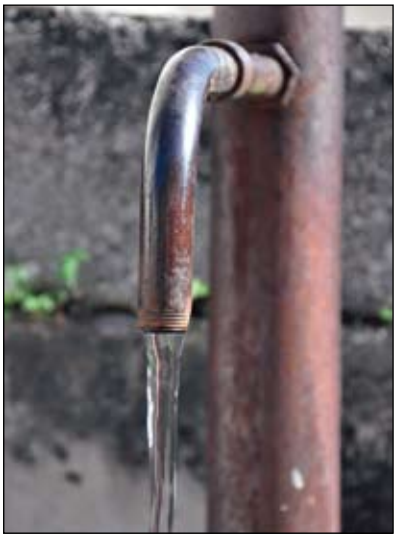
Youth to be more involved in environment

The Deputy Minister of Water & Environmental Affairs Rejoice Mabudafhasi has launched a new National Youth Service Programme in Saldanha, in the Western Cape.

The pilot project will see 150 unemployed youths between the ages of 18 and 35 working on environmentally-focused projects over the next year, including greening the environment, conserving natural resources, coastal management, waste management and upgrading of public infrastructure. It is expected that the project will later be expended to include a further 250 youths in the next two years.

In addition to serving their communities, the youths will be empowered through training accredited by the National Qualifications Framework in the several areas, including computer skills, environmental technical training, and entrepreneurship. They will also be provided with the opportunity to obtain their drivers licences.

Course offered on water quality management



The University of Pretoria is hosting a short course on water quality management and effluent treatment on 17-21 August.

The course aims at updating delegates on the most recent strategies for water quality management and providing useful insights into current and future solutions for water quality and availability problems encountered in this region. Featured in a workshop format, the course includes discussion sessions and guest lectures presented by experts from industry. Open sessions are included that offer opportunities for delegates to share their own experiences thereby utilising the class as a critical information board.

This course provides both technical persons and decision makers in the field an extensive overview supported by updated reference materials. It is also a valuable preparatory tool to persons planning to enrol in the postgraduate degree programmes in water utilisation engineering and environmental engineering/technology in the near future.

For more information contact Elmarie Otto at Tel: (012) 420-3824 or E-mail: elmarie.otto@up.ac.za

WATER DIARY (continued)

WATER
SEPTEMBER 8-10
The Biennial AfriWater water and waste exhibition will be held at the Expo Centre at Nasrec, Johannesburg. *Enquiries: Zia Tomes (exhibitions manager); Tel: (011) 835-1565; Fax: (011) 496-2045; E-mail: ziat@specialised.com*

HYDROLOGY
SEPTEMBER 21-23
The 14th SANCIAHS Symposium with the theme 'Towards Sustainable Water Quantity and Quality Management: Challenges for the Hydrological Sciences', will take place at the University of KwaZulu-Natal, Pietermaritzburg. *Enquiries: Courtney Thompson; Tel: (033) 260-5490; Fax: (033) 260-5818; E-mail: thompsc@ukzn.ac.za*

WASH
NOVEMBER 30-DECEMBER 2
East London will host the Third International WASH (water, sanitation, health & hygiene) Practitioners' Marketplace and Fair. This year's theme is 'Keep Sharing for Effective WASH Knowledge Management'. *Visit: www.streams.net or www.wrc.org.za*

Partnerships the lifeboat over troubled waters

Government, business and society will all need to become part of the solution to South Africa's water challenges.

This was one of the main messages emanating from the Water Security Africa conference held at Magaliesburg earlier this year.

"The South African economy is fundamentally water constrained. We have reached that threshold and are now moving into an unknown area where assurance of supply will increasingly become a business risk," reported Dr Anthony Turton, Director of Touchstone Resources.

As the country strives to grow the economy while restoring historic imbalances in the population, South Africa's water resources are becoming ever more constrained, with several 'hot spot' areas being highlighted in the press in recent times. According to Dr Turton, now is not the time to point fingers. "We need to avoid playing the blame game. We need new partnerships between organised business and the national science councils to develop a fresh strategic vision. We need to mobilise greater technological skill and ingenuity than it took to create the problem (for example, acid mine drainage) to find solutions."

Some companies, such as Sasol, have already realised the importance to their own water security to become involved in catchment-wide water resource management initiatives. "Water is rapidly moving up the business sustainability agenda; water is the next carbon, and we can expect greater disclosure requirements, similar to carbon disclosure projects, going into the future," reported Sasol's Martin Ginster.

The petrochemical giant has made a strategic move to move beyond the factory fence, which has required a shift in focus to the catchments impacted on by operations, and on which operations depend for water. "We see huge potential for public-private partnerships. Cooperation is essential to achieve equitable benefit sharing."

One of the greatest hurdles hampering progress in the water sector today is the huge shortage of skills experienced in the sector at present, especially in government departments. According to Dr Chris Herold, Chair of the water division of the South African Institution of Civil Engineering, the sevenfold loss of engineers and technologies within the Department of Water & Environmental Affairs since 1994 is one of the main reasons for the failure of many national water resource management programmes. "The loss of capacity and skills is one of the main reasons why the National Water Act is not being implemented successfully."

Dr Herold pointed out that the private sector still had a large reservoir of professional expertise and technical skills that could be tapped. "South Africa has many highly regarded skills in the water sector. They must be harnessed and fully used."

Mercury study shows surprising results

Preliminary results from South Africa's first comprehensive national study of mercury in the country's water resources indicate that levels are lower than feared.

The investigation, which is nearing completion, has taken CSIR researchers to over 70 sampling sites covering all 19 water management areas. According to project leader Dr Vernon Somerset the project is an attempt to understand the condition of South Africa's water and atmosphere in terms of mercury released into the environment; how it builds up (bioaccumulates) in the aquatic food chain; and what its impact is on water resources and human health.

Mercury is typically released into the environment through coal combustion, waste incineration, base-metal smelting, gold and cement production. "Since South Africa uses coal to produce energy, mercury is potentially released into the environment at our coal-fired power stations. Some of this mercury ends up in our water ecosystems through wet and dry deposition. It is therefore crucial to monitor and manage mercury," said Dr Somerset.

Dr Stanley Liphadzi, Director: Water & the Environment at the Water Research Commission, one of the main stakeholders and partial funder of the studies, said the Commission had been keenly following the results and looked forward to studying the final report, scheduled for release later this year. This report will show the range of mercury concentrations in sediment, invertebrates and water at various sites. "The results will also help us identify hotspots in the country, where focused interventions should be aimed at," he noted.

Dr Somerset warned that, while some concentrations may be perceived as being relatively low, mercury emission remains a concern due to biomagnification in aquatic food chains. "Inorganic mercury can be transformed under specific conditions into a more toxic organic form, called methylmercury that is able to bioaccumulate in the food chain, ending up in fish consumed by humans. This can result in people eating methylmercury-contaminated fish on a regular basis and after a while experiencing symptoms of mercury poisoning."

The samples collected are analysed in the newly established mercury reference laboratory at CSIR's regional office in Stellenbosch to further provide accurate data on the total mercury and methylmercury concentrations in these samples at the parts per trillion concentration level. The data obtained from the national survey will also provide input into the human health aspects of possible high mercury concentrations in freshwater systems.

"Our focus is now on completing the last field survey and analysing all the samples," reported Somerset. Ultimately, the researchers hope to establish a framework for mercury mapping as well as to provide input into the formulation of evidence-based policies, which will help with mercury monitoring and management at a national and regional scale. "This will act as a benchmark against which the success of national management initiatives can be measured," said Dr Somerset.

Source: CSIR

Scott Fendorf

Scientists solve puzzle of arsenic-poisoning crisis in Asia

Scientists at Stanford University, in the US, have discovered how arsenic enters the groundwater below the Himalayas.

Every day, more than 140 million people in southern Asia drink groundwater contaminated with arsenic, leading to thousands of cancer deaths a year. In the Himalaya Mountains sediments containing naturally occurring arsenic are carried downstream to heavily populated river basins below. However one mystery remained: instead of remaining chemically trapped in the river sediments, arsenic was somehow working its way into the groundwater metres below the surface.

The study to find the answer to this question was launched in 2004, focusing on the Mekong River in Cambodia. Scientists had long assumed that the contamination process occurred deep underground, in buried sediments that release arsenic into the aquifers. However, the Stanford team, led by soil scientist Scott Fendorf, found that within the first metre from the surface, arsenic was coming out of the solids and into the water, and then it migrated down into the aquifer.

The culprits responsible for dissolving the arsenic turned out to be bacteria that live in the soil and sediment of the river basin. The researchers discovered that arsenic flowing down the river from the Himalayas sticks to rust particles (iron oxides). Upon reaching the river delta these arsenic-laden particles are buried by several layers of soil, creating an anaerobic environment. As the bacteria metabolise the iron and arsenic, they convert it to a form that readily dissolves in water.

"As these sediments get buried very rapidly, the bacteria go through an anaerobic metabolism that dissolves the iron minerals and the arsenic with it," explained Fendorf. "The arsenic goes into the water and the problem starts."

The results, published in the journal *Nature*, noted that arsenic contamination was occurring near the surface and, in fact, would take at least 100 years to reach the aquifer below. The Stanford team also showed that the 100-year-scale cycling of arsenic into the aquifer was a natural process that had been occurring for thousands of years, preceding any human influence.

China tackles vast water quality issues

A project to improve water quality in China has been launched by the government.

This is reportedly the largest State expenditure on environmental protection since the founding of the People's Republic in 1949.

SciDev.Net reports that the project, which has an estimated budget of more than 30 billion Chinese yuan (about US$4,4-billion) over 12 years, aims to counter the deteriorating water quality affecting millions of Chinese people and their livelihoods. The Water Pollution Control and Management Project will focus on the treatment of whole river basins instead of the conventional approach of end-of-pipe treatment, according to Meng Wei, chief engineer of the project and director of the Chinese Research Academy of Environmental Sciences. By taking this approach the treatment of the highly polluted Lake Tai, for example, the third-largest freshwater lake in China, will benefit not just Shanghai but also the eastern provinces of Jiangsu and Zhejiang.

Pesticide review sees mass removal of substances from market

The detailed human health and environmental risk assessment by the European Commission (EC) of some 1 000 active substances authorised for use in pesticides before 1991 has led to the removal of more than two thirds of them from the market.

The risk assessment review evaluated each substance with respect to the health of consumers, farmers, groundwater and non-target organisms, such as birds, mammals, earthworms and bees. According to the EC, there were around 1 000 active substances contained in tens of thousands of products on the market when the review was launched in 1993. The review has led "to the removal from the market of more than two thirds of these substances," said Health Commissioner Androulla Vassiliou. The majority of substances (about 67%) were eliminated because "dossiers were either not submitted, were incomplete or were withdrawn by the industry," the EC said. Some 70 substances were withdrawn from the market because the evaluation revealed risks to human health and the environment.

Time of conception linked to birth defects in US

A study published in the April 2009 issue of the medical journal *Acta Paediatrica* is the first to report that birth defect rates in the US were highest for women conceiving in the spring and summer. The researchers also found that this period of increase correlated with increased levels of pesticides in surface water across the US.

Studying all 30,1 million births which occurred in the US between 1996 and 2002, the researchers found a strong association between the increased number of birth defects in children of women who conceived in April, May, June or July and elevated levels of nitrates, atrazine and other pesticides in surface water during the same months. While many of these chemicals, including the herbicide atrazine which is banned in Europe but permitted in the US, are suspected to be harmful to the developing embryo, this is the first study to link their increased seasonal concentration in surface water with the peak in birth defects in infants conceived in the same months.

"While our study did not prove a cause and effect link, the fact that birth defects and pesticides in surface water peak during the same four months makes us suspect that the two are related," said Dr Paul Winchester, Indiana University School of Medicine professor of clinical paediatrics, the first author of the study. "Birth defects, which affect about three out of hundred newborns in the US, are one of the leading causes of infant death. What we are most excited about is that if our suspicions are right and pesticides are contributing to birth defect risk, we can reverse or modify the factors that are causing these lifelong and often very serious medical problems," noted Dr Winchester.

Indian sanitation innovator wins global award

Indian sanitation innovator and social reformer Dr Bindeshwar Pathak has been awarded the 2009 Stockholm Water Prize.

As the founder of the Sulabh International Social Service Organisation, Dr Pathak is known around the world for his wide ranging work in the sanitation field to improve public health, advance social progress, and improve human rights in India. His accomplishments span the fields of sanitation technology, social enterprise, and healthcare education for millions people in his native country, serving as a model for non-governmental agencies and public health initiatives around the world.

Dr Pathak has worked since the 1970s to develop cost-effective toilet systems and waged an ongoing campaign to abolish the traditional practice of manual 'scavenging' of human waste from bucket latrines in India while championing the rights of former scavengers and their families to economic opportunity, decent standards of living, and social dignity.

Dr Bindeshwar Pathak with a Sulabh Shauchalaya toilet

World's major rivers disappearing

Climate change, and an increased threat to water supplies are causing some of the developing world's largest rivers to dry up, SciDev.Net reports. Researchers from the US-based National Centre for Atmospheric Research (NCAR) analysed data combined with computer models to assess flow in 925 rivers – nearly three-quarters of the world's running water supply – between 1948 and 2004. A third of these had registered a change in flow and most of them – including the Niger in West Africa, the Ganges in South Asia and the Yellow River in China – were dryer.

"Reduced runoff is increasing the pressure on freshwater resources in much of the world, especially with more demand for water as population increases. Freshwater being a vital resource, the downward trends are a great concern," reported Aiguo Dai, a scientist at NCAR and lead author of the research. According to the researchers rivers are losing their water due to a variety of reasons, including the installation of dams and the use of water for agriculture. But in many cases the decrease in flow is because of climate change, which is altering rainfall patterns and increasing evaporation because of higher temperatures.

As well as endangering water supplies, the decreased river flow could affect the world's climate. If less freshwater is discharged into the oceans they become saltier, which could affect salinity- and temperature-driven ocean circulation patterns that, in turn, play a fundamental role in climate regulation.

Sewage treatment plants breeding grounds for 'superbugs'

Research in the US has shown that antibiotic-resistant 'superbugs' being created in urban wastewater plants are finding their way into freshwater resources.

In the first known study of its kind, Chuanwu Xi of the University of Michigan School of Public Health and his team sampled water containing the bacteria *Acinetobacter* at five sites in and around the city of Ann Arbor's wastewater treatment plant. They found the so-called superbugs – bacteria resistant to multiple antibiotics – up to 90 m downstream from the discharge point into the Huron River.

Xi, an Assistant Professor of Public Health, stresses that while the finding may be disturbing, it is important to understand that much work is still needed to assess what risk, if any, the presence of superbugs in aquatic environments poses to humans. Xi and colleagues found that while the total number of bacteria left in the final discharge effluent declined dramatically after treatment, the remaining bacteria were significantly more likely to resist multiple antibiotics than bacteria in water samples upstream. Some strains resisted as many as seven of eight antibiotics tested.

Multiple antibiotic-resistant bacteria have emerged as a public health issue worldwide in the last few decades as the overuse of antibiotics and other factors have cased bacteria to become resistant to common drugs.

Global news in brief

- China has clamped down heavily on a company that polluted a major freshwater lake with arsenic, fining it US$2,34-million and sentencing three of its senior executives to jail terms. Yunnan Chengjiang Jinye Industrial and Trade Company was found guilty of polluting the waters of the 30 km^2 Yangzonghai Lake, one of the plateau lakes of the Yunnan Province.
- India and Pakistan have agreed to incorporate a new clause into the Indus Waters treaty during the annual meeting of the Permanent Commission, intended to strengthen the commission's role.
- According to a report of the African Development Bank, more than 73% of Rwandans now have access to safe drinking water, 2% up on the year before. The document also reveals that 45% of the country's population now have access to improved sanitary facilities.
- The World Bank has approved an additional grant of US$33,5-million to help restore irrigated agricultural production in Afghanistan's rural communities through improved and reliable water supply to irrigation schemes. The additional funds will support the continuation of the country's emergency irrigation rehabilitation project, which is part of a wider effort to rehabilitate and restore irrigation infrastructure.

Source: IWA

African consultants select female chair

Madame Mayen Adetiba from the Association of Consulting Engineers Nigeria was elected as Chair of GAMA for 2009. She will be assisted by Arthur Taute, the newly-elected Deputy Chair from South Africa. Seen here with Adetiba is outgoing GAMA president Exaud Mushi and John Boyd, President of the International Federation of Consulting Engineers (FIDIC) to which GAMA belongs.

African consulting engineering association collective, the Group of Africa Member Associations (GAMA) has selected its first female Chairperson at a conference in Durban earlier this year.

Namibia forges ahead with plans to mine the sea

Namibian bulk water supplier NamWater is forging ahead with longstanding plans to establish a large-scale seawater desalination plant outside Swakopmund. This is despite the fact that the project has suffered long delays as a result of political and financial hurdles.

Water demand in Namibia's Erongo Region is set to rise sharply as a result of new and expanding uranium mining operations in the area. World uranium oxide demand is estimated to reach 114 700 t/year by 2020. Seven percent of this will come from Namibia. According to reports the existing mine at Rössing is already expanding, while new mines have been or are being developed at Trekkopje, Valencia, and Langer Heinrich, while several others are in the exploration phase.

At present the Erongo area is supplied with water from two alluvial aquifers in the Kuiseb and Omaruru rivers. However, according to Dr Kuiri Tjipangandjara, General Manager: Engineering and Scientific Services at NamWater, these resources are fast approaching the end of their sustainable yield. "The company has been exploring the possibility of augmenting its conventional supplies with alternative resources since 1995. Among the possibilities investigated were such grand engineering schemes as towing icebergs, tanking water from the mouth of the Congo River or piping it from the Kunene River on the Angolan border, 800 km away."

While these projects might be technically possible none were economically feasible and the company settled on seawater desalination. The proposed 25 million m^3/year plant will be situated near Mile 6 on the northern outskirts of Swakopmund. The project will cost about N$1,8-billion (One Namibian Dollar is equal to one Rand) and have a minimum lifespan of 20 years.

Engineering technologies to be applied will consist of screening, dissolved air flotation, flocculation, ultrafiltration, cartridge filtration, reverse osmosis and post treatment. About 60% of the seawater abstracted will be returned to the sea as brine. The desalinated water will be linked via pipeline to NamWater's existing water supply network.

Dr Tjipangandjara told delegates at the recent Water Security Africa 2009 conference that the project started off well and that by 2007 the main technical components had been identified. However, there had been little progress on the financial side and it proved difficult to get buy-in for a technology that is still not considered mainstream. Cabinet finally approved the project in July last year and a National Desalination Task Force, made up of several ministries, was made up to oversee the process. Several financing options, including build-own-operate-transfer and public-private partnerships are being considered. NamWater now hopes to commission the new desalination plant before the end of 2011.

"We remain convinced that the sea provides a potentially unlimited source of raw water, and that the only way to secure Namibia's water is through desalination," concluded Dr Tjipangandjara.

Engineering skills champion gets honorary doctorate

Former president of the South African Institution of Civil Engineering (SAICE), Allyson Lawless, has had an honorary doctorate conferred on her by the University of Stellenbosch.

Lawless received the degree Doctor in Engineering (Deng), *honoris causa*, for her excellence as a civil engineer and scientist, leadership as a businesswoman and being a role-model for young people from all backgrounds.

The first female president of SAICE, Lawless has a lively interest in the technical skills of engineers, particularly those from disadvantaged backgrounds. After identifying large-scale skills gaps in local government, she devised a government intervention under the banner of SAICE by which retired professional engineers are reappointed in the service of local governments. Here they support (primarily formerly disadvantaged) students who need practical training or graduates who cannot find work.

Following extensive research, she published two books on skills development, *Numbers and Needs* and *Numbers and Needs in Local Government*. In the latter she provided a turnaround strategy for service delivery in local government, which could change the face of this crucial sector. The findings resulted in the launching of major national initiatives, including increased funding to tertiary engineering departments. Lawless gives guidance on skills development from primary education through to professional development.

She has won numerous awards, among others the Shoprite-Checkers/SABC 2 Woman of the Year Award in the category Science and Technology in 2007. She has also won a National Science & Technology Forum Award in the category outstanding research in science, engineering and technology by an individual.

Allyson Lawless with Prof Russel Botman, Rector and Vice-Chancellor (left) and Dr Frederik van Zyl Slabbert, Chancellor of the University of Stellenbosch (right).

East Rand wastewater treatment firm gets thumbs up from government

The East Rand Water Care Company (ERWAT) has become one of the first organisations in the country to qualify for the Department of Water & Environmental Affairs' (DWEA's) Green Drop status.

The department has initiated the Blue and Green Drop certification system to acknowledge excellence in drinking water and wastewater quality management. The first certification process was finalised in May. According to DWEA, water services authorities will receive Green Drop status only when they comply with comprehensive and stringent criteria determined for the collection, treatment and discharge of wastewater.

Apart from Green Drop certification, ERWAT has also received an Excellence Award: Large System from DWEA. The company operates some 19 wastewater care works, treating a combined capacity of some 600 Ml/day of wastewater from the Ekurhuleni area.

ERWAT Executive Manager for Operations Jurie Terblanché reports that the certification and excellence award are testimony to the fact that the company offers innovative and advanced technologies developed to meet the ever-growing demand for improved quality in the industry. At the same time, the company is working towards meeting the DWEA 2010 standards for water quality.

Receiving the Green Drop certification and the Award for Excellence to ERWAT are sitting: Jurie Terblanché (Executive Manager: Operations), Pat Twala (MD), Loura Roode (District Manager) and standing: District Managers Johan Hendricksz, Fortune Mabunda and Werner Rössle.

Firms amalgamate to form global consulting giant

Two of South Africa's leading consulting engineering firms, Africon and Ninham Shand have come together with one of Asia Pacific's firms, Connell Wagner, to form a new multi-disciplinary global group.

The newly-created group, Aurecon, will provide professional technical services on large-scale integrated infrastructure projects to clients across Europe, the Middle East and Africa (AME) and the Asia Pacific. The global group will be headquartered in Singapore and employ over 6 700 people across 87 offices in 28 countries.

Paul Hardy, previously CEO and Chair of Connell Wagner, has been appointed Aurecon's Global CEO and the former non-executive Chair of African, Prof Jakes Gerwel, will be Aurecon's non-executive Global Chair. Dr Gustav Rohde, previously CEO of Africon and Arnie Möhr, past MD of Ninham Shand, will assume the roles of CEO AME and the Deputy Chair of the Leadership Team, AME Zone, respectively.

New from the WRC

Report No: 1492/1/08

Model Output Statistics Applied to Multi-model Ensemble Long-range Forecasts over South Africa (WA Landman; F Engelbrecht; A Beraki; C Engelbrecht; M Mbedzi; T Gill and L Ntsangwane)

Improved seasonal forecasts would greatly assist managers in the fields of water resources and agriculture in adapting to climate variability and, more particularly, in preparing adequately for seasons characterised by climate extremes. The main emphasis of this project was, therefore, to develop a multi-model forecasting system for South Africa that would be able to produce objective operational seasonal rainfall, streamflow and global sea-surface temperature forecasts skilfully.

Report No: TT 371/08

The Impact of Large Consumer Unit Size on Water and Sanitation Services in Lower Income Urban Areas in South Africa (Kim Walsh)

Palmer Development Group was appointed by the WRC to conduct research into the impact of large consumer unit sizes on access to and affordability of water and sanitation services in lower income formal urban areas. The purpose of this research is to assess whether being a member of a large consumer unit, defined as more than eight people sharing a stand, results in inhibited access to water and sanitation services, and whether large consumer units find water and sanitation services to be unaffordable. The research concluded that large consumer units cannot be viewed simply as a homogenous group. Different types of consumer units, and different households making up those consumer units, face different challenges with respect to water and sanitation. Nuanced policy approaches will be necessary to help to alleviate these differing challenges.

Report No: TT 369/08

Training Manual for Small-scale Rainbow Trout Farmers in Net Cages on Irrigation Dams: Water Quality, Production and Fish Health (K Salie; D Resoort; D du Plessis and M Maleri)

This training manual for fish farmers provides guidelines for dealing with water quality and improving the success of trout farming in net cages on irrigation dams. Its aim is to provide a quick reference to procedure and practices for the farmer. It will furthermore contribute to the production of quality fish and to the maintenance of environmental integrity. The manual has been written to address aspects of farming that requires hands-on management, namely, site selection, operational procedures (i.e. water and feed management), monitoring and evaluation. It also gives the contact details of people who can advise the farmer on urgent questions regarding procedures or abnormalities in production.

Report No: TT 364/08

Towards a Socio-ecological Systems View of the Sand River Catchment, South Africa: An Exploratory Resilience Analysis (Sharon Pollard; Harry Biggs & Derick du Toit)

Several initiatives in southern Africa (such as integrated water resource management) are attempting to adopt a more holistic approach to natural resource management than historically used. In this study, the authors test resilience thinking and its associated concepts to explore if the potentially scarce water-based ecosystem services of the Sand River catchment can be mobilised and sustained in a sustainable and equitable manner.

Report No: TT 375/08

Guideline to the Inspection of Wastewater Treatment Works (LA Boyd and AM Mbelu)

This guideline documents deals with the requirements for undertaking an inspection at a wastewater treatment works. The purpose of the guideline document is to assist the process controller to prepare for an inspection at the works and take corrective action where a problem is identified. It also allows the inspector to undertake an inspection and give guidance where a problem is identified. Checklists are provided for those unit processes that are most frequently encountered at South African wastewater treatment works.

Report No: TT 372/08

Development of a Knowledge Management System for Operation of the Algal Integrated Ponding System – a Training and Operations Tool for Small Wastewater Treatment Plants (KJ Whittington-Jones; PD Rose; W Leukes; G Lok; S Naidoo and D Lok)

The WRC had embarked upon the Integrated Algal Ponding System (IAPS) project in Grahamstown as a means of promoting low-cost sanitation for low-income consumers. The IAPS plant was designed as a demonstration plant and a research facility with the objective of promoting acceptance and advancing knowledge in the operation of low-cost photosynthetic water treatment systems. The primary objective of this initiative was to capture the expertise, skills and knowledge developed by the people who have performed demanding tasks at the IAPS.

Report No: 1541/1/08

Production of Enzymes for Industrial Wastewater Treatment: Proof of Concept and Application to the Textile Dye Industry (C Mutambanengwe; O Oyekola; C Togo and CG Whiteley)

A previous WRC project into the enzymology of solubilisation of municipal sewage sludge identified the involvement of a plethora of hydrolase enzymes. Furthermore, it was found that these enzymes could be used, in situ, to bioremediate effluents from acid mine drainage, tanneries and abattoirs. This research project exploited this idea further through an investigation to show that hydrogenase enzymes could be used to bioremediate industrial waste effluent from the textile dye industry.

Report No 1671/1/08

A First Order National Audit of Sewerage Reticulation Issues (BW de Swardt and B Barta)

This solicited WRC project aimed to identify key issues and develop appropriate research responses in the field on reticulated sewer infrastructure in South Africa. The main objectives were to identify and characterise the sewerage reticulation issues

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on the background of international and regional research work available from accessible databases; prioritise the sewage reticulation issues requiring attention within the context of integrated urban water resource management in South Africa; and to develop strategic guidelines for dealing with the issues above. The findings of this project will form the framework for solicited projects and lead to a roll-out of focused research projects dealing with specific needs in the industry.

Report No: 1729/1/08

Reactor Design for Metal Precipitation in Mine Water Treatment (A Lewis; J Nathoo and T Mokone)

While research to date in South Africa has led to a detailed understanding of the biological sulphate reduction process and the implementation of a potential process, key aspects require further understanding and optimisation for the successful implementation of this technology. The biological treatment process is partly motivated through its ability to generate easily separated metal sulphide precipitates. However, metal sulphide precipitation is well known to be an extremely difficult process to manage and control. The main aim of the research was to understand the fundamental mechanisms in the metal salt precipitation component of the sulphate reduction bacteria process; and define the operating conditions to achieve effective metal precipitation in a fluidised bed reactor as an individual unit operation in the sulphate reducing bacteria process.

Report No: 1625/1/08

Development of a Complete Process Integration Framework for Wastewater Minimisation in Multipurpose Batch Plants (T Majozi and JF Gouws)

Wastewater minimisation in the processing industry is becoming ever more important as sources of fresh water become limited and environmental legislation becomes more stringent. This has prompted researchers to look into cost-effective means of reducing effluent discharged into the environment. To date, however, much has been on continuous processes and the reduction of wastewater within these processes, rather than on batch processes. Thus the main objective of this project was to develop a mathematical optimisation technique for wastewater minimisation that could be applied to industrial scale problems. A final model was derived for application at an industrial site, which produces mainly liquid products and women's sanitary products. At this plant, which uses the batch process, the amount of water used per washout was between 22% and 55%.

Report No: 1371/1/07

Dual-Stage Ceramic Membrane Bioreactors for the Treatment of High-strength Industrial Wastewaters (W Edwards; WD Leukes; CC Bezuidenhout; KJ Riedel; VM Linkov; PJ Jansen van Rensburg; HWJP Neomagus and J Burgess)

This project focused on the development of a unique operations strategy employing membrane bioreactors for the treatment of wastewaters of industrial origin. The process facilitated a continuous development and acclimation design strategy for generating groups or consortia of microorganisms capable of degrading specific industrial wastewaters. These adapted consortia were then harvested to be used in the continuous operation of 'hydrolysis' reactors. The hydrolysis reactors were operated under similar conditions as conventional wastewater treatment tank facilities. However, the continuous addition of adapted microbial populations developed within the seeding reactor configuration facilitated, firstly, significantly decreased adaptation periods associated with conventional treatment strategies, and, secondly, an inherent robustness facilitated by obviating the requirement for adaptation within the hydrolysis reactor configuration.

Report No: 1563/1/08

Water Resources Management in Rainwater Harvesting: an Integrated Systems Approach (J Mwenge Kahinda; BBP Sejamoholo; AE Taigbenu; JR Boroto; ESB Lillie; M Taute and T Cousins)

This three-year project revisited the practice of rainwater harvesting in South Africa. The overall objective of the project was to support efforts of integrating rainwater harvesting into the water demand and supply equation by providing an understanding of its associated potential impacts as well as a policy framework for its broad-scale adoption from a water resource perspective.

Report No: 1701/1/09

Assessment of the Feasibility of Using a Dual Water Reticulation System in South Africa (AA Ilemobade; JR Adequmi; and JE van Zyl)

The main aim of this study was to assess the feasibility of implementing dual water reticulation systems in South Africa based on local and international experience. The project found that dual water reticulation systems are feasible water supply options, especially for communication located in arid areas, provided there is an enabling environment (i.e. regulations, guidelines, institutional capacity etc). If all treated effluent produced within an area is recycled, total water supply to the area will increase by nearly 100%.

Report No: KV 222/09

A Scoping Exercise to Investigate the Potential Need for, and Nature of, Water Trading in South Africa (A Pott; K Versfeld; M van Rooyen, A Muir)

This project concluded that there is a high need for water trading in South Africa. Inter and intra-sectoral trades promise to be the most important types of trade in the future. Very few inter-sectoral trades are happening at present, but will probably take place after the completion of the compulsory licensing process (i.e. the initial allocation of water use entitlements.

Report No: TT 373/08

Assessment of the Occurrence and Key Causes of Drinking Water Quality Failures within Non-Metropolitan Water Supply Systems in South Africa, and Guidelines for the Practical Management Thereof (Grant Mackintosh & Unathi Jack)

This project investigated drinking water quality management in the Western Cape, Free State and the Eastern Cape (as being broadly representative of the conditions in South Africa) and identified the minimum requirements for effective and sustainable drinking water service delivery within non-metropolitan water distribution networks in order to ensure an acceptable drinking water quality is supplied to all consumers in South Africa. From the experiences gained, guidelines were then developed.

Report No: 1664/1/09

Development of a Model for Determining Affordable and Sustainable Sanitation Demand in Dense Settlements of South Africa (R Martin and P Pansegrouw)

The main objective of this study was to determine the effective sanitation demand of residents in dense settlements by making use of an adjusted computer housing program, developed by Sigodi Marah Martin. This computer model determines the effective demand for services according to the integrated affordability of all the services to the residents of dense settlements by making use of a cognitive process called contingent valuation. It is, as far as could be ascertained, a world first in terms of the integration of the affordability of all the services to determine the sustainable demand for these services.

SA Joins the Ultrafiltration Production Market

The completed module. There are about 5 000 capillary membranes in a single module.

All photographs by Lani van Vuuren

South Africa's first capillary ultrafiltration manufacturing plant has opened its doors in Somerset West, in the Western Cape. Lani van Vuuren paid a visit.

Capillary ultrafiltration is arguably the fastest growing filtration technology in the world. The water produced by these types of membranes is said to be of a very high quality, mostly exceeding the quality of water produced by conventional treatment methods. This is achieved without excessive use of chemicals or operator intervention.

Ultrafiltration membranes essentially clean water through a 'sieving' process. These membranes have extremely small pores (in the nanometre size range), which prevent particles, colloids, micro-organisms and dissolved solids that are larger in dimension than the pores in the membrane surface from passing. The membranes therefore act as a physical, size-exclusion barrier.

SOUTH AFRICAN PRODUCT

In South Africa, investigations into the possibility of establishing locally-produced membrane and filtration systems for potable and industrial water management started in the 1990s at the Institute of Polymer Science at the University of Stellenbosch. Over 15 years, with financial support from the Water Research Commission (WRC), the institute managed to, among others, produce a suitable cost-effective capillary ultrafiltration membrane to replace expensive imported equivalents.

The membranes, manufactured from polyether sulphone (PES), have an outside diameter of 1,6 mm and a lumen (bore) diameter of 1,2 mm. The membranes are internally skinned, which means that the feedwater enters into the lumen from where it filters outwards under a pressure driving force.

The membranes are housed in a module (typically a tube-in-shell arrangement).

"Converting and modernising this laboratory-scale plant into a fully-fledged manufacturing plant proved considerably challenging."

An unusual feature is that these modules do not have to be discarded if a membrane breaks. Individual compromised capillary membranes can be identified and isolated by plugging the inlet and outlet ports of the damaged membrane. This extends the lifetime of a module considerably.

Rigorous testing over four years showed that the membranes consistently produce high-quality water. Virtually any type of water can be treated, and pre- or post-treatment can be added depending on the quality of the raw water.

The product was later patented by the University of Stellenbosch and the WRC, and, in 2008, black economic empowerment firm Ikusasa Water acquired the necessary licences to commercialise the process.

FROM THE LAB TO THE FACTORY

Ikusasa purchased parts of the experimental plant employed in research at the Univeresity of Stellenbosch for its full-scale production facility in Somerset West. "Converting and modernising this laboratory-scale plant into a fully-fledged manufacturing plant proved considerably challenging," notes Ikusasa Chair Andrew Theunissen. The company managed to successfully set up shop, and started producing capillary ultrafiltration units in March this year under the watchful eye of Plant Manager Anja Eysvogel.

Stephanus Victor, responsible for further development of the membranes at Ikusasa, explains that the membrane is produced through a process of diffusion-induced phase separation (also known as wet-wet spinning). "The PES is dissolved in an organic solvent and additives are added to control filtration properties, such as pore size distribution and porosity. This polymer-rich solution is then extruded through an extrusion die called a spinneret to form the thin, straw-like capillary."

Thereafter, a non-solvent is injected on the lumen. The capillary is then cut into the required lengths and dried, whereafter the correct number of dried capillaries are inserted into a pressure vessel made from polyvinylchloride piping. Each end of the pressure vessel is then sealed with an epoxy resin.

Ikusasa Water Plant Manager Anja Eysvogel inside the capillary ultrafiltration production facility.

The capillary membranes are produced through a process of diffusion-induced phase separation.

"The membranes are wetted under controlled conditions and tested to ensure performance and quality," Victor tells ***the Water Wheel***. "The membrane modules are finally preserved with a biocide and sealed, ready for shipment and installation into a treatment plant."

SAFE DRINKING WATER FOR RURAL AREAS

At present, the plant is operational eight hours a day, with two modules being manufactured every three days. This is expected to increase as demand for the product grows. Ikusasa has already received several enquiries, especially from municipalities seeking drinking water treatment solutions for rural applications. At the time of writing, two pilot plants incorporating the technology were operating at Overberg Water.

"Capillary ultrafiltration suits a number of applications, it can be used for the primary treatment for drinking water, pretreatment prior to desalination of sea or brackish waters or as post-treatment of conventional systems, for example," says Dr Gerhard Offringa, Marketing Manager at Ikusasa. "These membranes can also be effectively employed in industrial processes, such as oil water separation, dye removal, caustic recovery, and whey fractionation."

The company has developed a small, mobile water treatment plant incorporating capillary ultrafiltration, especially suitable for rural or emergency applications. A robust system, it sports a telemetry control system enabling remote operator control. Unlike conventional membrane technology this system does not use much energy (it requires pressure of less than 1 bar), and can be gravity driven.

The unit can be cleaned-in-place and requires chemical cleaning only two to three times a year. Damaged modules are simple to replace. Depending on the quality of the raw water, the units can produce 200 ℓ/h to 400 ℓ/h per module installed. Such a system proved successful in supplying additional drinking water to the community of Struisbaai, in the Western Cape, during the peak holiday season. The systems can, however, be scaled up to any size required.

INVESTING IN THE FUTURE

The work on locally-developed and manufactured membranes is continuing and Ikusasa has signed a Memorandum of Understanding with the University of Stellenbosch, which will, among others, allow students to make use of the capillary ultrafiltration production plant for their studies. It is hoped that this will enable further research into especially lower cost and lower maintenance systems, and more efficient membranes.

"The idea that membranes are a costly alternative technology is fading. We believe that, with continued investment in research and development, these systems could provide effective and efficient water treatment, especially for South Africa's far flung communities," concludes Dr Offringa.

The thin, straw-like capillaries prior to being cut to size.

The cut capillaries being hung out to dry.

New Certification System Improving SA's Water drop for drop

www.sxc.hu

The Department of Water & Environmental Affairs' (DWEA's) new Blue Drop Certification system hopes to encourage municipalities to improve their drinking water quality management while empowering the public with the right information about what is coming out of their taps.
Compiled by Lani van Vuuren.

The inaugural ***National Blue Drop Report 2009*** was launched by newly-appointed DWEA Minister Buyelwa Sonjica earlier this year. A total of 22 water supply systems across South Africa were awarded the prestigious Blue Drop following the assessment period, which ran from March 2008 to January 2009.

The certification process judged municipalities' water supply systems on criteria such as the skills levels of process controllers, operation and maintenance, operational and compliance monitoring, number of key analyses per population serviced and proof that these analyses results are used to improve process controlling, among others. The process proved that while there are areas which require urgent intervention, tap water remains safe to drink in most cities and towns in South Africa. A nationwide average of 93% was achieved with regards to compliance with the microbiological limits of the national standards for drinking water quality (SANS 241).

"Given the skills challenges that face the sector, I am encouraged by the content of this report which indicates what is possible in spite of the challenges we face," noted Sonjica. "It is evident that a

CURRENT WATER SUPPLY SYSTEMS WITH BLUE DROP STATUS:

Bitterfontein
Caledon
Cape Town
Ekurhuleni
Franschhoek
George
Greater Durban
Greater Johannesburg
Loxton
Maselspoort
Matsulu
Nelspruit
Paarl Mountain
Paradyskloof
Peddie at Kings Lynn
Plettenberg Bay
Pretoria
Primkop
Potchefstroom area
Sandile
Sundumbili
Worcester

Source: National Blue Drop Report 2009

mountain of challenges can be shifted if the required passion is available." It is particularly noteworthy that a wide variety of water supply systems were awarded certification, including two small rural systems, Peddie (Amathole District Municipality) and Loxton (Ubuntu Local Municipality). This is proof that it is not impossible for smaller systems to achieve Blue Drop status.

"The Blue Drop report should not be regarded as just another document produced by government, but should be deemed as evidence that the department, with its partners, are serious about regulation, and serious about our responsibility to improve the manner in which the drinking water of the South African people is being managed," said Sonjica. The Minister expressed her satisfaction with municipalities' general positive attitude towards the certification programme.

It is important to note that failure to achieve Blue Drop status does not necessarily mean that the municipality does not comply with drinking water standards. However, generally, those municipalities with higher Blue Drop scores achieved better sustained water quality. In general, areas supplied by water boards faired better than those municipalities who are responsible for their own water supply.

"Low-scoring municipalities will be placed under close surveillance with the objective of ensuring improvement."

A total of 54 water services authorities failed (or were unable) to present the DWEA with the required information for Blue Drop certification assessment. These authorities have automatically achieved a zero blue drop score and their water supply systems will be subject to a strict regulatory audit in coming months.

Provincially, Gauteng faired the best out of all the provinces, with the vast majority of citizens being served from Blue Drop certified water supply systems (the provincial average Blue Drop score is 74,4%.) According to the report the performance of the water boards, which includes Rand Water (Africa's largest water utility), in the province have contributed to this achievement. However, the advantageous position of the three metropolitan municipalities (Tshwane, Johannesburg and Ekurhuleni) to have highly-skilled municipal officials employed to manage drinking water quality is an important contributing factor. Provincial average drinking water quality compliance is 96,2%.

KwaZulu-Natal and the Western Cape are in the second and third places respectively, with the former achieving an average Blue Drop score of 73% and the latter 60,3%. In KwaZulu-Natal DWEA's drinking water quality regulation unit noted that while the majority of the province's water institutions performed well during assessments, concern remained over some of the rural areas where formal services have not been introduced, since the unserved communities remain at risk to waterborne diseases such as diarrhoea and cholera. In general, the unit identified inadequate process control as a reason for municipal water supply systems not achieving Blue Drop status.

In the Western Cape municipalities complied rather well, with the City of Cape Town and George municipality achieving a score of 100%. The few low-scoring municipalities will be placed under close surveillance with the objective of ensuring improvement.

Eastern Cape municipalities achieved an average score of 50%, while average drinking water quality compliance was 91,6%. The Blue Drop performance of water services institutions in this province varied from surprisingly well to expectedly poor. Interestingly, neither Nelson Mandela Metropolitan Municipality nor Buffalo City obtained Blue Drop status (water quality supplied by both these systems is well within the limits of the national standard, however). The drinking water quality regulation unit expressed concern over the actual quality of water in Jansenville and Klipplaat (both under jurisdiction of Ikwezi Local Municipality), since recurring bacteriological failures have been noted.

Mpumalanga has been hardest hit by various diarrhoea outbreaks over the past few years (notably Delmas, Carolina and Bushbuckridge). The Blue Drop scores for the various systems varied from exceptional to poor, however, the actual compliance is reason for concern since insufficient data prevents the department from calculating credible compliance. The same unease was expressed for Free State municipalities, where 12 water services authorities failed to adhere to the call to be assessed.

In Limpopo, where huge challenges have been faced during recent cholera outbreaks, the highest Blue Drop score was 64%. "This is a clear indication of the amount of effort and investment required before high confidence levels could be instilled in the drinking water quality management by the responsible authorities in this province," said the DWEA.

The North West and Northern Cape achieved the lowest Blue Drop scores (40% and 28,3% respectively). While there were several elements of promise in the North West only the water supply system of Potchefstroom was awarded Blue Drop status. With regards to the Northern Cape, the department believes there is reason to be concerned about the capability levels of most water services authorities in this province to manage drinking water quality efficiently. However, in general, the microbiological compliance of drinking water was still satisfactory in this province.

"The incentive-based regulatory approach is a first for South Africa. We are still in our infancy with this approach and the concept must be further developed towards perfection" reported Sonjica. "Revealing the performance of individual municipalities has ensured that the public at large has confidence in tap water quality. It has also resulted in authorities and providers upping their game towards higher levels of efficiency since the assessments started."

LAINGSBURG – THE SMALL MUNICIPALITY THAT COULD

The Municipality of Laingsburg, in the Karoo, is put forward as a good example of the energy the Blue Drop certification programme has brought into the South African water supply landscape.

This municipality is responsible for services in the rural towns of Laingsburg and Matjiesfontein, in the Western Cape. In November last year, Laingsburg was assessed and scored 0% compliance with regulatory criteria. This was an indication that water quality management was not anywhere near the top of the municipality's agenda.

However, the water services institution used the five months to the final assessment round to good effect to get maximum requirements in place. Municipal officials came prepared to the final assessment, to the extent where Matjiesfontein scored 70,7% and Laingsburg 44,5%. While this is still well short from obtaining a Blue Drop, the massive improvement is what the DWEA is intending to ignite all over South Africa with the regulatory initiative.

Source: National Blue Drop Report 2009

PROVINCIAL AVERAGE BLUE DROP SCORES

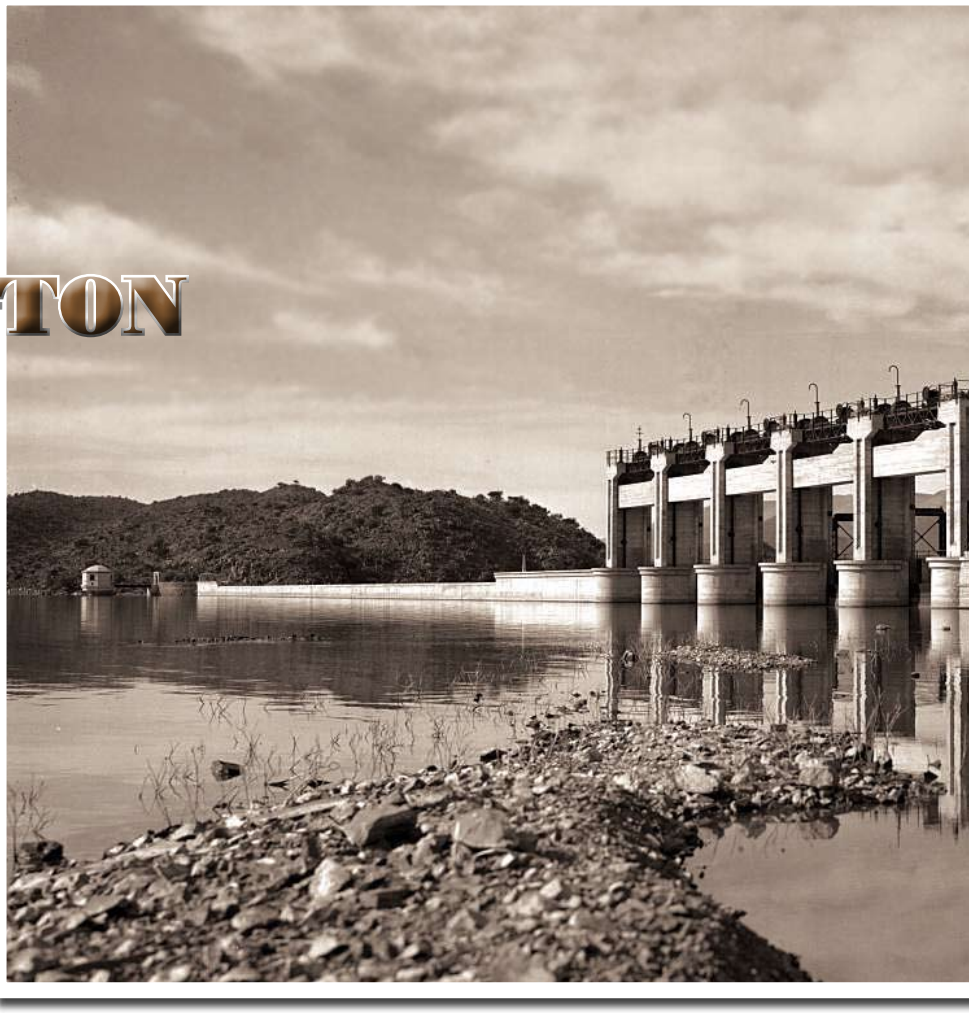
Province	Provincial Average Blue Drop Score (of WSAs assessed)	Provincial Average drinking water quality compliance	Nr of WSAs that failed (or was unable) to present required information for assessment (0% Blue Drop score)
Gauteng	74,4%	96,2%	3
KwaZulu-Natal	73%	82%	1
Western Cape	60,3%	91%	3
Eastern Cape	54,3%	91,6%	6
Mpumalanga	51%	84,58%	11
Limpopo	40,8%	<86%	5
Free State	40,3%	95,5%	12
North West	40%	71,5%	5
Northern Cape	28,3%	<93%	8

Source: National Blue Drop Report 2009

A parallel effort is underway for wastewater services and, at the time of writing, the Green Drop report was being finalised. Green Drop status has proven much more difficult to achieve. "For too long wastewater treatment has been out of the public eye, allowing authorities to under-invest in the adequate maintenance of this essential service. However, a count of 30 wastewater plants qualifying for Green Drop status to date is encouraging, proving that excellence is possible," noted the Minister.

To access the National Blue Drop Report 2009 Visit:
www.dwaf.gov.za/dir_ws/DWQR/

DARLINGTON DAM – SA's Troubled Lake



Neither drought, depression, disease nor the dearth of the barren Noorsveld could prevent the construction of Darlington Dam, near Kirkwood, in the Eastern Cape. Lani van Vuuren explores the chequered history of this dam, at one time the second-largest in South Africa.

The initiative to establish large-scale irrigation in the Sundays River Valley can be traced back to the arrival of prominent Port Elizabeth auctioneer James Somers Kirkwood. Described as, 'a tall man of pleasing personality, flowing beard and smiling eyes', Kirkwood came to the valley in 1877 to oversee the auction of the farm 'Gouwernements Belooning'.

PIONEER'S DREAM

The story goes that on that particular day Kirkwood could not reach the farm as the Sundays River was in flood. So he climbed a hill (known today as the 'Look-out') from where he had a view of the entire valley. The view he saw inspired him, and shortly thereafter he bought Gouwernements Belooning himself and settled in the area.

In 1877 legislation was passed on irrigation which aimed to encourage, by means of financial assistance, settlement on farms and the development of private irrigation schemes. Kirkwood tried to convince his neighbours to combine to form an irrigation scheme, which would be entitled to assistance from the government. The majority of farmers, however, viewed the legislation with suspicion, and in the end Kirkwood bought up sufficient land on his own so as to float a company and so establish an irrigation scheme himself.

In 1883 he owned 21 farms in all, totalling more than 35 000 morgen (29 984,5 ha) of land. He introduced irrigation on a small scale on his farms through the years. In December 1883 Kirkwood founded the Sundays River Land and Irrigation Company. Despite all the

DWEA/eWISA

A historic photograph of Darlington Dam, taken in 1936.

publicity given to the enterprise when the lists closed in January 1884, not a single share was taken up.

Kirkwood could not have picked a worse time to start his venture. At that time South Africa was in the grips of a depression, and those who had money preferred to invest in ostrich farming or the newly established diamond mines at Kimberley where returns were not only quick but certain and adequate. Kirkwood died a broke and bitter man in 1889.

STRATHSOMERS ESTATE

In 1887 Kirkwood's insolvent estate was taken over by the Guardian Assurance and Trust Company of Port Elizabeth, and in 1903 it was sold to the Strathsomers Estate Company. The company employed engineer David Gerrard to bring more land, on both sides of the Sundays River, under irrigation, and in 1909 Gerrard, along with Ninham Shand (who became the company engineer in charge of this work) inspected the site of the Korhaan's Drift scheme.

The scheme entailed the construction of a diversion weir across the Sundays River at Korhaans Drift where the river leaves the Zuurberg Mountains and enters the Sundays River Valley. The scheme was delayed for some years by litigation as other irrigators contested the company's water rights. In the end, the court ruled in favour of Strathsomers Estate and construction of the Korhaans Drift weir got underway in 1911.

At its completion in November 1913, Korhaans Drift was the largest irrigation scheme in South Africa, designed to irrigate 4 875 morgen (4 176,4 ha) of land. The weir was 286 feet (87,2 m) wide, with two abutments 30 feet (9,1 m) high from the crest of the weir. Water for irrigation was released through seven sluice gates built at right angles to the river, and emptied into the main canal, 32 inches (812,8 mm) wide.

Kirkwood's vision eventually attracted others to the idea of using the water of the Sundays River to irrigate large tracts of land. By 1913, there were three irrigation companies in the area: the Strathsomers Estate, Addo Land and Irrigation Company, and Cleveland Estate, who all had weirs on the Sundays River.

THE ARRIVAL OF SIR PERCY FITZPATRICK

Famed author and businessman Sir Percy Fitzpatrick visited the Sundays River Valley to view the irrigation schemes in 1913. Soon thereafter he purchased a block of farms surrounding Addo. Fitzpatrick was always keenly interested in land settlement. In February 1914 negotiations were opened with the Cleveland Estate, which was experiencing financial difficulties. This resulted in the birth of the Cape Sundays River Settlements Company, of which Fitzpatrick was chairman.

Fitzpatrick committed himself to citrus as a core crop. Port Elizabeth provided a major market and port nearby, and exports to Europe had already begun, taking advantage of South Africa's reverse season. Citrus production, however, required a sustainable water supply.

The droughts of 1913-1915, coupled with the collapse of the ostrich feather

DARLINGTON DAM: FAST FACTS

Completion date: 1922
River: Sundays
Nearest town: Kirkwood (Eastern Cape)
Type: Gravity
Height above lowest foundation: 48 m
Length of crest: 418 m
Volume content of dam: 0,209 million m^3
Gross capacity of reservoir (in 1975): 252 million m^3
Purpose: Irrigation
Maximum discharge capacity of spillway: 632 m^3/s (controlled)
Source: DWEA

Addo Elephant National Park

The dam wall has two spillways with control gates – the main spillway and an auxiliary spillway. Near the left abutment is the river outlet system with a number of release valves.

industry (which forced farmers to look at other income possibilities) made it perfectly clear that any permanent extension of irrigation, coupled with settlement operations on a large scale, would be impossible unless large storage works were undertaken and the entire system of irrigation altered from flood irrigation to irrigation based on the storage of flood water.

At its completion in November 1913, Korhaans Drift was the largest irrigation scheme in South Africa, designed to irrigate 4 875 morgen (4 176,4 ha) of land.

A flood in 1916 reinforced the argument that 'large volumes of water were being lost', which could only be rectified with a large storage scheme. The irrigation companies decided to work together and approached the Union government with a view of establishing a large storage dam at the head of the valley which would ensure adequate and perennial supplies of irrigation. Minister of Lands, Col Hendrik Mentz, and Director of Irrigation, Francis E Kanthack, supported this idea. Not long after, the project was approved by Parliament.

In 1917, the Sundays River Irrigation Board was established with the sole purpose of constructing what was soon named Lake Mentz after the Minister of Lands. A loan was provided by the State to construct the dam and the repayment of the loan was the responsibility of the irrigators by the imposition of a canal levy by the irrigation board.

The Sundays River Project, as it was then known, was considered unique by virtue of the fact that almost the entire area of irrigable land was controlled by companies and not by private individuals, and that the existing irrigation works, weirs, canals etc had been constructed by the companies themselves. Lake Mentz would be the second-largest dam after the Hartbeespoort, which was also being constructed at the time.

CONSTRUCTION OF LAKE MENTZ

Kanthack made a personal examination of the entire length of the Sundays River Poort, 'one of the most imposing bits of mountain scenery in South Africa', rejecting as impractical both provision sites which had been previously surveyed. He selected a new site a short distance upstream, in the Jansenville district.

In a report for 1917/18 Kanthack writes: "The project itself is, in my opinion, one of the soundest and most promising ones I have ever been associated with in South Africa, and paves the way for one of the most favourable closer settlement schemes which the Union is ever likely to produce. Soil, topography, climate, communications and market conditions are all of the most favourable, and I have no hesitation whatever in strongly recommending that the works should be financed by the State."

Field and preliminary work had been completed in the middle of 1917 and in March 1918 the Sundays River Irrigation Board took over direct control of the project from the Irrigation Department. Initial impoundment of the lake was scheduled for 1919.

The mass concrete-type gravity section was to have a concrete wall 1 000 feet (304,8 m) in length and 84 feet (25,6 m) high. In the wall six sluice gates, each 30 feet (9,1 m) wide and 25 feet (7,6 m) high, worked by hydraulic pressure, would regulate the flow and be capable of dealing with the biggest known flood. When full, the original dam held 5 000 million cubic feet (142 million m^3) of Sundays River water.

FRAUGHT WITH DIFFICULTIES

In April 1918 RW Neumann was appointed Resident Engineer on the project, with AG Bridgman as his assistant. According to Kanthack 'the Board could certainly not have made a better choice'. Had Neumann but known what a difficult project Lake Mentz would turn out to be, however, he might have thought otherwise than to take on the project!

Firstly, the site selected for the dam was in the heart of the barren Noorsveld 40 km from the nearest station. Before any work could get underway a new road had to be constructed, around 30 km long, through mountainous country, from Wolwefontein to the site of the dam, as only 8 km of divisional road existed. At the same time a telegraph link from the works to the station was constructed. The road, telegraph line and all required buildings were completed by the end of 1918.

There was still the matter of transporting the materials from the station to the site. Carts drawn by donkeys were used to haul the total estimated 28 000 t of material to site. With no natural vegetation for the animals to feed on the wagons also had to carry sufficient food for the journey there and back.

It became necessary to place outspans at 13 km intervals with supplies of drinking water for the donkeys. At one stage during construction, 30 wagons and 500 donkeys were being continuously employed. Neumann, writing his report for 1922 stated that a team of 16 donkeys, drawing 7 000 pounds (3 175 kg), made an average ten trips a month, 30 km in each direction.

Construction was further marred by the conditions created by the raging World War. Not only was it difficult to recruit labour, but the importation of suitable plant was practically impossible. In sheer desperation obsolete and often second-hand material and machinery had to be purchased at prohibitive prices.

Recruiting ex-soldiers offered the same difficulties at Lake Mentz as it did at the Vaal Barrage site under construction around the same time in the north of the country. Not only were the men unaccustomed to the work required of them, but many suffered from relapses of malaria contracted in German South West Africa. The 1918 influenza epidemic reduced labour to a pitiful handful.

SOURCES

Cape Sundays River Settlements, Addo, Cape Province, 1918 (Author unknown)
The Rise of Conservation in South Africa – Settlers, Livestock & the Environment, 1770-1950 by Wiliam Beinart
Sundays River Valley, Its History and Settlement by Jane Meiring
Streams of Life: the Water Supply of Port Elizabeth and Uitenhage, by David Raymer
Sunday River Water User Association (www.sundaysriverwater.co.za)
Department of Water & Environmental Affairs

Thanks to Addo Elephant National Park and eWISA for photographs

Matters were made worse by an outbreak of Bubonic plague and protracted drought, which cut down water supplies for domestic as well as construction purposes. Neumann estimated that the demand for the works as well as for domestic use was often as much as 100 000 gallons (454,6 kℓ) a day. In the end, the dam was only completed in 1922. The most ironic part of the dam's completion was that it was followed

Addo Elephant National Park

Darlington Dam now forms part of the Addo Elephant National Park.

by a drought, and the dam only filled in 1928.

SETTLEMENT AND SILTATION

This delay in completion of Lake Mentz proved the death knell in the dreams of many settlers who invested too early in the scheme. Kanthack had warned prospective British settlers that they needed £2 000 in capital and enough money to tide them over for four years. Even this proved optimistic. Early settlers survived by farming chickens and lucerne; a number had to live and work in Port Elizabeth and Uitenhage.

The Cape Sundays River Settlement Company ran into financial difficulty and was eventually liquidated in 1923. Mounting financial demands on the Irrigation Department led the State to take over the scheme in 1925. By 1934 all outstanding monies owed by the irrigators to the State, totalling some £2 350 000 had to be written off.

Kanthack had anticipated that the dam would experience a problem with siltation. The solution he proposed was the provision of a number of large scouring sluices with their sills 25 feet (7,6 m) below full supply. Despite this measure, excessive siltation resulted in the dam wall having to be raised in 1935 by 1,5 m to restore its original capacity. The wall had to be raised again in 1951, this time by 5,8 m.

After the second raising of the dam the Irrigation Board embarked on what was termed the Betterment Programme, which entailed the concrete lining of some 70 km of main canal and some 155 km of subsidiary distribution canals. This project was completed in 1962.

THE SUNDAYS RIVER VALLEY TODAY

To further secure water supply to the valley, water from the Orange River Project was linked to Lake Mentz in 1978 by a temporary pumping arrangement. Following construction of the De Mistkraal Weir in 1987 the supply system from Gariep Dam to Darlington Dam was completed.

Lake Mentz was renamed Darlington Dam in 1995 after the settlement which was overrun when the dam was created. The dam became part of the Addo Elephant National Park in 2000, with further consolidation of properties in 2001. At the time of writing, land on the western side of the dam was still being consolidated.

Addo Elephant National Park

Darlington Dam, originally known as Lake Mentz, was once the second-biggest dam in South Africa (after Hartbeespoort Dam).

water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

PUBLIC NOTICE

INVITATION TO SUBMIT WRITTEN COMMENTS ON PROPOSED GENERAL AUTHORISATIONS FOR SECTION 21(c) AND (i) WATER USES OF THE NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The National Water Act, 1998 (Act No. 36 of 1998)[NWA] requires that activities entailing the impeding and diverting of flow of water in a watercourse and altering of the bed, banks and characteristics of a watercourse must be authorised. Such activities are regarded as section 21(c) and (i) water uses and are permitted through the continuation of an existing lawful use, general authorisation or a licence.

The Director-General: Water Affairs and Forestry (DWAF) intends to generally authorise section 21(c) and (i) water uses of the NWA subject to a set of conditions and precautionary practices including sustainable use and the protection of resource quality. DWAF proposes two general authorisations (GAs) in relation to these water uses - a Wetland Rehabilitation GA; and a replacement GA for GAs 1 and 2 to the Schedule of Government Gazette Notice No. 398, dated 26 March 2004, as published in Government Gazette No. 26187.

The proposed GAs were published in Government Gazette No. 32212 in Notice 541 and 542 respectively on **15 May 2009** for public review and DWAF is inviting comments on the published GAs by 15 July 2009. The documents are available electronically on the Department's website, see http://www.dwaf.gov.za/documents/.

Comments must be submitted to the Chief Director: Water Use,
Department of Water Affairs and Forestry, Private Bag X313,
PRETORIA, 0001; Fax: (012) 336 6608;
email: duplessisv@dwaf.gov.za,
marked for the attention of Ms Valerie Du Plessis – Sub Directorate
Environment and Recreation.

Small Farm Dams: A TICKING TIME BOMB?

Many of South Africa's small farm dams have become mere sediment traps threatening the country's larger storage reservoirs, as research in the Karoo indicates, writes John Boardman, Ian Foster, Kate Rowntree, Tim Mighall and Tony Parsons.

South Africa is heavily dependent on storage reservoirs to maintain reliable water supplies at times of water stress. Recent estimates suggest that the country already allocates over 98% of its available water resources and that many storage reservoirs are accumulating sediment at a pace that may make water provision at current rates unsustainable.

Across South Africa a plethora of small farm dams and reservoirs have also played an important role in the economic development and sustenance of rural areas – especially those regions with water deficits or prone to drought. Their role has been one of harvesting runoff to provide water for stock or for irrigation. While major dam projects have received much publicity and their historical significance is well documented, small farm dams have been neglected in the literature and their wider role in the landscape largely ignored.

SEDIMENT TRAPS

The longest monitored sediment yield record in South Africa is from the lower Orange River. It is suggested that the decline in sediment yields after 1950 shown by a 40-year-old record was likely to reflect two key factors: a reduction in the amount of sediment available for erosion, and sediment trapping by farm ponds. The latter contention is supported by work done by the authors, as described below.

The data presented point to small farm dams in badly eroded dryland areas playing a significant role in trapping sediment. Although the exact timing of sediment yield increases and the amount of sediment deposited in these small reservoirs varies in relation to local factors, such as the presence or absence of

badlands, the extent of rainfed wheat production, the role of fire, both natural and anthropogenic, and the intensity of grazing, the pattering of the authors' findings shows a consistent increase from the early twentieth century, followed by a declining but still high rate of sedimentation after the middle of the century.

Many of these dams are now full and have lost their trapping capacity; others have breached and are beginning to lose their sediment to the downstream system. Do we now have a situation where the myriad of small dams that protected South Africa's larger storage reservoirs are now providing many small stores of sediment threatening those selfsame reservoirs? This article provides evidence to suggest that this is indeed the case and points to the need for more in-depth research into this sediment 'time bomb'.

DIGGING FOR EVIDENCE

About ten years ago, as part of a project on erosion, runoff and overgrazing in the uplands of the Karoo, the authors started to document small dams. Their interest in the history of erosion led them to look at several dams in some detail in order to reconstruct the depositional history of their sediments and identify the drivers of erosion. This work fitted into the ongoing debate on 'desertification' of the Karoo, but shifted the focus from vegetation change to broader landscape change and, in particular, to the erosional history of badlands and gullies (dongas).

While documentary evidence (farm diaries, oral records etc) had provided important information on the history of land management, the sediment contained in these reservoirs provides an historical record of the physical process of catchment erosion and sediment yield. Where documentary evidence has provided the age of dam construction or re-construction, by coring at several points in the reservoirs the project team has been able to estimate the volume of stored sediment. They have then been able to estimate sediment yields for specific periods since dam building by using sediment characteristics to date the different layers.

Dating the sedimentary layers has relied on ^{137}Cs, first seen in 1958 and peaking in 1965, on variations in unsupported ^{210}Pb activities with depth in the sediment column, and on fine gravel layers which can be association with known storms, for example, four extremely wet days from 1 to 4 March 1974 with 209 mm of

South Africa's Van Ryneveldspas Dam on the Sunday's River at Graaff Reinet has a catchment area of 12,382 km^2. By 2009 it is estimated that there will be around 49,1 million m^3 of sediment in the reservoir, with a remaining storage capacity of only 29 million m^3.

32 Farm dams

Above: *Compassberg Dam breach. Initial breaching occurred in 2000 and this photo, taken in December 2003, shows the establishment of a new gully that is eroding previously stored sediment.*

Right: *By July 2006, a well established gully was cutting back into the stored reservoir sediments. The gully head has extended around 25 m since 2003.*

COMPASSBERG FARM DAM

Catchment area:	6,33 km^2
Relative relief:	662 m
Average annual rainfall:	498 mm
Land use:	Sheep grazing and former cultivated land on valley bottom
Reservoir area:	3,37 ha
Dam age:	ca. 1935
Current status:	Full of sediment; breached in 2000
Average sediment yield:	490 t/km^2/y[1]*
Total sediment volume:	ca. 50 000 m^3

**Takes into account estimated trap efficiencies*

rain that brought widespread flooding to the Craddock-Graaff-Reinet region.

Finding old dams has been a challenge and, to date, with the focus on the Karoo, the oldest investigated is at Cranemere (1843), located some 10 km west of Pearston in the Eastern Cape and made famous by Eve Palmer in her book ***The Plains of Camdeboo***. The project team has concentrated on small catchments where the history of land use is known and where, because of their small size, most eroded sediments are

not stored on footslopes or hillslopes but reach the dam.

SITE SELECTION

This allows them to reconstruct the history of catchment sediment yields from the sediment stored in the dam. Sites for detailed investigation were chosen partly based on contrasting land uses within the catchments. All have been subject to sheep farming in historical times; some are overgrazed, others less so; some include formerly cultivated areas, some not. Some include badland erosion (an intricate network of small gullies), but in all cases the channel network has been deepened by gully erosion to form the characteristic linear dongas of the Karoo.

Results indicate that, ***in extremis***, badlands probably developed as a result of overgrazing between 1850 and 1950. Once established they persist and even reduced stocking rates seem to have little direct effect in terms of re-colonisation of grasses and shrubs. In parts of the area, dryland wheat production on valley floors, especially in the first half of the twentieth century, led to severe erosion and badland formation. However, badlands have also appeared in the catchments where there is no documentary evidence of cultivation.

One of the more surprising conclusions of the work is that the extensive gully systems appear to have been fully developed before the first aerial photographs were taken in 1945 and have changed little since, contributing little sediment to the dams. At present, they act as efficient conduits of water and sediment between the main source areas – hillslopes and badlands – and rivers and dams. Erosion of gullies in the nineteenth century under intense grazing pressure seems most likely, and there is some documentary evidence to support this.

Documentary evidence has, in some cases, provided the age of dam construction or re-construction. Estimates of dam trap efficiency have continued to be a challenge, especially at Cranemere where the dam wall has been raised on at least three occasions since it was first built in the 1840s.

GANORA FARM DAM

Catchment area:	2,78 km^2
Relative relief:	281 m
Average annual rainfall:	338 mm
Land use:	Grazing; includes about 15% badland areas
Reservoir area:	5,23 ha
Dam age:	1910
Current status:	74% full and unbreached
Average sediment yield (1939-97):	662 t/km^2/y^1*
Total sediment volume:	109 303 m^3

*Takes into account estimated trap efficiencies

Badland at Compassberg in the Sneeuberg.

SEDIMENT STORAGE IN SMALL DAMS

While investigating a small number of dams in detail the authors have become aware of the number and variety of these small dams. Mapping an area of just over 80 km^2 revealed 95 small dams. Their age and size vary. Some are still functional in terms of holding water, but many are now full of sediment, may be breached, and are no longer capable of water retention.

Estimating amounts of sediment stored in the small reservoirs is difficult, but details of two typical ones at Compassberg and Ganora are provided in the boxes on pages 32 and 33. Sizes vary, but 50 000 m^3 of sediment per dam would seem a reasonable estimate. A very conservative estimate of sediment storage in small reservoirs would be 2 million m^3 in an area of 100 km^2. Assuming a sediment density of around 1,35 t/m^3 this would be equivalent to a store of 27 000 t/km^2.

DAM BREACHING AND SEDIMENT LOSS

Most dams in the area investigated are earth-built, with only 18 stone-built ones often constructed with assistance of government grants in the mid-1950s and one as recently as 1980. With the exception of the latter, all stone-built dams are full of sediment and currently store no surface water. Breaching of stone-built dams is rare, but has happened on occasion, resulting in stored sediment being released directly into the channel.

Those dams constructed of earth may have a stone-built spillway or a spillway on bedrock which resists erosion. However, during exceptional rainfall events the dams fill, the spillway cannot cope and overtopping occurs at the lowest point of the earth wall. This may result in erosion of the wall and the development of an incised channel through the dam sediment.

Of 95 small farm dams mapped in the Sneeuberg, 46 (48%) are full of sediment and incapable of water storage. Of the 95, 28 of the dams are breached and therefore potential sites of sediment loss. Having acted for up to 170 years as sites of water and sediment storage the reservoirs are now beginning to act as sources of sediment in that gullies are eating back into the sediment fill.

For example, the Compassberg Dam wall was breached as a result of 118 mm of rain on 24 March 2000; the dam was already full of sediment. Since 2000, a gully has begun to eat back into the sediments in the reservoir above the breach. Breaching is also occurring as a result of animal burrowing activity in dam walls. Many dams are therefore providing a ready source of sediment to downstream sections of rivers and reservoirs. If the authors' conservative estimates of 27 000 t/km^2 are correct, there is a large volume of sediment waiting to be mobilised in a relatively short time.

BIG DAMS

Amounts of sediment stored in big dams are given in Roosemboom et al. (1992). Generally their figures apply to a period before the mid-1980s. To estimate current storage some extrapolation has to be done.

The nearest big dam to the study area in the Sneeuberg is the Van Ryneveldspas at Graaff Reinet. This dam on the Sundays River, has a catchment area of 13 382 km^2 and surveys show that about 47 million m^3 of storage capacity remained in 1978 with about

Badland in the Sneeuberg; willows in the distance occupy the site of the infilled small dam.

31 million m^3 sediment partly filling the reservoir. This suggests an average deposition rate of 584,906 m^3/y and that by this year there will be around 49,1 million m^3 of sediment in the reservoir with a remaining storage capacity of about 29 million m^3. At present rates of sediment transport this suggests a dam life of about 50 years.

POTENTIAL IMPACT OF SMALL DAMS

It is not known how many small farm reservoirs there are in South Africa, however, the project team was surprised by their density, and their sediment storage capacity, in a small area of the Sneeuberg.

A simple and conservative extrapolation from mapping in the Sneeuberg suggests that in a catchment of 13,382 km^2 (the area of the catchment of the Van Ryneveldspas Dam) there could be as many as 10 000 of these reservoirs. If each is the size of the Compassberg reservoir, containing about 50 000 m^3 of sediment, then there is a potential for around 500 million m^3 of sediment storage in the catchment.

The sediment stored in Sneeuberg dams is largely fine-grained – it is not coarse bedload. The potential for movement as suspended load means that the material could reach large dams quite quickly.

The increasing availability of small farm reservoirs which are full of sediment, and perhaps the continuing failure to repair breaches, suggests that the sediment yields in rivers will increase and large reservoirs will fill quicker than in the past. However, available potential sediment for downstream transportation exceeds the remaining capacity of a reservoir such as the Van Ryneveldspas by an order of magnitude.

Such crude calculations also ignore changing climate – in the Sneeuberg at least there is good evidence for increased intensity of rainfall events over the last 50 years, a continuation of this trend would lead to an increase in breaching and more rapid sediment evacuation from dams. There is also evidence of changing land use. The effect of changing land use is difficult to predict since decreasing stocking rates should be influencing runoff and erosion, but changes in farm practice from dominantly sheep to wildlife/conservation are introducing an unknown factor.

FUTURE WORK

The above analysis, based on evidence from a small number of farm reservoirs in the Sneeuberg area of the Karoo, has pointed to a potential problem of significant magnitude; these reservoirs, small in size but large in number, provide a ready source of sediment for the larger storage reservoirs downstream.

The project team aims to assess the actual number of small reservoirs in a major catchment that has a storage reservoir at its downstream limit. In addition, there is a need to know the approximate volumes of stored sediment within these farm reservoirs and the rate at which the sediment is being released from dams that are breached. The research will involve construction of a GIS database in which information for individual reservoirs will be stored and field surveys to calculate sediment storage and rates of sediment release.

Dates of breaching will be established through interviews with local land owners and by an analysis of farm diaries, historical photographs, aerial photographs and satellite imagery. Of particular concern in this project is the number of breached dams and the rate at which sediment is being recycled from these sites to impact on downstream river systems and, more importantly, the rate at which sediment is likely to be reaching large reservoirs.

Give the present estimates of the amount of sediment stored in farm reservoirs, they may indeed be a ticking bomb that may leave South Africa facing a water crisis much sooner than anticipated.

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WRC Studies Shed Light on Groundwater Polluting Chemicals

While the pollution of South Africa's surface water has been receiving much attention lately, the degradation of the country's underground resources has largely gone unnoticed. The Water Research Commission (WRC) has been funding substantial research into understanding the extent of contamination of the country's aquifers by dense non-aqueous phase liquids (DNAPLs). Lani van Vuuren reports.

Dense non-aqueous phase liquids (DNAPLs) are chemicals or mixtures of chemicals that are heavier than water, and are only slightly soluble in water. This means that when released into the environment in sufficient quantities, they can move through soils and groundwater until they encounter an impermeable layer that will impede further mass vertical movement and allow the liquid to pool or move along the dip of an impermeable layer or within a fracture. DNAPLs have thus the potential to move in the opposite direction to that of the localised groundwater flow direction.

Contamination with DNAPLs is a worldwide phenomenon, but to date there has been limited awareness and understanding of the problem locally. There are thousands of potential sites in South Africa, as elsewhere in the world, were DNAPLs may have been released to the subsurface in varying quantities. Examples include chlorinated solvents (degreasers and dry-cleaning fluids), creosote, coal tar, and polychlorinated biphenyls (as found in dielectric oils, for example).

POTENTIALLY HARMFUL

Public awareness of DNAPL pollution to date has been very low. According to WRC Research Manager Dr Shafick Adams, South Africans should become more aware of the hazards DNAPLs pose to the environment, and specifically to groundwater resources. "Because of the low solubility of DNAPLs they often persist for several decades in the subsurface. In addition, some DNAPLs are highly toxic at even very low concentrations and can thus pose unacceptable health risks to both humans and the environment."

It is also reported that DNAPLs are not often released into the environment as pure chemicals but rather as solvents that contain varying amounts of other contaminants. These other components can significantly influence the overall properties of the DNAPL, and both aid detection and complicate remediation.

DNAPLs trapped in the subsurface act as continuing sources of dissolved contaminants to groundwater. Their removal from aquifers is very difficult and costly. As a result, these chemicals have been classified as high priority pollutants in several countries, including South Africa.

INCREASING AWARENESS

While major industries are now becoming increasingly aware of the problems associated with organic pollution, the challenge exists that there is often no routine monitoring for organic compounds. When coupled with the current lack of analytical capabilities in South Africa, one can begin to understand why DNAPL contamination still often goes undetected.

"Large operators sometimes have systems in place to monitor organic pollution emanating from leaks and accidental spillage," explains Dr Adams. "However, until recently there were no specific guidelines for the assessment of DNAPLs in the country."

TAKING THE LEAD

Recently, the first comprehensive publicly-funded study into the fate and

transport of DNAPLs in groundwater in South Africa was concluded with support from the WRC. The project resulted in the development of guidelines for a range of activities linked to the identification, characterisation and monitoring of DNAPL-contaminated sites.

This is important as South Africa's aquifers are mainly fractured aquifers with a unique set of challenges when assessing the fate and transport of DNAPLs in the subsurface. "Because of our complex aquifer systems as well as the physical and chemical properties of these substances accurate prediction of the behaviour of the chemicals is challenging," Dr Adams tells ***the Water Wheel***.

WRC-funded investigations into DNAPLs have found that the extent of the problem in South Africa's urban areas is potentially much greater than expected. The problem is not confined to large urban centres, as many of the potential sources (such as auto shops and dry cleaners) are found in all types of settlements across the country. This means that the development of groundwater resources to supply urban areas (one of the considerations under the Department of Water & Environmental Affairs' Water for Growth and Development Framework) is thus very likely to be affected by potential contamination from DNAPLs.

GUIDELINE DOCUMENTS

Rather than creating one large report, the study was split into a several, easier digestible, documents. The latest reports to be published include a layman's guide to DNAPLs in South Africa. This is a very important document as even wrongfully disposing of one's used car oil can lead to groundwater pollution.

There is also a handbook for DNAPL-contaminated sites. This publication provides an overview of the most important considerations for DNAPLs in South Africa. It discusses the sources and occurrences of DNAPLs and the most important factors controlling the migration and fate of DNAPLs and dissolved organics. It is aimed at site investigators, geohydrologists, site-owners and regulators.

The completed DNAPL study also laid the foundation for new research into light non-aqueous phase liquids (LNAPLs), which started in 2007. Crucial partnerships were built with industry partners during the DNAPL study, and the petrochemical sector, for example, has made some of its sites available for research for the new LNAPL study.

It is hoped that the outcome of these investigations will do much to aid the sustainable management and prevention of pollution of South Africa's precious groundwater.

DNAPLs trapped in the subsurface act as continuing sources of dissolved contaminants to groundwater.

TOP TEN SOURCES OF POSSIBLE DNAPL GROUNDWATER CONTAMINATION

- Production of agricultural chemicals (fertilisers, herbicides, pesticides)
- Metallurgical processes
- Metal (predominantly gold) and coal mining
- Transport
- Petrol service stations (underground storage tanks)
- Wood processing and preserving
- Manufacturing – chemicals
- Workshops (mechanical and electrical)
- Stormwater/sewer systems
- Automotive manufacturing

DNAPL REPORTS AVAILABLE FROM THE WRC:

Handbook for DNAPL Contaminated Sites in South Africa (**WRC Report No: TT 326/07**)
DNAPLs in South Africa: a Layman's Guide (**WRC Report No: TT 325/07**)
Manual for Site Assessment at DNAPL Contaminated Sites in South Africa (**WRC Report No: 1501/2/08**)
Guidelines for the Acceptance of Monitored Natural Attenuation Processes in South Africa (**WRC Report No: 1501/3/08**)
Groundwater Monitoring Guidelines for DNAPLs in South African Aquifers (**WRC Report No: 1501/4/08**)
Field and Laboratory Investigations to Study the Fate and Transport of DNAPLs in Groundwater (**WRC Report No: 1501/5/08**)

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WHAT'S IN A NAME:

Looking Back at the Start of Public Water Governance

Newly elected President Jacob Zuma's announcement that the Department of Water Affairs & Forestry will in future be known as the Department of Water & Environmental Affairs (DWEA) is not the first time that this government department has been subjected to a name change. Lani van Vuuren delves into the archives to discover what previous name changes have meant for the country's main water regulator.

The Department of Irrigation (as it was then known) was established in 1912, two years after South Africa became a Union, to administer the newly promulgated Union Irrigation and Conservation of Waters Act (No 8 of 1912). Before the promulgation of this Act there were few large storage dams in South Africa. The Union government aimed to aid the growth and development, through storage schemes, of irrigated agriculture, which, together with mining, was the mainstay of its economy.

SMALL BEGINNINGS

The first Irrigation Department was lead by a Director. He was aided in the department's headquarters by three draughtsmen, a hydrographic surveyor, two assistant hydrographic surveyors, an inspector of gauges, boring engineer and five boring inspectors. The department also had regional or 'circle' staff: there were nine circle engineers and nine assistant engineers. In addition, temporary staff was engaged in construction and reconnaissance surveys from time to time.

Assisting in the development of irrigation projects and settlements were the main activities of the Irrigation Department, together with the administration of the applications for loans from Irrigation Boards and individual farmers. The department also aided farmers to bore for water for agricultural and stock farming activities.

The first Director of Irrigation was renowned engineer Francis Edgar Kanthack, an expert in irrigation engineering who had worked in India prior to his appointment as Director of Irrigation in the Cape in 1906. He was the main drafter of the 1912 Act. Among others, he established the country's first meteorological service.

Interestingly, in Kanthack's first Annual Report there occurs a most familiar phrase which seems to run like a continuous thread through the history of the department: "The shortage of engineers was particularly badly felt." Right from the start there appears to have been conflict between the public demands on the department and the capacity of the department to satisfy those demands.

The young department had to deal with both droughts and unprecedented rainfall while, at the same time, suffering from the effect of a major portion of its staff being away at war. Kanthack himself played an important role in preparing

water supplies for Africa, and arranging water supplies along the planned route of invasion of German South West Africa (Namibia).

Despite these setbacks the years immediately following the war was the first 'golden era of dam building' in South Africa, with a number of large dams over 20 m in height being constructed. These include Hartbeespoort, Kamanassie, Lake Arthur, Van Rynveldspas and Lake Mentz (now Darlington Dam). In these early years, the development of water resources was generally straightforward. The single-purpose schemes at that time were relatively simply to build and administer. Expenditure peaked in about 1922, after which there was a decline, since existing facilities satisfied demand.

DEPRESSION YEARS

From 1924 to 1929 South Africa's economy flourished. The growth of the economy was mainly due to the discovery of new diamond fields, the protection of the agricultural industry and the promotion of local industries. However, after 1929 South Africa joined the rest of the world bearing the brunt of the Great Depression.

The economic situation, as well as a coincident eight-year drought, which started in 1925, gave rise to the second expansion of water infrastructure, accelerated by schemes to counter unemployment. Several large schemes were initiated during this time, including the Vaal, Buchuberg and Loskop dams, as well as the giant Vaalhartz Irrigation Scheme. In the mid-1930s, subsidies were also introduced to accelerate the development of private irrigation schemes. By 1938, expenditure on water matters was nearly ten times that of 1928.

In 1921, AD (Alfred) Lewis took over from Kanthack as Director of Irrigation, becoming the first South African to lead the department. Lewis laid the foundations for many of the country's bulk water supply schemes, both for

DWEA

AD (Alfred) Lewis was the second Director of Irrigation and the first South African to lead the department.

irrigation and industry. Among others, a detailed report written by Lewis following his extensive journey along the Orange River (much of it on foot in 40°C heat) served as an information source for planning for many years. Ironically, Lewis' greatest achievement was not in the true field of water engineering. With the aid of the South African Airforce, he managed to produce the first complete topographical map of the Union, without which the actual catchment areas of rivers could not be calculated.

By the end of the 1920s the activities of the Irrigation Department were expanded to include the collection and compilation of hydrographic data throughout the Union; meteorological services; systematic reconnaissance surveys; the maintenance and administration of irrigation works; professional assistance to farmers, Irrigation Boards and River Boards at a prescribed fee (although it is reported much advice was provided free of charge). The department also acted as the adviser of provincial administrations on all matters regarding water supply, drainage, sewerage or irrigation within the areas controlled by municipalities and public institutions.

WORLD WAR II

During World War II more than 50% of department staff were on active service, and only essential services could be carried out. The Director himself was seconded to the Technical Committee of Defence on Water Supplies. Planning for future schemes went ahead, however,

After the war there was a period of recovery during which schemes for industrial water supply increased in priority. The country's economy was stimulated by the production of gold. The income from the gold-mining industry diffused through the rest of the economy, leading to economic boom. South Africa had now developed into an agriculture-mining-manufacturing economy.

In 1946, the department established a Research Branch, while expanding its

DWEA/eWISA

The 41 m high and 389 m long Kammanassie Dam near Oudtshoorn, completed in 1923, was one of the first large dams to be constructed under the Department of Irrigation.

Lani van Vuuren

DWAE DG Pam Yako and former Minister of Water Affairs & Forestry Lindiwe Hendricks at the launch of the Water for Growth & Development Framework in March.

Hydrographic Survey Branch to organise, coordinate, ad increase the tempo of basic tasks of investigation and evaluation of resources.

WATER FOR MINING

From the early 1950s there was a major shift in emphasis in water policy from the provision of water for mainly agricultural purposes to the provision of water for an increasingly industrialised and urbanised country. The first regional scheme in which irrigation played no part included the scheme to supply the Orange Free State goldfields. Other schemes were to follow, some of which were multi-purpose schemes, such as the Umgeni and Pietersburg schemes in 1963, the Vaal-Gamagara scheme in 1964 and the Buffalo River and Springbok schemes in 1970.

The Water Act No 54 was passed on 13 July 1956, and the department was renamed the Department of Water Affairs (DWA). The focus of this new department was not only on irrigation alone, but had a wide scope in that it managed the water resources of South Africa for a wider user group.

The 1956 department had, among others, a Research Branch (which undertook preliminary investigations into the potential development of water resources for different uses); a Planning Branch, assisted by the Reconnaissance Section, and a Construction Division, which organised and carried out construction work. There was also the Superintending Division, a Mechanical Division, Hydrographic Branch, Hydrological Division, a General Administration Division and the Servitudes Branch. In addition, there were eight regional offices (known as Circle Organisations) which had their own headquarters.

In 1961 South Africa became a Republic and, in 1962, as South Africa faced increased world isolation because of its apartheid policies, the Prime Minister announced the go-ahead of the largest water development project yet to be undertaken in South Africa – the Orange River Project. The project was to stimulate investment in the country and restore confidence in its economy. The project included the construction of the Vanderkloof Dam (then the highest dam in the country), the huge Gariep Dam and the Orange Fish Tunnel, which at 82,45 km long remained the longest continuous water transfer tunnel in the world for many years.

MISSION OF ENQUIRY

A Commission of Enquiry into Water Matters was appointed in July 1966 to investigate all aspects of water provision and utilisation with the country. Its findings were published in 1970. Importantly, the Commission found that "unless the essential steps are taken to plan the exploitation and augmentation of our water resources to conserve and reuse our available supplies, and to manage and control our resources in the most efficient manner, serious shortages will be suffered somewhere before the close of the century."

In 1970, the government approved a national programme to enlighten the public on the importance of water in the economic prosperity of the Republic. Throughout the year the Minister of Water Affairs and the DWA kept the attention of South Africa focused on water matters. A number of dams were opened, and the programme culminated in an international symposium on water.

The Commission had important spinoffs, such as the development of the Hydrological Research Institute (now known as Resource Quality Services) within the department. Interestingly, the institute's first director was a woman, Joan S Whitmore. In 1978, the Division of Geohydrology was established, and in 1986 the department added a Dam Safety Office.

WATER RESOURCE DEVELOPMENT SLOWS

The 1980s saw one of the most severe droughts ever experienced in South

The Vaalhartz weir was one of the bulk water supply projects undertaken in the 1930s to create employment during the Great Depression.

Africa. Expenditure by the DWA on major water resource development was less than 1% of gross national expenditure. Of the funds allocated to the department, an increasing portion had to be spent on operating and maintaining a growing number of schemes, on the control of pollution and abstraction of water and on expanding other areas of activity, such as research and investigations needed due to the increased complexity of the planning function. Still there were a number of considerably large projects executed, such as the Drakensberg Pumped Storage Scheme and the Grootdraai augmentation project, in which the flow of the Vaal River was reversed.

In April 1980, due to government's rationalisation programme for the public service, the DWA merged with the then Department of Forestry and Environmental Conservation. However, this union was short-lived, and on 1 September 1984, the DWA was reinstated as an independent department. Regional organisations replaced the old 'circles' in 1987/88.

DAWN OF A NEW ERA

In the early 1990s South Africa experienced another severe drought. Various municipalities in the Karoo experienced water shortages and the levels of irrigation dams in the region were critically low. Assistance was given in the form of geohydrological surveys and the sinking of boreholes. In 1990, the Forestry Branch was incorporated and the DWA became the Department of Water Affairs & Forestry.

When the National Water Act (No 36 of 1998) was adopted in 1998, South Africa became the first country in the world to adopt a national water law in which water was seen as a tool in the transformation of society towards social and environmental justice. Whereas the Water Act of 1956 originated from the need to supply water to an ever-growing economy, the NWA was born from the inequalities of the past.

DWEA

Buyelwa Sonjica is the first Minister of the new Water & Environmental Affairs.

In the first decade following democratisation, DWAF's focus was on ensuring access to the poor to adequate water supply and sanitation services. The department inherited a backlog of 14 million people lacking access to safe water and 21 million (half the population) lacking access to safe sanitation. In addition to these enormous backlogs, the department was also faced with the fragmented institutional arrangements created by the previous regime. When the homelands existed, South Africa effectively had 11 water acts with various structures administrating them, which all needed to be transformed.

By 1997, one million additional people had been supplied with access to safe water. This number reached 10 million by 2004. Between 1994 and 2004 nearly 7 million people were provided with basic sanitation facilities, mainly through housing programmes. Today, around 91% of South Africa's population has access to clean water while around 74% has access to safe sanitation.

Prior to President Zuma's announcement that the DWAF would merge with the environmental branch of the Department of Environmental Affairs & Tourism, the department's prime responsibility, as custodian of South Africa's water and forestry resources, was to formulate and implement policy governing these two sectors. A number of its previous implementation functions were transferred to water and forestry institutions. Led by the Minister of Water Affairs & Forestry and a Director-General, the departmental structure included a Policy & Regulation Branch; Regions Branch; Corporate Services Branch; Financial Branch and a Forestry Branch.

WATER FOR GROWTH AND DEVELOPMENT

Earlier this year, the department launched its Water for Growth and Development Framework, the intention being to place water at the heart of all planning that takes place in the country so that any decisions that rely on the steady supply of water adequately factor in water availability. The framework further seeks to ensure that there is sustained investment in the water sector and that water management supports government's social and economic growth targets.

At the time of writing, the structure and vision of the department had not yet been finalised. However, there is no doubt that this name change signals a new era for the custodian of South Africa's most previous natural resource.

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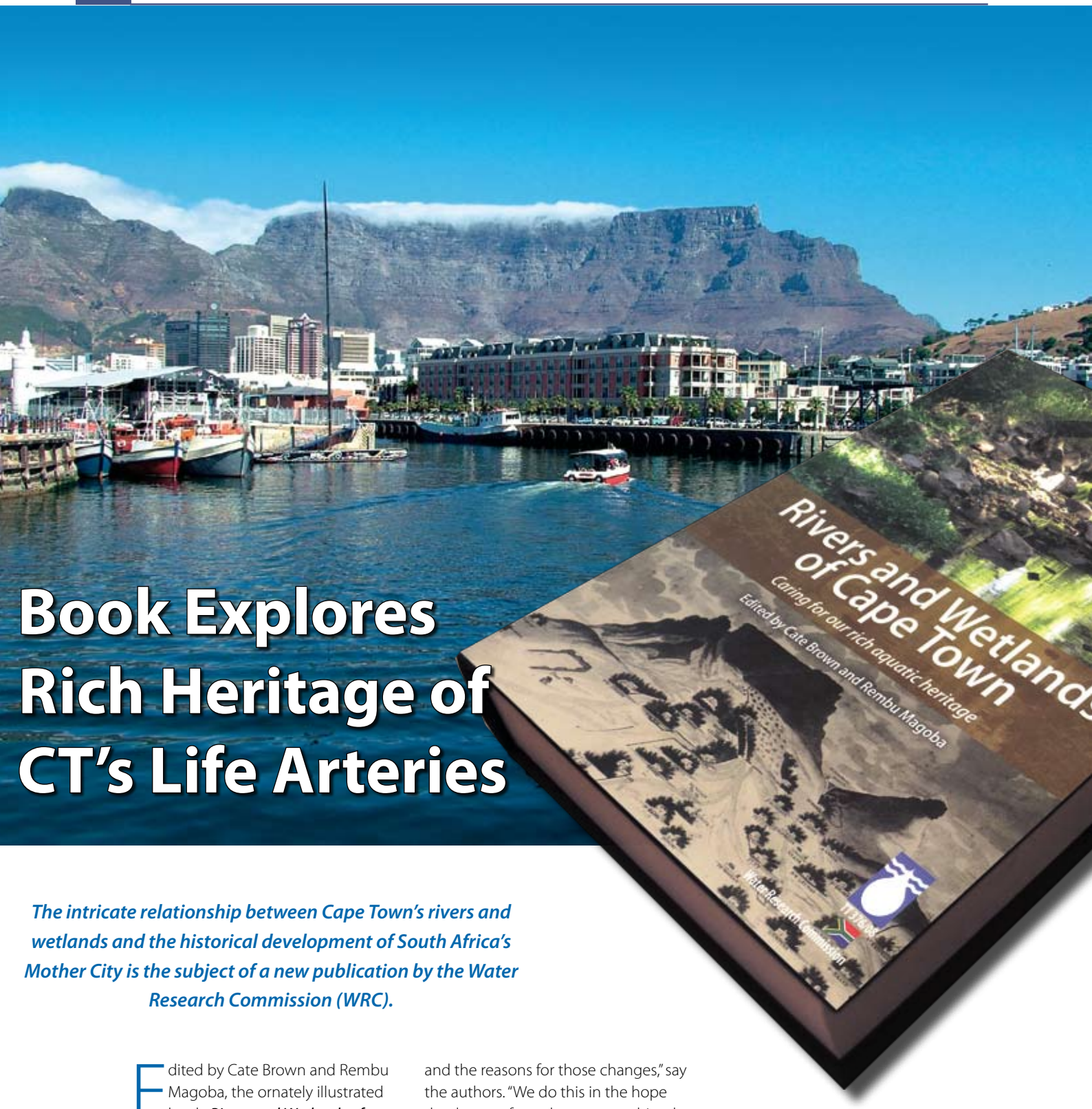

Book Explores Rich Heritage of CT's Life Arteries

The intricate relationship between Cape Town's rivers and wetlands and the historical development of South Africa's Mother City is the subject of a new publication by the Water Research Commission (WRC).

Edited by Cate Brown and Rembu Magoba, the ornately illustrated book, ***Rivers and Wetlands of Cape Town, Caring for our Rich Aquatic Heritage***, provides a fresh perspective on rivers and river management in Cape Town, using the lenses of time and space. "We step back in time and track the changes that have occurred and the reasons for those changes," say the authors. "We do this in the hope that lessons from the past, combined with insights from a society that has learnt much about its dependence on nature, will assist us not only in understanding where we are but, more importantly, in plotting a better path into the future."

Cape Town and Stellenbosch are richly blessed with rivers such as the Diep River, Liesbeek River, Hout Bay River, Eerste River and Lourens River. Added to this are the wealth of small, shallow lakes and wetlands, known collectively as vleis, situated mainly on the Cape Flats,

including Rondevlei, Zeekoevlei, Blouvlei, Paardevlei, and Wildevoëlvlei.

The waterways and water bodies have played a pivotal role in the history of the area. In common with many major cities around the world, the streams, rivers, wetlands and vleis of Cape Town have been shaped as much by the region's political and social history as by nature and technology.

Inevitably these aspects have had an effect on the ecological integrity and functioning of the city's water system. The provision of water supply, drainage and waste removal for a city is no mean feat, and past decisions and actions should be seen in the social, economic and technological context of their time.

"The development of Cape Town and Stellenbosch in the last three centuries is associated with astounding engineering progress, and littered with unsung engineering heroes. These men designed, dug and built in, around and on our rivers and vleis with the purpose of promoting the safety and convenience of the residents. Our duty is to learn from our predecessors, build on the good they have left behind, try to rectify the mistakes made and use their legacy of knowledge to do better in the future."

This WRC-funded project has drawn on a wealth of information in the libraries of the Cape Town City Council, the State Archives and the University of Cape Town. In addition much of the engineering information contained in the book was provided by an unpublished text by retired city council engineer and historian Tony Murray, entitled 'Much Water under Many Bridges'.

Of course, Cape Town's rivers and wetlands were originally shaped by forces that had nothing to do with humans, so the book begins with background information about the area's geology and geomorphological history, and the effect of long-term climate change and sea level oscillations, dating back to 250 million years ago.

The chapters of the book are arranged on the basis of the major river and vlei catchments in the area. While it was not possible to include every stream, the sections outline the known history of at least 15 sets of rivers, streams and wetlands from 250 million years ago to the present day.

There is also a section on the economics of the rehabilitation of rivers and wetlands. This chapter describes the services provided by rivers and wetlands, and summarises the way in which these have been impacted by urbanisation and related interventions. The costs of managing Cape Town's urban rivers and wetlands is outlined, while it is demonstated how the benefits have increased through investment in more holistic engineering solutions that make better use of the potential for provision of ecosystem services.

The book concludes with a chapter entitled: 'Looking to the future', offering some practical suggestions for improving river and wetland functioning while dealing with the challenges of flooding and waste disposal.

One thousand copies of the book have initially been made available with additional funding from Ninham Shand (now part of the Aurecon group) and Southern Waters Ecological Research and Consulting.
To order a copy of *Rivers and Wetlands of Cape Town* (**WRC Report No: TT 376/08**), contact Publications at Tel: (012) 330-0340 or e-mail: orders@wrc.org.za

Former mayor and leader of the Democratic Alliance, Helen Zille writes in the foreword: "Cape Town is blessed with remarkable environmental resources, not the least of which include a rich freshwater heritage. But this city has grown from 80 000 people to 3,4 million in the past 50 years.

"This has placed tremendous demands on natural resources and urban infrastructure. The information in this book is a valuable synthesis of unpublished documents and personal communications. We hope that preserving the past lessons, documented in this test will assist us in future with the conservation and sustainable management of our precious aquatic resources."

Sue Matthews

Seen at the launch of Rivers and Wetlands of Cape Town, Caring for our Rich Aquatic Heritage are Dr Cate Brown (co-editor, Southern Waters), Ms Connie September (former Chair of the Parliamentary Portfolio Committee on Water Affairs & Forestry), Mr Rembu Magoba (co-editor, Southern Waters) and Dr Rivka Kfir (CEO, WRC).

WATER Kidz

New Version of
Mini Water Quality Bug Test

For years the South African Scoring System (SASS) has formed a key tool in the assessment of the health of the country's rivers. A simplified version of this tool, developed for use by schools and non-specialists, has now undergone a welcome upgrade. Report by Dr Mark Graham.

South Africa has been a world leader in biomonitoring techniques using macroinvertebrates (animals that have no backbone and can be seen without using a magnifying glass). The most successful of these have been the SASS, particularly version 5.

The miniSASS tool was originally developed during the late 1990s as an easy-to-use, scientifically reliable and robust technique to monitor water quality in rivers and streams. The mini version reduced the taxonomic complexity of SASS to a few aquatic invertebrate groupings (13 instead of the original 90) which would act as surrogates for the complete suite of SASS taxa.

A recent Water Research Commission sponsored review of miniSASS identified a need for the programme to be upgraded as a community and environmental education resource tool which would be linked to the River Health Programme and would assist in the new national Adopt-a-River drive. A survey was conducted to identify the limitations which were an issue with the current miniSASS (version 1) and to align the programme more closely with the national curriculum.

Zandvlei Nature Reserve education officer Mark Arendse helps Logan Theron from Crestway High School and Nathaneal Diedericks from Muizenberg High School to identify invertebrates found in one of the canals flowing into Zandvlei estuary.

The key output from this work has been the refinement of the tool (version 2) in the form of a pamphlet and a field guide, as well as the development of source materials to support educators in addressing water-related themes in the formal and informal education arena.

The new miniSASS version 2 pack contains an information pamphlet covering the history of miniSASS, step-by-step methodology, information regarding the importance of water-quality monitoring and management in South Africa, a glossary, keywords and sites for further reading, step-by-step instructions for the scoring and up-to-date contact details. In addition, the field guide contains a dichotomous key which will aid in the identification of the aquatic macroinvertebrates, new line drawings and some additional general information on macroinvertebrate feedings habits and diet.

A complete reworking and statistical investigation of the quality value scores assigned to each miniSASS macroinvertebrate group was undertaken as part of the study. This was based on over 6 000 SASS records extracted from the national rivers database and used to verify and refine quality values for the new miniSASS version 2. This process was also able to allow a simplifactions of the qualify value scores to be applied throughout the country and made for an easier and less ambiguous interpretation of the final score calculations for the miniSASS (identified as one of

the areas to be addressed during the audit phase of the project).

The educational aspect of the upgrade was dealt with in a series of integrated lesson plans which have river health as a central theme and use miniSASS as a central tool for these lessons. Grades five, seven, nine and eleven have each been provided with five different activities which cover a range of subjects, including geography and life sciences.

Version 2 of the miniSASS tool underwent field testing at the Wildlife and Environment Society of South Africa Environmental Centre in Howick by river health practitioners and environmental educators. It was well received by all the participants.

The revised miniSASS tool was also used by a group of schools in Cape Town as they embarked on a series of source-to-sea expeditions on a schools catchment study. Along with a variety of GPS work and identification of the indigenous and alien flora in the area the pupils carried out the revised miniSASS tests on the Prinskasteel stream where it ran through a farm, the Tokai industrial area and the Zandvlei estuary at the end of the catchment.

The expeditions introduced the students to a local river which many had not even realised was there and, using the miniSASS tool made the students realise how badly polluted the river was in certain areas and how it is everybody's responsibility to keep the rivers clean.

Based on the response of the groups who have already used the upgraded miniSASS, it promises to continue to be a valuable tool in educating pupils and interested community members about the quality of water found in South African rivers and streams.

A fully downloadable version of the new miniSASS toll and the integrated lesson plans can be found on the GroundTruth website http://ground-truth.co.za or from miniSASS@ground-truth.co.za or from the Share-Net/WESSA offices in Howick (e-mail: sharenet@wessa.co.za).

Leighan Mossop from Table Mountain National Park collecting bugs for a miniSASS test at the castellated weir on the Keyser River.

Learners from Cape Town carrying out the miniSASS test in the Keyser River on Dreyersdal Farm, (left to right) Samantha September and Julian Gouws from Crestway High School and TC Nortje from Zwaanswyk High School.

Susan Gie, one of the group assistants, helping a group of learners to identify their organisms.

VIP construction as easy as one two three...

Curious onlookers were surprised to see a ventilated improved pit (VIP) toilet superstructure arise on the pavement outside the Water Research Commission offices earlier this year. The structure was built as a demonstration of a research project into the development of alternative materials for the construction of superstructures for on-site sanitation systems. The project is being led by Associate Professor Elsabé Kearsley from the School of Civil and Biosystems Engineering at the University of Pretoria. The aim is to create a light-weight superstructure which can either be moved by the household or disassembled easily and the material used to build another structure when the toilet pit becomes full. The prototype superstructure, constructed from pre-cast high-strength concrete panels, was put together by UP concrete technologist Derek Mostert and his team in less than 30 minutes.

All photographs by Lani van Vuuren

THE WATER WHEEL

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