THE WATER WHEEL
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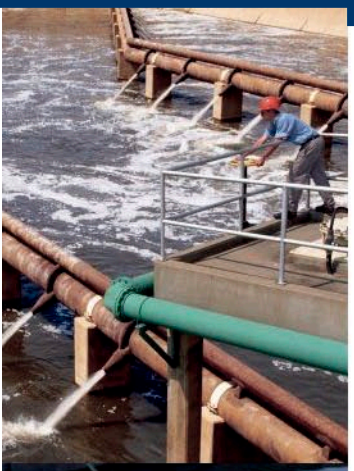
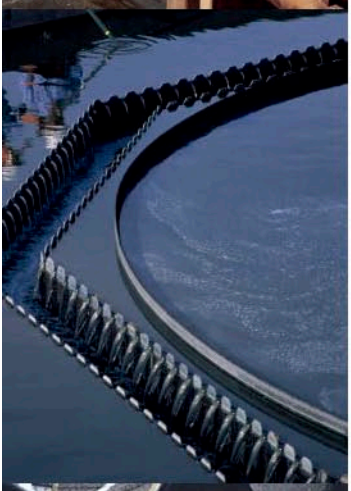
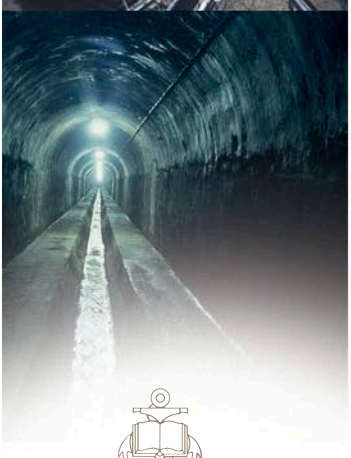
Mine managing water for a lighter footprint

WATER RESEARCH COMMISSION



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

For academic enquiries, please contact the Course Leader:
Professor Evans Chirwa
Tel: +27 (0)12 420 5894
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For brochures and registration forms please contact the event coordinator:
Refilwe Selepe
Tel: +27 (0)12 420 5015
Fax: +27 (0)86 638 1715
E-mail: info.ce@up.ac.za

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

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

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Date: 20-22 October 2010
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For academic enquiries, please contact the Course Leader:
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***Cover**: By reducing ingress and reusing available water, Eland Platinum is not only saving costs but reducing its ecological footprint (See page 12).*

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

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Decline in environmental crime prosecutions

Dedicated courts to hear violations against the environment will be set up in the next six months.

According to Minister of Water & Environmental Affairs Buyelwa Sonjica, the establishment of dedicated courts, including dedicated prosecutors, will have a profound impact on the fight against environmental crimes. Sonjica said that a meeting between the Minister of Justice, Jeff Radebe, and herself in September last year resulted in the decision to move forward with the process of re-establishing the courts to address many of the challenges experienced in effectively enforcing the environmental laws. "The big issue would be how to find them [courts], where do we establish them, and finding the skilled people who will be working there."

Released late last year, the National Environmental Compliance and Enforcement Report revealed an increase in the number of cases where the National Prosecution Authority (NPA) declined to prosecute from 16 in 2007/08 to 100 in 2008/09. The number of convictions for environmental crimes decreased from 748 to 258.

Commenting on the decline of cases prosecuted, Sonjica said that this was because environmental crimes were not the core function of the NPA, hence the need for dedicated courts. "The heart of the problem is conviction. Most people are getting away with murder when it comes to the environment." Department of Environment Compliance and Enforcement Support Director Mark Jardine said that, going forward, his department would focus on the causes for the fluctuations in the number of reported convictions, acquittals and decisions not to prosecute. They would also investigate why some institutions were recording over 200 convictions a year while others recorded nothing.

Source: BuaNews

Centres expanding water knowledge in Southern Africa

As coordinator of the NEPAD Water Centres of Excellence Initiative, Stellenbosch University (SU) will over the next three years take the lead when it comes to network expansion in southern African water research and tertiary training communities.

A consortium of centres of excellence focusing on water research has been established through the NEPAD Water Centres of Excellence Initiative in southern African countries such as South Africa, Malawi, Botswana, Zambia, Mozambique and Namibia. The initiative is funded by the European Commission.

The Water Initiative is also supported financially by the South African Department of Science & Technology (DST) and enjoys high-level recognition by the African Ministers' Council on Water (AMCOW). The initiative aims to promote cooperation and knowledge transfer between organisations involved in water research in the region in order to improve resource management, policy formulation, the provision of high-quality water sources in rural and urban areas and water purification technology, in particular. It also aims to limit the damage caused by flooding.

"The initiative focuses on people and strengthening networks, and not on funding specific research topics as such," explains Prof Eugene Cloete, Dean of the Faculty of Science at SU. Prof Cloete chairs the executive committee heading the initiative on behalf of SU.

The universities and research institutions that have already been awarded the status of Centre of Excellence in Water Research all have proven experience in the areas of training, scientific research, consultation and policy formation. It is expected that the network will be expanded to include other relevant institutions in the region.

Besides SU, other South African institutions, such as the CSIR, the University of the Western Cape, and the University of KwaZulu-Natal also form part of the initiative. During a meeting of the executive committee towards the end of last year, the general aims of the centres were determined. These include strengthening the water researchers' network in the region, as well as capacity-building projects such as the provision of bursaries for staff and post-graduate students, and technology and knowledge transfer through workshops and conferences.

Bank and French development agency partner to accelerate infrastructure development

The Development Bank of Southern Africa (DBSA) and Agence Française de Dévelopment (AFD) have entered into a financial agreement to promote financing opportunities to accelerate infrastructure as identified by the New Partnership for Africa's Development (NEPAD) over the next five years.

The first phase of this agreement has been fully committed. The two organisations will each provide €200 000 for the financing of studies. In addition, the AFD will provide further technical assistance to obtain an expert in the energy field, financed through a grant of €600 000.

The first agreement between the two organisations goes back to 2003. To support the NEPAD initiative, they created and jointly funded the Project Preparation and Feasibility Study (PPFS) Fund for the purpose of financing the pre-investment stages of regional integration infrastructure projects.

This second agreement regulates how the parties will work together regarding the disbursement of funds relating to the African development initiatives. The DBSA will continue to provide the management to execute the implementation of the development of these projects funded by the PPFS Fund.

The NEPAD projects which will benefit from this alliance must meet certain criteria, including:

- Having a regional or continental impact;
- Having an acceptable environmental impact;
- Falling into one of the four priority sectors (transport, energy, ICT, water and sanitation);
- Prioritising the implementation of public-private partnerships; and

- The size of the financing by the fund shall not exceed US$500 000.

The PPFS Fund has played a catalyst role and mobilised other funds from relevant international finance institutions and donors in supporting project implantation. It facilitates the establishment of partnerships, provides funding for pre-project assessments and feasibility studies, with its secretariat and management based at the DBSA.

Nominate now for prestigious WISA Award

People have until 15 February to submit their nominations for the prestigious Water Institute of Southern Africa (WISA) Dr CG Cillié Award.

This award, administered by WISA's Anaerobic and Sludge Processes Division, acknowledge high-level research in anaerobic and sludge processes and technologies. Awarded biennially, the award goes to a student who made the most significant contribution to the understanding and application of anaerobic and sludge handling processes and technologies. The award consists of a trophy and a R3 000 cash prize.

To submit a nominee, contact Bileen Nel at Tel: (035) 753-5283 or E-mail: bileen@yay-us.co.za

Water savings in the pipeline for CT

Work has been completed on a new pipeline that will distribute treated effluent water from the City of Cape Town's Athlone Wastewater Treatment Works, to surrounding areas.

"Despite Cape Town's rapid growth in population and industrial expansion we have shown a significant 26% saving in water usage by the end of the previous financial year on 30 June and the new pipeline will help us improve on that figure," says Alderman Clive Justus, Mayoral Committee Member for Utility Services. "Five years ago the City implemented a programme to save water and, in June 2007, we adopted a R75-million Water Demand Management Strategy to reduce unnecessary losses and wastage. The new pipeline will now make purified and treated sewage effluent of high quality available for re-use."

The treated effluent is suitable for irrigation and industrial processes where it is not necessary to use potable water. Treated effluent is currently distributed to the Durbanville farming area, the Chevron oil refinery in Milnerton, the Century City development and to various local schools and sports fields. Interest has also been expressed by the Grand West Casino, the Old Mutual complex, several factories in Epping, schools, sports fields and two golf courses along the route of the pipelines.

The initial supply will be approximately 21 million ℓ/m and the plant has ample capacity to further increase this supply as more users are linked to the network. The project cost R34-million. This includes the construction of a pump station for distribution, three pipelines, filter banks, electrical control panels and ponds to store the treated effluent.

Construction has been completed on the three pipelines, one from Grand West towards Thornton Station, which then follows the Elsieskraal canal through Pinelands towards the N2. A second pipeline has been constructed along Jan Smuts Drive in the direction of Sunrise Circle, turning off along Avonduur Road and crossing Forest Drive and then linking up with the Elsieskraal pipeline. The third pipeline has been constructed parallel to the N2 in front of the old Athlone Power Station, through Langa and Bonteheuwel towards Epping Industria.

Editor of leading scientific water journal retires

Editor of South Africa's leading scientific water journal, Ingrid Buchan, is retiring.

Buchan joined the *Water SA* team at the Water Research Commission (WRC) in 1984. "Before I arrived at the WRC I had envisaged the science editor's job as being the quiet pursuit of scholarly publishing, much intellectual discourse, promoting and upholding editorial freedom, simulating readers to learn more, educating them about what is known, and informing them of new research," she says.. "While these lofty ideals certainly became part and parcel of the daily life of this editor, the sheer pace of the place came as a complete surprise."

With assistance from referees and the members of the editorial board, Buchan managed to take the journal to the next level. "Slowly but surely one built the confidence to run a busy editorial office, calm unhappy authors and resolve disputes. The journal prospered as eager authors now entrusted us with their high-quality papers and made *Water SA* their journal of choice. Growing numbers of enthusiastic readers started supporting us."

Buchan achieved several highlights during her tenure as editor. In 2005, the journal appointed its first editorial board and moved from being mainly paper-based to being primarily electronic, becoming a free online e-journal. "Although I had had reservations about the move, and had anticipated a huge loss in readership, I was pleasantly surprised by the resilience and depth of the journal," she notes.

Since then, the journal has gone from strength to strength. In 2007, *Water SA* achieved an Impact Factor of 1.120, its highest ever, thereby setting its own benchmark. Another highlight has been the move to digitise all back copies, creating a digital archive of the entire *Water SA* collection, dating back to the first edition in 1975.

Buchan has been awarded the Aqua Vita Est Award by the Water Institute of Southern Africa (WISA) for her efforts in contributing to the success and esteem of the organisation.

Buchan is succeeded by Tamsyn Sherwill.

Nominations sought for industrial water awards

The 2010 Stockholm Industry Water Award is open for nominations.

The Award recognises the business sector's contribution to sustainable water management by minimising water consumption and environmental impact. It is given to any sector of business and industry. The Award recognises improved performance in production processes, new products and management, as well as innovative approaches in water and wastewater process technologies, which together help to improve the world water situation.

The Award was established in 2000 by the Stockholm Water Foundation in collaboration with the Royal Swedish Academy of Engineering Sciences and the World Business Council for Sustainable Development. It is administered by the Stockholm International Water Institute.

The 2009 winner was Trojan Technologies, a Canadian developer and proponent of large-scale ultraviolet water disinfection systems used worldwide. For more information, Visit: www.siwi.org/stockholmindustrywateraward

Water pests turned into asset

Communities blighted by water hyacinth may soon view the aquatic weed as an asset rather than a scourge, thanks to a technique devised in the Philippines to turn the plant into a textile.

Scientists from the Philippine Textile Research Institute at the country's Department of Science & Technology have made fibres from the stems of the water hyacinth *(Eichhornia crassipes*). These can be blended with polyester to make clothing and domestic textiles.

E. crassipes is almost 60% cellulose – a complex carbohydrate. To turn the stems into usable fibres they must undergo a series of treatments, including

boiling to soften them and reduce their moisture content, reports Nora B. Mangalindan, officer in charge of the research.

Holia Onggo, a researcher at the Research Centre for Physics at the Indonesian Institute for Science says that, handled well, water hyacinth can be transformed into a source of income for communities. According to Onggo, a number of practical uses have been found for the plant. Stems can be turned into furniture, paper and handicrafts, for instance, or used to create fertilisers or biogas.

Source: www.scidev.net

Water shortage fuelling displacement of thousands of Iraqis

According to a UNESCO study, over 100 000 people in northern Iraq have been forced to evacuate their homes since water supplies began to dwindle in 2005.

Drought and excessive well pumping have drawn down aquifer levels in the region, causing a dramatic decline of ancient underground aqueducts, known in Iraq as karez, upon which hundreds of communities depend. The study is the first to document the effects of the ongoing drought on the karez systems.

Since the onset of the drought four years ago, 70% of the active karez have dried up. The overexploitation of groundwater by modern pumped wells has also been a major factor.

By August last year, only 116 of 683 karez systems in northern Iraq still supplied water to their beneficiaries. Before the onset of drought, the greatest threats to the karez in Iraq were political turmoil, abandonment and neglect. Hundreds of communities lost their karez during the 1980s Anfahl campaign launched by the previous regime. Others saw theirs dry up when wells were dug nearby.

Today, few people in Iraq know how to maintain or repair them, and this causes the karez to stop functioning over time. The rapid decline of karez is forcing entire communities to abandon their homes in the pursuit of new sources of water. Population declines have averaged almost 70% among the communities adversely affected since 2005. The village of Jafaron, one of the hardest hit in the region, witnessed 44 of its 52 karez dry up in 2008, leaving its only source of food – 113 ha of irrigated land – barren, and prompting most of its population to emigrate.

An additional 36 000 people are on the brink of abandoning their homes if conditions do not urgently improve. Beyond the trickle of water that they receive from their karez, these people are relying on water tanks, which must be refilled several times by trucks travelling long distances, or pumped wells, which often need to be dug deeper.

UNESCO has been working with the government of Iraq to rehabilitate karez systems since 2007, and plans to launch the new Karez Initiative for Community Revitalisation this year. The project will aim to help rural communities rebuild their karez and promote better livelihoods.

World species disappearing fast

More than 1 000 freshwater fish species and 1 900 of the planet's amphibians are threatened with extinction, reflecting the strain on global water resources.

This is according to the latest *Red List* published in November.

Published since 1963 by the International Union for Conservation of Nature (IUCN), the *Red List* provides an annual status of species and subspecies on a global scale – highlighting those threatened with extinction and promoting their conservation. According to the list, 12% of all known birds, 28% of reptiles and 25% of invertebrates are under threat. Among the animals threatened is the Kihansi Spray Toad from Tanzania, which is thought to be extinct in the wild due to the construction of a dam which destroyed their habitat in the Kihansi Falls, removing

90% of the water flow to the gorge. Nearly 70% of the world's plants are also in danger of disappearing.

"The scientific evidence of a serious extinction crisis is mounting," said Jane Smart, Director of IUCN's Biodiversity Conservation Group. "The latest analysis of the *Red List* shows that the 2010 target to reduce biodiversity will not be met. It is time for governments to start getting serious about saving species and to make sure it's high on their agendas for next year, as we're rapidly running out of time."

The year 2010 has been declared the International Year of Biodiversity.

Airborne nitrogen affecting alpine lakes

The impact of airborne nitrogen released from the burning of fossil fuels and widespread use of fertilisers in agriculture is much greater than previously recognised – extending even to remote alpine lakes. This is according to a study published in a November edition of the journal *Science*.

Examining nitrogen deposition in 90 alpine and subalpine lakes in Colorado, Sweden and Norway, James Elser, a limnologist in the School of Life Sciences at Arizona State University and his colleagues found that, on average, nitrogen levels in lakes were elevated, even those isolated from urban and agricultural centres. It was also revealed that nitrogen-rich air pollution has already altered the lakes' fundamental ecology.

Economists failing to account for 'natural capital' – Report

Many economists are failing to assess the value of their countries' natural resources, putting billions of people's well-being at risk and contributing to catastrophic species loss, according to a new United Nations Environment Programme report. *The Economics of Ecosystems and Biodiversity for Natural and International Policy Makers 2009*, released late last year, states that governments must adopt better accounting systems that measure the true value of natural resources, and integrate them into government decision-making.

World nature organisation WWF has welcomed the report, urging governments to heed the call to reform their economic policies to halt the destruction of natural resources. "Governments need to pay attention to this report and start looking at nature in a more holistic way," said WWF Director of Global and Regional Policy Gordon Shepherd. "With smarter approaches to economics this can change, but right now we are paying for their ignorance."

Investing in conservation, management and restoration of ecosystems will provide economic returns to society that outweigh the immediate monetary returns of unchecked use of natural resources, such as the clear-cutting of forests or overfishing, according to the report.

"We are running down our natural capital stock, without understanding the value of what we are losing," the report states. "Degradation of soils, air, water and biological resources can negatively impact on public health, food security, consumer choice and business opportunities. The rural poor, most dependent on the natural resource base, are often the hardest hit."

Virtual streams to help restore real ones

Researchers at the University of Minnesota have developed a new computer model designed to help restore real streams to a healthier state. Dubbed the Virtual StreamLab, the model demonstrates the physics of natural water flows at an unprecedented level of detail and realism. A team of researchers, led by Prof Fotis Sotiropoulos, Director of the university's St Anthony Falls Laboratory (SAFL), have completed their first simulation of SAFLS's Outdoor StreamLab, a scaled natural stream along the Mississippi River.

More than 90 data points have been mapped into the computer model resulting in what is believed to be the most accurate model of a real stream to date. The model employs sophisticated numerical algorithms that can handle the arbitrarily complex geometry of natural waterways, features advanced turbulence models, and uses the latest advances in massively parallel supercomputers.

The ability to simulate water flow over topography with this degree of realism provides researchers with the insights necessary to improve sustainable stream restoration strategies, helping to optimise techniques to fight erosion, help prevent flooding and restore aquatic habitats in degraded waterways.

"The practice of stream restoration has had a rocky rate of success as practitioners have struggled to alter a natural system with countless unknowns," said Sotiropoulos. "The need for more effective and reliable stream restoration strategies is clear, but the underlying physical processes which govern the behaviour of a stream and its inhabitants are very complex. Our new model should provide researchers with a deeper understanding of those complexities."

Diarrhoea three times more deadly than previously thought

Diarrhoea kills three times more over-five-year-olds in Africa and South-East Asia than previously thought.

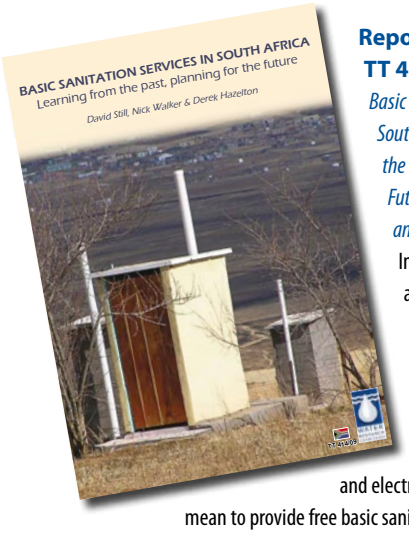
This is according to research commissioned by the World Health Organisation. Some 1,5 million over-fives – thought to be mostly adolescents and the elderly – are dying in these regions every year from diarrhoeal diseases. Historically, the death toll for these areas was estimated to be 380 000.

Preliminary results from the study were presented at the latest meeting of the Foodborne Disease Burden Epidemiology Reference Group (FERG), which took place in Geneva, Switzerland last year. "These estimates highlight the significant burden of diarrhoeal diseases in adolescents and adults in the developing world," said Martyn Kirk, Chair of the FERG Enteric Diseases Task Force, who presented the results.

The new estimate is on par with the global annual death toll for malaria. It is also equivalent to nearly one-third of all HIV/Aids deaths and to almost half the number of global deaths from tuberculosis.

Source: SciDev.Net

New from the WRC



Report No: TT 414/09

Basic Sanitation Services in South Africa: Learning from the Past, Planning for the Future (D Still; N Walker and D Hazelton)

In 2001, South Africa adopted a policy of free basic services to the poor. These services include water supply, sanitation, refuse removal and electricity. What does it mean to provide free basic sanitation to the poor? In March 2009, the Minister of Water Affairs & Forestry approved the Free Basic Sanitation Implementation Strategy. This document is intended to give water services authorities a framework for planning and operating sanitation services for the poor. It provides substantial leeway to municipalities to determine how to go about this, depending on their geography, demographics, income distribution and capacity.

Report No: 1679/1/08

Integrated Ecological-Economic Modelling as an Estuarine Management Tool: A Case Study of the East Kleinemonde Estuary. Volume 1: The Economic Value of the East Kleinemonde Estuary and Impacts of Changes in Freshwater Inputs (J Turpie; A Joubert; H Babiker; J Chaudhry; M Child; T Hempson; G Humphrey; G Joseph; R la Grange; M Lipsey; G Mann; N Okes; J Puttick and T Wistebaar)

Co-funded by the University of Cape Town, this study is part of a greater WRC project aimed at developing an integrated ecological-economic model of the East Kleinemonde estuary to enable the assessment of different water flow and management scenarios in both ecological and socio-economic terms. This volume reports on the efforts to collect the economic data necessary to complete the economics component of the model.

Report No 1679/2/08

Integrated Ecological-Economic Modelling as an Estuarine Management Tool: A Case Study of the East Kleinemonde Estuary. Volume 2: Model Construction, Evaluation and User Manual (J Turpie; B Clark; P Cowley; T Bornman and A Terörde)

Co-funded by the University of Cape Town, this study is part of a greater WRC project aimed at developing an integrated ecological-economic model of the East Kleinemonde estuary to enable the assessment of different water flow and management scenarios in both ecological and socio-economic terms. This volume reports on the study to investigate the economic value of the East Kleinemonde estuary, and how this value might change with a change in estuary condition. In particular, the study concentrated on the direct use value (mainly recreational) and the non-use (or existence) value of the estuary.

Report No: 1577/1/09

Increasing Water Use Efficiency of Irrigated Sugarcane by Means of Specific Agronomic Practices (FC Oliver; NL Lecler and A Singels)

In the South African sugar industry about 25% of the total sugarcane crop is produced in the northern irrigated areas of KwaZulu-Natal and Mpumalanga. Low irrigation water use efficiency has been identified as a major problem in the northern irrigated areas in spite of a very high climatic potential. Recent surveys among sugarcane farmers have also indicated that there is a huge need for more information on techniques for maximising efficiency in utilising the limited water resources in the area while minimising the loss of production associated with reduced water availability. The main objective of this project was to increase low irrigation water use efficiency and profitability of irrigated sugarcane production by formulating a set of best management practices, including optimal use of trash blanketing, variety, row spacing and irrigation.

Report No: 1529/1/09

The Testing of a Membrane Technology Unit for the Removal of Nitrate, Chloride, Fluoride, Sulphate, Calcium and Magnesium Pollutants for Groundwater, and the Monitoring of Rural Consumer Knowledge and Attitude to Water Purification (M Hlophe and MD Venter)

Madibogo is one of many rural villages in North West that depend on groundwater and are experiencing a problem with nitrogenous pollution. Tests performed on groundwater from this community indicated high concentrations of nitrate, chloride, calcium and magnesium ions whose concentrations were respectively 23,6 ppm, 637 ppm, 176 ppm and 102 ppm. In this study, the use of membrane technology (nanofiltration and reverse osmosis) was investigated for the removal of excess concentrations of these determinands in brackish groundwater at Batlhaping Primary School in Madibogo village. Since membrane technology is relatively new in South Africa, an important aspect of the study was determining how the community would receive this type of water purifying methodology.

Report No: 1395/1/09

Upgrading Existing South African Filtration Plants to High Rate Filters (PA Thompson; B Brouchkaert; M Ngcekwa; R Rajagopaul; S Budhram and M Mhlongo)

The capital cost of water treatment plants doubled from R1 500/m^3 to R3 500/m^3 between 2005 and 2008. It is anticipated that these costs could increase even further over the next few years. It is thus imperative that researchers and practitioners explore the options of minimising the capital costs of treatment plants without compromising public health. Filtration is one of the most critical unit processes in the treatment process. There is a drive to increase the filtration rate of the filters to achieve higher filter loading rates in order to delay capital

WEBSITES

www.artificialrecharge.co.za
This is the website of the South African Artificial Recharge Information Centre. Supported by the Department of Water Affairs, the site aims to increase awareness of, and utilisation of, artificial recharge as a water management strategy.

www.gwd.org.za
The Groundwater Division of the Geological Society of South Africa has established a new website. Among others, the website offers interesting snippets of groundwater news, as well as related documents and events.

www.regulationbodyofknowledge.org
Created with funding from the World Bank and the Public-Private Infrastructure Advisory Facility (PPIAF), this website provides resources for capacity building and policy analysis in the field of infrastructure management and regulation.

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expenditure on new infrastructure. This report provides the practising engineer with a guide for the design and operation of pilot plants to establish the design parameters for the full-scale upgrade of a water works. A survey of the South African filtration industry indicates that there is limited application of the technology, which is contributing to the high unit capital costs of water treatment plants. Recommendations for the full-scale design and operation are also included in the research report.

Report No: TT 412/09

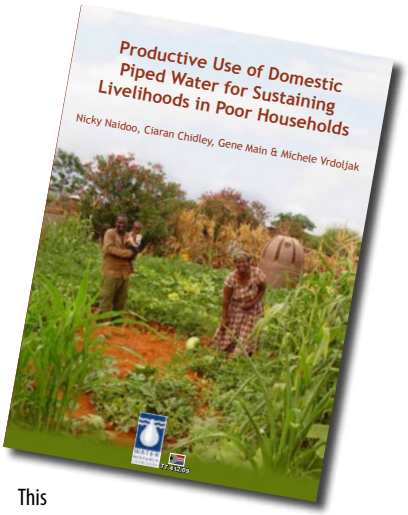
Productive Use of Domestic Piped Water for Sustaining Livelihoods in Poor Households (N Naidoo; C Chidley; G Main and M Vrdoljak)

This study investigated aspects of the provision of productive water to poor households. Specifically, the study aimed at determining whether the provision of domestic piped water for productive uses is featured in national policies, legislation and strategies. The study also reviewed both local and international literature to determine the trends in the provision and use of domestic piped water for productive uses. Lastly, through selected case studies, the following was investigated: whether domestic piped water is being used for productive uses; the types of productive uses; and the volume of water used for each productive use.

Report No: 1772/1/09

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

In line with many countries across the world, South Africa has developed its own biofuels strategy.



This strategy is generally considered to be conservative, tempering the international drive towards large-scale biofuel production with a pragmatic approach towards a goal of 2% biofuel penetration within five years. Impacts on water resources are a major concern in the production of biofuels with several international studies highlighting that water use in the feedstock production phase is the biggest unknown factor when quantifying the water used in biofuel production. The WRC instigated a study in 2007 to assess both the potential growing areas and water use of potential biofuel feedstocks in South Africa. Among others, the objectives of the study were to identify all crops and trees grown in South Africa that can be used as a biofuel feedstock; assess the available knowledge on water use of these crops and trees; estimate water requirements where knowledge is lacking; and determine existing gaps in knowledge regarding water use and crop parameters.

WATER DIARY

WATER TREATMENT
FEBRUARY 8-11

The University of Stellenbosch is hosting a short course on Water and Wastewater Treatment in Cape Town. *Enquiries: Elmien Lovell; Tel: (021) 808-4352; E-mail: elmienl@sun.ac.za*

WATER & SANITATION
MARCH 15-18

The International African Water and Sanitation Congress and Exhibition will take place in Kampala, Uganda. The event is organised by the African Water Association and the National Water and Sewerage Corporation of Uganda. *E-mail: info@afwa-hq.org or afwacongress2010@nwsc.co.ug*

WATER & SANITATION
APRIL 18-22

The WISA Biennial 2010 conference is taking place at the International Conference Centre in Durban. *Visit: www.wisa2010.org.za*

TRANSBOUNDARY WATER
APRIL 12-23

The Stockholm International Water Institute will be hosting an international training programme in transboundary water management in Mozambique and Swaziland. This training programme provides a meeting place for professionals involved in water issues around the world, with the aim of building both personal and institutional bridges. *Enquiries: Anton Earle, E-mail: anton.earle@siwi.org or Björn Hansson, E-mail: bjorn.hansson@ramboll.se*

WATER BY NUMBERS

- **4 000 Mℓ/day** – The estimated demand for water from Rand Water by 2012.
- **4 661** – The number of environmental cases reported nationally in 2008/09. During this period the total number of criminal dockets registered was 2 412 compared with 1 762 in the previous reporting record. A total of 258 convictions were obtained.
- **40%** – Irrigated agriculture's current contribution to the world's food production.
- **R5-million** – The money spent by the Limpopo Department of Agriculture during the current financial year on drought mitigation in the province.
- **R500-million** – The value of the water project for which a joint agreement has been signed between the South African and Dutch governments. The project aims to supply 165 000 people in the rural Zululand District Municipal area with potable water.
- **R452-million** – The monies Soweto residents owe on their water bills, according to *the Star* newspaper.
- **10 days** – The average time a water molecule spends in the air once evaporated.
- **215 000 ℓ** – The average volume of water required to produce one metric ton of steel.
- **1 120 km** – The length of the Vaal River, the main tributary of the Orange River, and one of South Africa's main rivers.
- **300 ℓ** – The average volume of water required to produce a kilogram of paper.
- **1832** – The year the world's first municipal water filtration works opened in Paisley, Scotland.
- **35** – The age (in years) of the average large dam in the world today.
- **2 650** – The average number of people employed by Johannesburg Water.
- **200 km** – The length of concrete pipes that still remain in Rand Water's pipe network of 3 000 km. Over the next five years, the water utility plans to replace the last of its concrete pipes with steel pipes where the condition is no longer acceptable.
- **23,2%** – The level of the Garden Route Dam, George's main water source, at the end of November.

SRK's Pretoria office turns ten

The Pretoria office of SRK Consulting celebrated its tenth year in November last year. The Pretoria office is one of 37 SRK Consulting branches in 16 countries.

SRK partner and founder of the Pretoria office, Matt Braune, reported that the Pretoria office initially focused on stormwater management and river rehabilitation projects. Today, professional services offered have grown to include disaster risk assessments, planning for disaster management centres and compilation of disaster management plans for national government, local authorities and southern African countries, as well as water resource assessment and environmental management. These professional services were further enhanced when the office established a GIS applications section. "We have all the specialist skills to drive these initiatives," said Braune. The Pretoria office liaises with other SRK offices regarding contracts in other parts of South Africa and beyond.

Moses Maliba (Ekurhuleni Metro), Matt Braune and Brian Middleton (SRK Consulting)

Looking forward, Braune said new strategic initiatives in the Pretoria office are asset management, relating to the creation of asset registers for local authorities concerning stormwater networks and enterprise risk management. "We will also go further into environmental compliance for both the industrial and governmental sectors. This will be expanded under the umbrella of disaster management."

Utility unveils upgraded sewage treatment plant

Johannesburg Water has unveiled its upgraded Northern Wastewater Treatment Plant.

The Northern Works is by far the biggest in the city. Rapid population growth and extreme weather put pressure on the works. This resulted in the works becoming unable to cope and, at times, led to spillages when the sheer volume of water reaching the works exceeded its ability to treat it.

Hence Johannesburg Water embarked on a project to increase the capacity of the plant. The ultimate treatment capacity of the new unit will be 150 Mℓ/day constructed in three increments of 50 Mℓ/day to pace the growth in wastewater flow to the works.

The new treatment plant includes sedimentation, flow balancing, biological nutrient removal, activated sludge treatment with supplementing chemical dosing facilities, secondary clarification, effluent disinfection and effluent outfall and site services.

On the sludge treatment side, the plant includes primary sludge fermentation with disposal of the fermented sludge to the previously refurbished digesters from Unit 2, waste activated sludge thickening in gravity thickeners. The thickened sludge is then treated in dewatering facilities under a separate project to handle the increased sludge masses from the new treatment capacity.

Foreign students find new home at SA groundwater firm

Four international interns have arrived at Cape Town earth sciences consultancy Umvoto Africa.

This brings the total of young people who have gained experience at the consultancy to 40. Undergraduate and honours students from the Cape Peninsula University of Technology, Fort Hare, Cape Town, Stellenbosch, Pretoria and Limpopo universities have come to gain experience at the firm. Masters students have travelled from as far afield as the UK, Germany and France, while students from African countries such as Madagascar and Kenya have also benefited from Umvoto's interns programme.

New intern Matt Webb (26) hails from the Lake District in the UK. He recently finished his masters degree at Birmingham University. He is focusing on modelling work for a long-term Umvoto project for the Overstrand Municipality, where the firm discovered an excellent groundwater supply and is now testing the aquifer and monitoring systems for long-term sustainability.

Anne Rosenkranz (23) is completing her B.Sc in Geosource Management at the University of Aachen, in Germany. This is her first work experience and she is keen to get an overview of various hydrogeology specialisations before studying for her masters degree.

Vancouver-born Paula Hay (22) has completed a degree in Social Science at the University of Utrecht. She has visited South Africa on several occasions, and is assisting with an Umvoto project exploring social vulnerability linked to water issues.

Len von Scherenberg (24) is in his last year of Water Management Studies at Germany's Dresden University. He plans to do his masters thesis after the internship. He is currently working on a project in the Eastern Cape, focusing on literature research and examining geological maps to assess groundwater resources.

"The interns programme has become internationally renowned since Umvoto first accommodated students about nine years ago, says Helen Seyler, who oversees the programme. "It is a highly instructive environment as South African and foreign students learn from one another while gaining practical experience on cutting-edge projects. Our goal is to access funding, accommodation and institutional support for the students, as to date the company has supported the initiative single-handedly."

The Gansbaai Water Treatment Works was one of the Technical Excellence Winners in this year's AQUATANSAICE Most Outstanding Civil Engineering Project Awards. With the award are Garth Gademan of SSI, Stephen Müllar and Peter Scholtz of Overstrand Municipality and Francois Gibbons of SSI.

WRC project reaches out to future scientists

Projects funded by the Water Research Commission (WRC) not only impact positively on the end-users of the research outcomes, and the scientists and post-graduate students doing the research, but also on future scientists.

So a number of high-school learners have benefited from a joint bioprospecting project between Stellenbosch University (SU) and the CSIR. Funded by the WRC, the project is aimed at obtaining anammox bacteria from different South African environments. Initiated to find a specialised group of bacteria able to oxidise ammonia to nitrogen gas, the project holds great potential for the future of wastewater treatment.

The project has already touched the lives of several prospective scientists. Grade 11 learners from selected schools around Stellenbosch, who showed the best marks in science, have been invited to visit the facilities of the Department of Microbiology at SU. Among others, the learners have been given the opportunity to obtain some first-hand experience with the basic methods used in microbiology, such as how to work with a microscope, aseptically prepare dilution series and spread plates, as well as separate DNA fragments using gel electrophoresis.

The schools involved were Kayamandi High School, Kylemore High School, Lückhoff High Senior Secondary School, and Stellenbosch High School. In addition, bursaries ranging from R500 to R1 500 have been presented to learners with top science marks. The bursaries were sponsored by CSIR, SU and the WRC.

In other news from the project, Wendy Stone, the student involved in the project, not only passed her honours degree *cum laude*, she has also been awarded as the most outstanding honours student by the South African Society for Microbiology. According to project leaders Prof Alf Botha and Dr Jac Wilsenach, these achievements could not have been accomplished without the support of the WRC and they thanked the institution for their commitment to investing in the future of the country.

Right: *Dr Jac Wilsenach of CSIR and post-graduate student Wendy Stone on the open ocean during a sampling exercise for anammox bacteria from the ocean floor off St Helena Bay.*

Far right: *Vusumzi Ncaphayi of Kayamandi High School receiving a bursary, sponsored by the WRC, for most outstanding learner in the field of science, from Prof Alf Botha of Stellenbosch University.*

Delegates training in management of aquifers

A successful training course on risk management of aquifers has been presented at the University of the Western Cape (UWC).

The course was presented by Geohydrological and Spatial Solutions International (GEOSS) and sponsored by the FETWater programme. FETWater is jointly funded by the Flemish government, UNESCO and the Department of Water Affairs (DWA), with the Water Research Commission acting as the implementing agent.

The course was given in the form of field monitoring and the use of various items of field equipment was demonstrated by members of the DWA, UWC and GEOSS. Delegates representing UWC, DWA and various municipalities commented on the standard of excellence enjoyed in conveying a complicated topic in an simple, yet informative, manner. In addition to the course itself, an informal social event provided excellent opportunities for networking and the sharing of knowledge – one of the aims of FETWater.

Delegates attending the course on risk management of aquifers presented at the University of the Western Cape.

Mine saves millions through ZERO DISCHARGE PLAN

Lani van Vuuren

At the on-site water treatment plant water is treated to both process and potable quality.

In a water-scarce South Africa, mines are not only compelled to prevent potential pollution of the aquatic environment, they also have to use their freshwater allocations sparingly. Xstrata's Eland Platinum Mine is proving that, with long-term vision and dedicated effort, mines can do both. Compiled by Lani van Vuuren.

The availability of water is fast becoming one of the major elements restraining the expansion of mining in South Africa. While not the biggest users of water in the country, the mining sector does require large volumes. In many instances existing bulk water infrastructure was developed with agriculture and industry in mind, and mining operations have to compete with these users for available water resources.

When additional bulk water infrastructure schemes are constructed for new mining developments, as is largely the case with the De Hoop Dam, mining companies are compelled to sign off-take agreements to help finance these schemes. The off-take agreements 'force' mines to buy a certain volume of water; irrespective of whether they use it or not.

Typical new raw water costs are more than R10/m^3. In this case there are no incentives for mines to use less water. As a result, simply constructing more expensive bulk water schemes are not an attractive option – both for the environment and for mining companies. In addition to water security issues, continued pressure from government and public forums are prompting mining houses to improve their environmental management practices.

DRAWING UP A PLAN

Situated outside Brits, in North West Province, Eland Platinum is situated in the western portion of the platinum-rich Bushveld Igneous Complex. The mine became operational in 2006, and in late 2007, it was bought by Xstrata Alloys. An opencast operation, the mine produces about 200 000 t a month.

The mine requires about 3 million m^3 per year of water, which is traditionally fed to the mine from the Hartbeespoort Irrigation Board canal system. However, this water supply can, at times, be erratic, due to, for example, unexpected maintenance and blockages in the system. Water quality is also affected by high nutrient levels and algae blooms.

Along with the erratic water supply, the mine experiences ingress of water into its opencast pits. Once in the pit, this water becomes polluted with suspended solids, hydrocarbons and other

contaminants. When this water seeps out into the environment and underlying aquifer it can affect downstream users, including farmers.

Historically, seepage water from the open pit was captured and retained in a dam on site, named Lapa Dam. However, it was found that the spillway of the dam had developed leaks, which further increased seepage of dirty water into the environment.

In 2008, a decision was made to optimise Eland Platinum's local water resources and improve water management. The mine came up with an integrated groundwater resource management plan. The primary aim of the plan is to introduce a culture where groundwater is viewed as a sustainable partner rather than as a risk to be managed.

The plan is designed to ensure that both the environment and the mine benefit from proper groundwater management. The strategy is framed by four phases: real-time monitoring, resource and system modelling, resource protection and training and development.

Groundwater inflows into open-pit area.

Courtesy Eland Platinum

Prior to the implementation of the mine's zero discharge plan, water pollution was a constant headache.

EARLY PHASES

During the initial phase, specialists worked together to prove the value of the integrated approach, explains independent consultant Fanie Botha. "Hydrogeological understanding was gained through adapting mineral resource exploitation data, thereby building a better conceptual hydrogeological model."

Core data was used to position water exploration boreholes and strikes with yields up to 30 ℓ/s were recorded. The mine now became aware of deep-seated water which could be removed before the aquifers are intersected by mining works.

ZERO DISCHARGE PLAN

One of the most important tasks under the integrated groundwater resource management plan is the zero discharge plan. The mine-water management team developed a site-specific integrated dynamic simulation model providing options to exercise zero water discharge from the operation and reducing the need for the abstraction of surface water for the mining operation.

Water is pumped from the open pit at a rate of between 450 and 900 m^3/h. The pumping can continue for anything between ten minutes and 24 hours, depending on the volume rainfall and fissure water. To improve handling of the dirty water, it needs to be pumped at a more constant rate, explains Botha. "This means water from the open pit needed to be captured and released at a constant rate."

Following a detailed site visit three retention dams were identified. Upstream it was decided to construct a stilling basin to serve as a first retention dam. An existing farm dam was identified as the second retention dam. The wall of this dam had been opened by the previous mine owners and the dam no longer functioned. The Lapa Dam, situated

Lani van Vuuren

Independent consultant Fanie Botha.

Lani van Vuuren

***Above**: At Eland Platinum Mine, outside Brits, in the North West water flowing into the opencast pit is captured and stored for re-use.*
***Below**: Captured water is used for, among others, dust suppression.*

Lani van Vuuren

downstream from the old farm dam, would serve as the third retention dam. A stilling basin would also be constructed to allow solids to settle before the water is captured in the old farm dam.

The stilling basin was constructed using gabions from fresh waste rock coming from the open pit. The old farm dam wall was repaired using the same material as well as limited fine material, also from the open pit. "This permeable dam wall creates an almost constant flow rate. It also acts as a stilling basin, allowing solids to settle further," explains Botha.

The Lapa Dam was re-designed to capture and pump excess water to the process water dam or raw water storage dam. All raw materials except the reinforced concrete came from the open pit. The dam wall was covered and compacted with moderately weathered norite. This lowers the risk of failure and ensures safer access to the spillway, notes Botha.

The pump system comprises a small artificial recharge basin with two boreholes equipped with submersible pumps. Each pump can transfer 25 ℓ/s. Both pumps are electronically controlled and are able to handle low and high flow volumes.

This water is treated on site at a specifically designed water treatment plant, operated on behalf of the mine by Fraser Alexander. The plant, which has a capacity of 300 m^3/h, has two streams – water is treated both to process water quality and to potable water quality.

Regular on-site testing and monthly laboratory analysis of the process streams conducted at an off-site accredited facility ensure that the respective plant performance remain within the required standard. In addition, Fraser Alexander is responsible for identifying and implementing suitable technologies to improve the efficiency and performance of the water treatment works over the contract period and to provide support and input into broader water management activities.

IMPROVED WATER MANAGEMENT

Apart from the obvious benefits to the environment, the zero discharge plan has brought Eland Platinum significant gains. The mine's conjunctive use of groundwater, surface water and return water (from the tailings dam) has greatly reduced the mine's dependence on surface water to the extent that it now only uses about 780 000 m^3/year. As a result of its reduced dependency, the mine is also paying much less for its water. The mine's reduced dependence on surface water has freed up that water for other uses, such as irrigation.

Eland Platinum's water requirements may double in the near future. Development of the first two underground decline shaft systems, which will replace the limited-life open-pit operations, has already started. However, the mine's water management system will allow it to be completely self-sufficient in the future.

THE WATER WHEEL

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TURNING UP THE HEAT – Research project investigates water temperature effects on freshwater systems

All photographs Helen Dallas

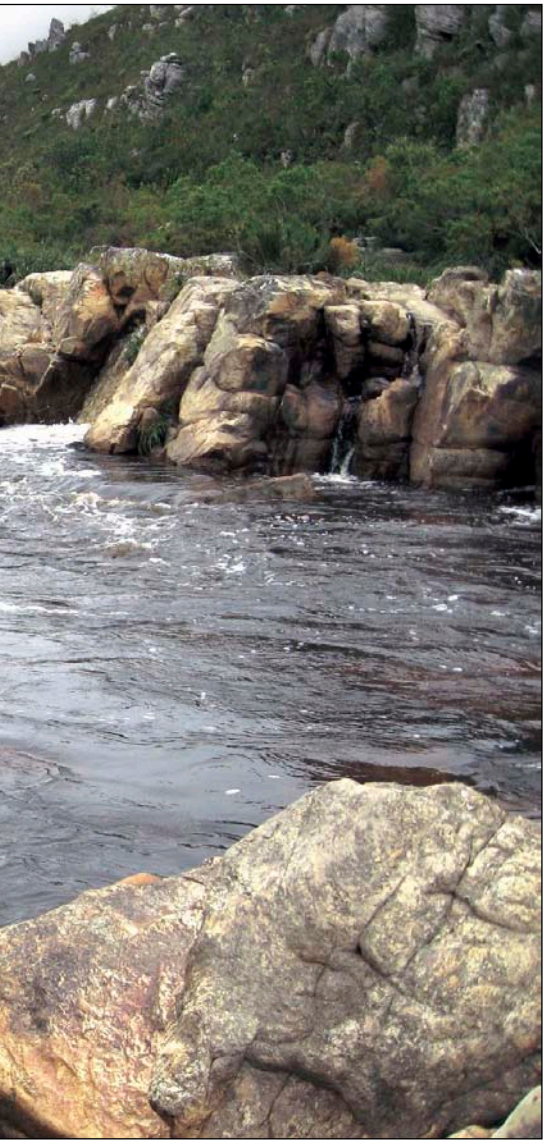
A four-year-study, funded by the Water Research Commission (WRC) is investigating water temperature in rivers and biotic response. Article by Sue Matthews.

Climate change is likely to have a range of impacts on South Africa's freshwater resources, causing a ripple effect of socio-economic consequences and putting the country's already stressed systems under increasing strain.

These impacts were explored during a two-day workshop held in the Western Cape in September 2008 and attended by more than 25 specialists. The workshop – jointly funded by the WRC and WWF – was convened by Helen Dallas of the Freshwater Consulting Group and Dr Nick Rivers-Moore (previously of) Ezemvelo KZN Wildlife.

The main repercussion of climate change worldwide is anticipated to be increased air temperatures and shifts in rainfall patterns. In South Africa, higher air temperatures are predicted for the entire country, while rainfall is expected to increase in the east and decrease in the west. The combination of rising air temperatures and lower rainfall in some regions will in all likelihood result in elevated water temperatures in riverine ecosystems, as one of the many side-effects of climate change.

The key point to emerge from the workshop, however, was that climate change is an additional, amplifying driver of system variability, and should not be viewed in isolation. Indeed, a paper published by Dr Dallas in ***Water SA*** identifies a number of other anthropogenic factors that affect water temperature in riverine ecosystems, such as thermal discharges from industrial plants, flow modification due to river impoundment,



inter-basin water transfers, and modification to riparian vegetation, which provides shade from direct solar radiation.

In addition, a variety of natural factors influence riverine water temperature. Obvious examples include regional factors like latitude and altitude, and climatic factors such as air temperature, cloud cover, wind speed and precipitation. But there are also hydrological influences such as the source of water, rate of flow and water volume, and structural influences such as topography and channel morphology, water depth and percentage of pool habitat. Plus, of course, there's spatial and temporal variation, as headwaters of a river system are typically cooler than lowland areas, and temperatures fluctuate according to the time of day and season.

While thermal characteristics of river systems - and the implications for aquatic organisms - have been relatively well studied in the northern hemisphere, information is sorely lacking for the southern hemisphere. In South Africa, particularly, water temperature data are largely confined to spot measurements and monthly trends, which are of limited use in understanding temperature effects on riverine biota.

Clearly, there is a need for fundamental research on water temperature and biotic response in South African systems, not only to understand and predict the impacts of climate change, but also to incorporate water temperature guidelines into the Ecological Reserve. To address this need, Dallas and Rivers-Moore are leading a four-year, WRC-funded research project that also involves the Albany Museum and Institute of Water Research in Grahamstown as collaborating organisations.

The project will allow Dallas – a research associate of UCT's Freshwater Research Unit - to combine her two main areas of expertise, given that she has considerable experience with SASS and other bioassessment tools, and previously co-authored and updated a review of the effect of water quality variables on aquatic ecosystems (WRC Report No: **TT 61/93** and **TT 224/04**).

"I've always been interested in how the physical and chemical aspects of water quality link to biology," she says. "Temperature and dissolved oxygen are two of the key variables that influence what lives where and how it survives. And we know that higher temperatures reduce the solubility of dissolved oxygen in water, decreasing its concentration and hence its availability to aquatic organisms."

The project's first aim is therefore to collect baseline water temperature data,

Project leader Dr Helen Dallas is well known for her work on water quality and the SASS biomonitoring tool. Here she conducts a river health assessment in Tanzania, while Masai children look on.

using loggers that measure temperature on an hourly basis. This ensures that detail is obtained on diurnal variation and temperature extremes, which are likely to be more ecologically significant than average temperatures.

"We've installed loggers at 92 sites on 62 rivers and streams in the Eastern,

Loggers recording air temperature and relative humidity have been installed at some of the study sites to determine their relationship to water temperature.

The water temperature loggers are housed in a protective metal casing and positioned in a run in the thalwag – the point of deepest flow.

Southern and Western Cape, and did the first download in May," says Dallas. "We've also had great collaboration with other research projects, allowing additional data to be sourced from a further 64 sites on 23 rivers."

Once a year's worth of baseline data have been collected, Dr Rivers-Moore will put his speciality to good use in developing a water temperature model to simulate daily minimum, maximum and mean water temperatures. The model will subsequently be refined and verified using the second year's data. At the same time, desktop analyses and laboratory studies will be conducted to understand the effect of temperature modifiers such as turbidity and flow so that these can be incorporated into the model, allowing water temperature time-series to be simulated under a range of different scenarios. Air temperatures are also being recorded at 45 of the study sites, with the ultimate goal of being able to predict water temperature from ambient air temperature.

Getting a handle on the factors that influence water temperature is only one aspect of the project though – the primary focus is to understand how water temperature regimes affect riverine biota. A number of studies are being conducted to achieve this, some undertaken by postgraduate students as MSc projects. One such project is investigating the thermal tolerance of aquatic macroinvertebrates through laboratory experiments. Typically, thermal tolerance studies assess lethal limits in terms of the minimum and maximum temperatures that animals can survive, sublethal effects such as physiological effects and disruption of reproduction and development, as well as behavioural avoidance preferences.

"Our research will initially focus on lethal limits, which should provide good fundamental data on the thermal tolerances of aquatic invertebrates, although there's still a long way to go," says Dallas. "It would be very useful to expand the research to include sublethal effects - such as the effect of temperature on growth, fecundity and fish spawning – and, of course, to develop some experiments to monitor behavioural responses."

Some indication of the effect of temperature on the developmental stages of aquatic insects will also be obtained through field studies on life history traits, such as the number of generations per year and emergence cues for particular species. Seasonal changes in temperature, together with photoperiod

Dr Nick Rivers-Moore

and dissolved oxygen in some cases, are known to affect the timing and duration of emergence, but little information is available for aquatic insects in local rivers. The research will involve monthly sampling of selected species with simultaneous data collection on water temperature, which will be linked to the rivers' hydrological aspects.

In addition, the role of temperature variability in structuring invertebrate communities will be assessed through quarterly surveys of aquatic macroinvertebrates in two river systems with different degrees of thermal variability. Such variability is believed to be important in maintaining temporal partitioning and spatial zonation of invertebrate species.

Since water temperature varies both spatially and temporally, an understanding of these dynamics is critical for ecologically sound river management. A map of preliminary thermal regions of South African rivers will therefore be developed by linking water temperature metrics to suitable spatial surrogates – such as air temperature, elevation or rainfall indices – using multiple linear regression modelling in conjunction with a suitable raster-based geographic information system. This will allow rivers to be classified into homogenous groups with similar thermal regimes, for which thermal guidelines can be set for the Ecological Reserve.

Finally, the project will explore the potential impact of climate and hydrological changes on selected aquatic organisms through scenario analyses, using agglomerative techniques to link biotic response to thermal triggers.

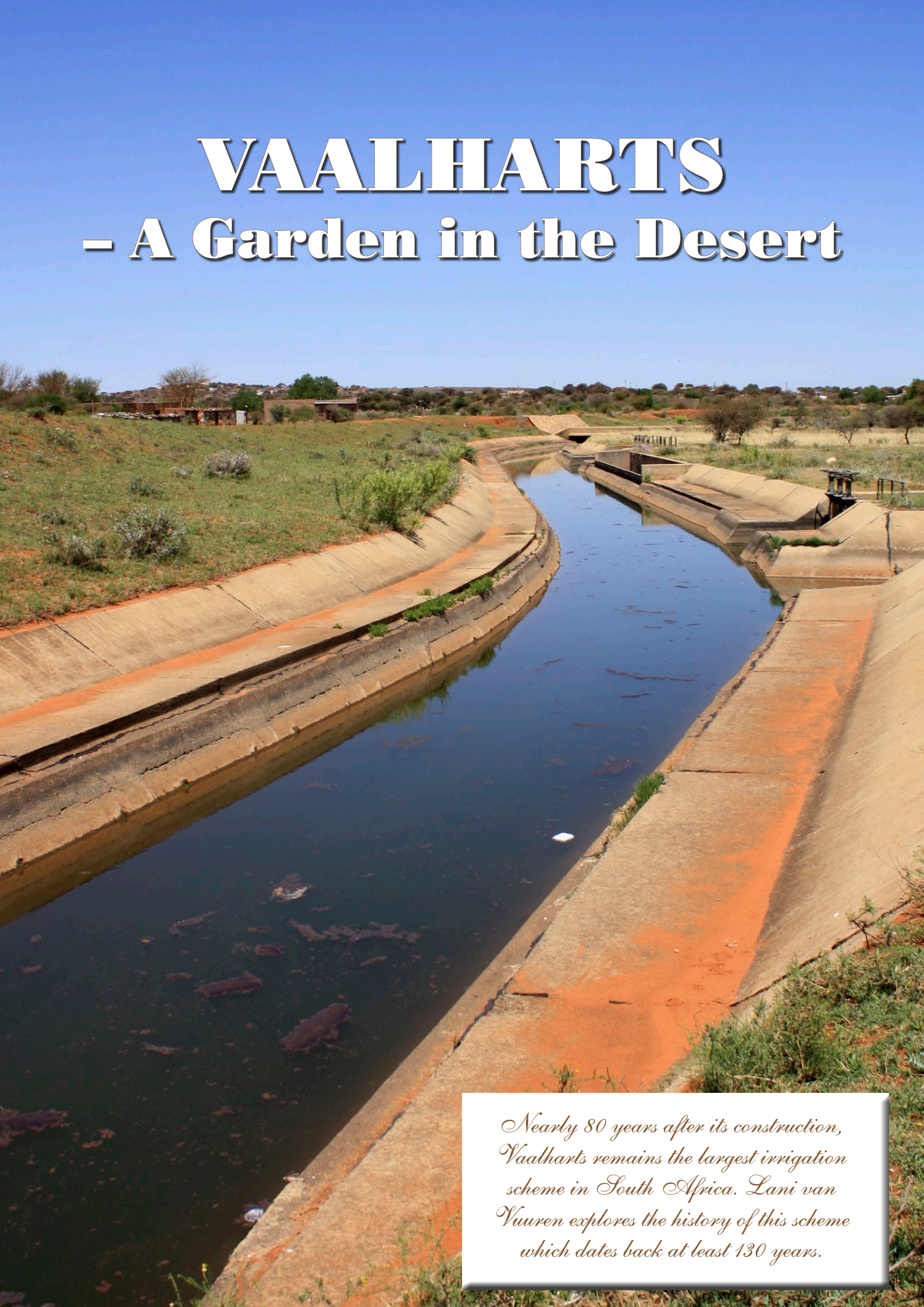
The water temperature loggers are secured via steel cabling onto a bolt drilled into rocks in the river channel. Here Cameron Dallas displays some brotherly love by doing manual labour for his sister's project.

Masters student Vere Ross-Gillespy and Honours student Evans Simeku of the University of Cape Town's Freshwater Research Unit sample aquatic invertebrates.

"For example, we hope to get a better idea of what's in store for aquatic organisms in mountain streams of the Western Cape, which are likely to be particularly hard hit by climate change given the prediction of rising air temperature and lower rainfall. This area is a biodiversity hotspot, with an incredible number of locally endemic insect and fish species," says Dallas. "We also know that fish are more susceptible to diseases and parasites when they are thermally stressed from elevated water temperatures, but what are the risks of outbreaks of pests such as mosquitoes and blackflies, which could have major implications for human health and agriculture?"

Time will tell, but the improved understanding gleaned through this research will hopefully facilitate the process of putting climate change contingency plans and mitigation measures in place. The insight obtained should also be useful in developing an ecologically meaningful water temperature classification for the Ecological Reserve, ensuring better protection of riverine ecosystems from more immediate threats caused by anthropogenic change.

VAALHARTS
– A Garden in the Desert



Nearly 80 years after its construction, Vaalharts remains the largest irrigation scheme in South Africa. Lani van Vuuren explores the history of this scheme which dates back at least 130 years.

Situated at the confluence of the Harts and Vaal rivers on the border between North West and the Northern Cape, the Vaalharts irrigation scheme was first suggested by surveyor-general Francis HS Orpen. He surveyed the area, which then formed part of Griqualand-West after it was annexed by the British in 1871 for the establishment of settler farms.

Orpen found that the Vaal River bed was higher than the Harts River valley floor, making irrigation through the use of gravity-fed canals possible. In his report dated 22 December 1875 he wrote: "It is possible, by taking out the water of the Vaal River near Fourteen Streams, to irrigate about half a million of acres in the Harts River Valley."

The Griqualand-West war broke out before Orpen's idea could be investigated further. In 1882, statesman John X Merriman proposed in parliament that a committee should be appointed to deal with irrigation matters, among others the proposed irrigation works at the Vaal and Harts rivers. The proposal was based on a report by Cape hydraulic engineer John Gamble. Merriman argued that the Vaalharts irrigation works would turn the 'desert into a garden.' Unfortunately the lack of funds prevented anything further to be done on the scheme.

RHODES PUSHES THE VAALHARTS SCHEME

Cecil John Rhodes advocated strongly for the proposed Vaalharts scheme (then known as the Harts River Valley Irrigation Scheme), possibly because of its proximity to the rich Kimberley diamond mines. In 1886, he had already carried a motion to get some land between the Harts and Vaal rivers for the purposes of irrigation. Government granted him the land, however, he was unable to raise the money to implement the irrigation works.

Interestingly, it was Rhodes who first suggested that the land be made available to poor white farmers who had lost everything due to an outbreak of Rinderpest. He argued that the poor whites refused to work in the mines and would rather farm.

At that time the State was not prepared to pay for an irrigation scheme of that magnitude, however, it was decided that Crown Lands between the Harts and Vaal rivers would be granted to any company or individual prepared to implement such an irrigation scheme (at a cost not exceeding £130 000).

Unfortunately, no-one took up this offer. This, despite the fact that some Tswana-speaking and Korana communities had already been displaced in the locality of the proposed irrigation scheme to make room for white settlers. Rhodes even persuaded the government to carry out the works when he was Prime Minister, to no avail. The government's argument was that other parts of the country also needed irrigation works.

In 1898, further efforts were launched to get the Vaalharts scheme off the ground when engineer HC Litchfield was appointed to investigate the possibility of an irrigation scheme in the Harts River valley. The Anglo-Boer War put a stop to investigations a year later.

After the war, the Directors of Irrigation of the Cape and Transvaal (J Gordon and W Hurley) attempted to revive the Litchfield report. Each of them wrote a report recommending the construction of a dam in the Vaal River. Again, there were no funds available.

The Vaalharts scheme was further put on the backburner by J Kanthack, the first Director of the Irrigation Department established after the Union of South Africa in 1910. His argument was that the area in the Harts River valley to be irrigated was too widespread. He thought that the limited resources of the government should rather be devoted to the encouragement of a large number of smaller schemes throughout the country.

THE PLAN IS REVIVED

The Vaalharts irrigation scheme gained new impetus following the first World War as it became government policy to grant land to soldiers returning from the war. The proposed scheme was studied intensively by the Irrigation Department for the first time in 1925. A large number of holes were drilled to test the depth of the soil. During 1926/7 planning of the project started and further precise measurements were made from Border station to Taung. Aerial surveys were also undertaken by the South African Air Force.

DWA

Gangs of ten to twenty men worked mostly with pick and shovel to construct the infrastructure for Vaalharts.

DWA/eWISA

The Vaalharts weir and main canal in 1946. Three hand-operated radial sluice gates of 3 m by 2,7 m make up the inlet sluices. These flow into a three-barrelled aquaduct, which controls the water flowing into the canal.

Vaalharts Water

The Vaalharts weir during construction.

Lani van Vuuren

In 1933, a decision was made to go ahead with the Vaalharts irrigation scheme (along with other large-scale public works) to relieve poverty among the white population, which had reached critical levels due to drought and the economic effects of the Great Depression. Originally, the plan was to construct a dam on the Vaal River at Christiana to provide water for the scheme. However, following negotiations with the Rand Water Board (who desperately needed to augment its water resources for a growing Johannesburg) the decision was made to construct the Vaal Dam at the confluence of the Wilge and Vaal rivers near Vereeniging. The Rand Water Board agreed to pay a portion of the cost to construct the dam. Water would flow from the Vaal Dam to a diversion weir 57 km downstream and then through the main canals to the scheme.

Dana Grobler

A concrete barrage-type structure, the Vaalharts weir has a height of 11 m and is 750 m long.

CONSTRUCTION OF THE SCHEME

In December 1933, construction teams started clearing land on the farm Andalusia, near Border Station, to make way for offices, accommodation and storage facilities. It was first thought that Warrenton would serve as the headquarters of the scheme, but when the town council refused, the project team had to find an alternative venue.

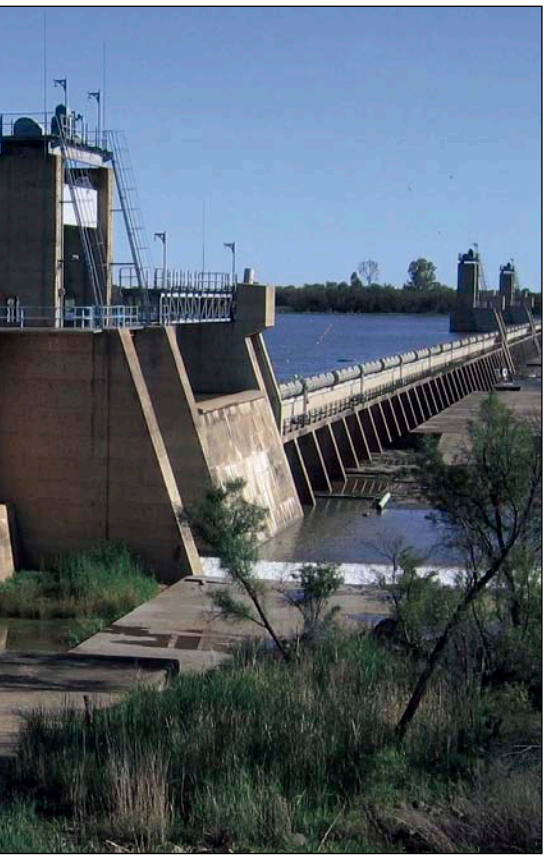
In 1934, work started concurrently on the Vaal Dam, the Vaalharts weir (then known as Knoppiesfontein Dam) and the main canal. It was government policy to only employ white labour. Labourers had to be unmarried (although married men were later also employed), between the ages of 18 and 45 and medically fit. Recruitment was done by the Department of Labour. Due to the 'lack of white labour' experienced later on in the project, coloured and black workers were also employed on sections requiring only 'unskilled' labour.

Vaalharts Water

In 1967, the Vaalharts weir was raised by 1,2 m to increase its capacity to 48,7 million m³.

The pay for white labourers was two shillings per day, with a bonus of one shilling 6d per day worked. These bonuses were paid into a Post Office Savings Bank and workers were only allowed to draw the money once they had completed their work. Money could be paid to dependents via a stop order. In the case of coloured labourers the greater of a man's wages was sent by cheque to his dependents and only a small part was paid out to the man himself for pocket money.

For all jobs of a routine nature where the output could be accurately measured, payment was made on a piece-work basis. A gang of 10 to 20 men worked as a unit and at the end of the month their output was measured up and its value worked out. The total value of the



job was then divided up among the members of the gang in proportion to the number of Mondays each one had worked during the month. If the members of a gang found that any particular member was not pulling his weight, they could throw him out and invite someone else to join their gang.

LIFE ON THE SCHEME

Labourers were not entitled to have their families with them on the works, but were accommodated in camps composed of a large number of wood and iron bunkhouses, each containing four double-deck bunks (dubbed 'hoenderstellasies' or 'chicken coops'). The more skilled workers and office staff were allowed to have their wives and families with them on the works and were provided with houses at a reasonable rental.

Interestingly, Vaalharts was one of the first schemes on which electric light was provided for the staff. In the early stages the power station closed down at 10 pm except when there was a special function on. Later, power was available throughout the night.

As the works were spread out over a linear distance of 80 km the job was divided into sections, each in charge of a section engineer, and all under the control of the resident engineer at the headquarters of the scheme. Each section had its own camp, number one being at the weir, near Fourteen Streams Station, section two being near Warrenton and section three next to the Headquarters Office near Border Station (this was later moved about a kilometre up the line and renamed Jan Kempdorp Station). Section four was started later near Pokwani – this job included the construction of two tunnels.

All meals were free, and large mess halls and kitchens were built and staffed. Contracts were given out for the supply of meat, vegetables and milk daily in large quantities. A dry-goods canteen was also supplied at each camp. Goods here were not sold for cash, but rather coupons and were generally cheaper than in town.

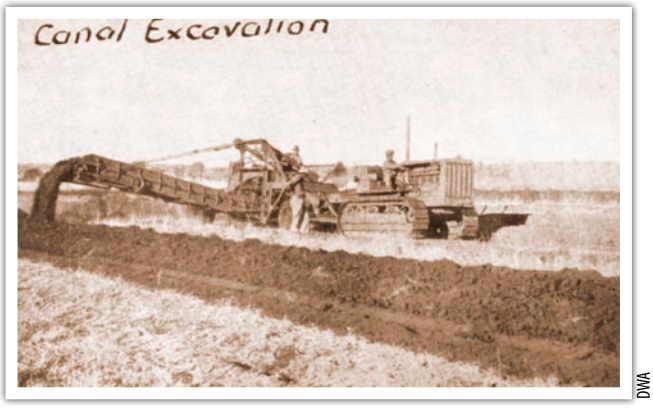
Recreation facilities were also provided, among others a large recreation hall which could house 600 people. This had a stage and two small dressing rooms for staging concerts and plays. The hall was also provided with a 35-mm cinematograph projector and films were shown twice a week. Rugby fields, tennis courts, a gold course and swimming pool were also provided.

The works also had a small church, a school and a number of field hospitals. The latter could handle the ordinary run of medicines and provide first aid treatment, however, serious cases had to be sent to Kimberley. When there was an outbreak of epidemics (such as diphtheria or typhoid) mass immunisation was undertaken.

Top right: *The post office and staff houses at Andalusia. The headquarters of the Vaalharts irrigation scheme later became a town on its own and in 1953 it was renamed Jan Kempdorp, after Genl Jan Kemp, Minister of Agriculture.*

Bottom right: *Mechnical and manual labour were employed at Vaalharts.*

DWA



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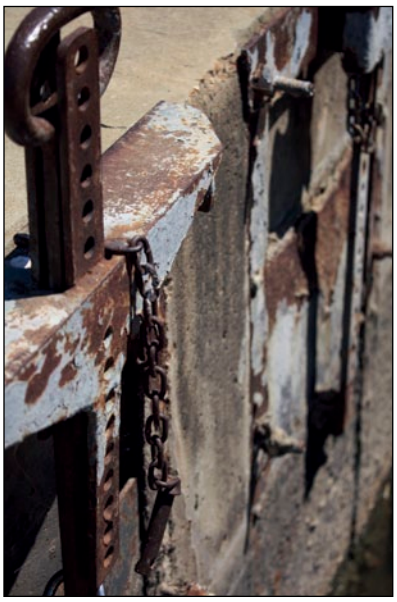

Almost all sluice gates at Vaalharts are still manually operated.

MAN AND MACHINE

At Vaalharts both mechanical and manual labour were used. Workers were transported to site by truck where each one got an area of 3 m by 3 m to dig out. Digging was done mainly by pick and shovel. Workers used 6 kg hammers used to break the rock, which was then placed in bags and hauled out of the steep sidewalls.

In really rocky areas it could take months to reach canal depth. The area known as the 'blue canal' was notoriously difficult to penetrate. Once one team had completed the digging another took over to cast the concrete lining.

The weir, a concrete barrage-type structure, has a height of 11 m and is 750 m long. It was designed to accommodate a flow of 10 000 cusecs (283,2 m^3/s), with water 4 m deep flowing over the crest. Three sluice gates of 8 m by 6 m were built into the weir. In 1967, the weir was raised by 1,2 m to increase the storage capacity to 48,7 million m^3.

Three hand-operated radial sluice gates of 3 m by 2,7 m make up the inlet sluices. These flow into a three-barrelled aquaduct, which controls the water flowing into the canal. Vaalharts comprises two main canals – A North Canal and a West Canal. By 1936 the first 40 km of the canals were completed and water first flowed into the canals on 15 December.

Work on the feeder and distribution canals started in 1937. However, due to the outbreak of the Second World War these were only completed by 1946. The main canal, feeder and distribution canals total more than 800 km. Later 300 km of drainage canals were also constructed. All the canals are lined with concrete. To reduce pressure on the Vaal Dam, the Bloemhof Dam was constructed in the 1970s to feed the Vaalharts weir.

THE FIRST FARMERS

By 1938, the first 80 lots were ready for occupation. Applicants were selected by a special committee. Healthy persons under the age of 50 with dependent children were selected above unmarried applicants. *Bona fide* farmers, who lost farms due to circumstances 'beyond their control' were also preferred. Joblessness did not disadvantage applicants but could not be provided as the only reason why they should be allotted a piece of ground.

Once an applicant had been selected he had to go to the offices of the Department of Lands at Andalusia where he randomly chose a plot by picking a piece of paper out of a box containing the numbers of all the available plots. By 1940 there were 304 settlers on the scheme.

Basic housing was provided. Probationary lessees received livestock and production materials, for example a team of mules, dairy cows, a wagon, harnesses, a plough, harrow, small tools, seed and fertiliser. In exchange the lessee had to give the state a percentage of his harvest for the first four years. After four years the lessee's probation was over and he had the choice to purchase his lot.

Lessees did not pay for their water quota and were provide with a social grant for the first 18 months, the amount depending on their marriage status and number of children. Initially, they were not allowed to hire labour and everyone had to pitch in, even the children.

Due to the nature of the soil, a decision was made to establish an agricultural research station at Vaalharts in 1935. These early researchers knew just as little about which crops would be most suitable as the new farmers and farming really was by trial and error. In the early years, farmers mostly grew lucerne, ground nuts, potatoes, grains and vegetables. Today, farmers also grow pecan nuts, cotton, olives, citrus, apricots, grapes, watermelon and peaches.

Wind was a considerable challenge and an early solution was to plant long rows of poplar trees along the hedges of fields. At one stage, Vaalharts had one of the longest hedgerows of poplars in the world. Today, few of these original poplar hedges remain.

The Vaalharts Water User Association took over the government scheme in 2003. It remains the largest irrigation scheme in the country, with a scheduled area of 29 181 ha.

SOURCES

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Living and working at Vaal Hartz, article in *Water*, House Journal of the Department of Water Affairs, August 1986
Vaalharts by Hans Bornman
Thanks to DWA, Vaalharts Water and eWISA for photographs

Time running out as Africa sprints towards MDG deadline

More than 8 out of 10 Africans without access to improved drinking water sources live in rural areas.

WaterAid/Layton Thompson

African nations are racing to meet the 2015 deadline set by the United Nations (UN) to halve the number of people without access to basic water and sanitation. But will the continent's slow start be the spoke in the wheel of its success? Lani van Vuuren reports from the Second Africa Water Week.

The Second Africa Water Week, held in Midrand in November last year, brought together decision-makers, UN agencies, civil society groups, the private sector and development cooperation partners to discuss ways of addressing the continent's water and sanitation challenges. The event was held in response to the Sharm El Sheikh Commitments on water and sanitation adopted by the African Union Heads of State in Egypt in 2008.

While 26 individual African countries are on track to meet the UN Millennium Development Goals (MDGs) to halve the number of people without access to drinking water, the continent as a whole is lagging far behind. The MDGs were set up by the UN in 2000. These goals establish quantitative benchmarks to halve extreme poverty in all its forms.

According to the ***WHO/UNICEF Joint Monitoring Programme (JMP) for Water and Sanitation***, around 600 million Africans have access to improved drinking


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Groundwater access is by far the fastest growing source of water supply for both urban and rural households in Africa.

water (2006 figures). That is 64% of the total population of the continent. Coverage of improved drinking water sources is highest in southern Africa (92%) and northern Africa (88%). In central, eastern and western Africa coverage of drinking water sources is still below 60%.

To meet the MDGs, coverage needs to increase across the continent to 78% by 2015. That means that, on average, 33 million people need to gain access to an improved drinking water source every year. Even when the drinking water target is met, 253 million Africans will still be without access to an improved drinking water source.

Urban residents remain much more fortunate than their rural counterparts. About 57 million people living in Africa's cities have no access to improved water sources compared to the estimated 284 million unserved people living in rural areas.

When drinking water is not available on the premises, women shoulder the bulk of the water collection responsibility, and it often takes considerable time to fetch the water. According to the ***JMP***, women are more than five times as likely as men to usually go to a source and collect drinking water for the household. In every one in seven households, children (boys and girls) are the main water collectors for the household.

With regards to sanitation Africa also faces steep challenges. The target is to provide improved sanitation to 63% of the region's population. That is about 370 million more than the estimated 242 million that were using such facilities in 2006. Still the continent has made remarkable progress. Access to basic sanitation facilities across Africa has increased by over 80% since 1990. At present six African countries are on target to meet the MDGs on sanitation.

As HRH Prince William of Orange, chair of the UN Secretary-General's Advisory Board on Water and Sanitation, pointed out, while the figures remain bleak, African countries have done much to improved access to services in the last few years. "[Halving the percentage of the population without access] is a far bigger job for a country that started off with a very high percentage of people lacking access to safe water and sanitation, and even harder if the population in the meantime is growing rapidly."

"Africa is making impressive progress on water and sanitation," noted Prince William. "For example, at least 17 African countries are outperforming the global average rate for expanding access to basic sanitation, while 21 African countries are performing above average for water supply."

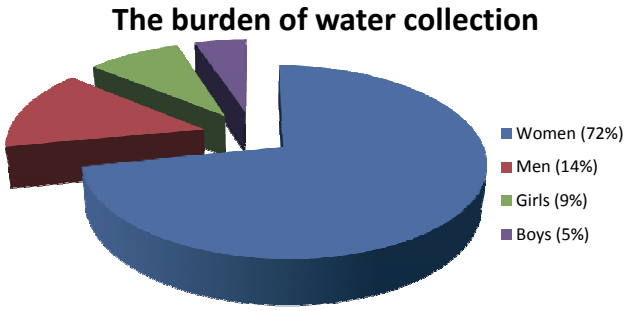
South African Minister of Water & Environmental Affairs, Buyelwa Sonjica, said that the continent's water crisis and policy challenges were now broadly recognised as central to the developmental agenda. "Already African Heads of State have at the highest level demonstrated political commitment to the development of the water and sanitation sectors."

However, the minister admits that Africa has now reached the point where there needs to be a greater convergence


Lani van Vuuren


WaterAid/Layton Thompson

Left: *South African Minister of Water & Environmental Affairs Buyelwa Sonjica; outgoing President of AMCOW Bruno Jean-Richard Itoua and AMCOW Secretary-General Bai-Mass Taal at the Second Africa Water Week.*
Right: *In 38 African countries, sanitation coverage is less than 50%.*



between these high-level commitments and delivery through concrete actions, strengthening and scaling up of existing mechanisms and initiatives, and refinement of strategies to close the gaps.

One of the main factors inhibiting Africa's progress is its vast urbanisation rate. Despite some advances, the continent remains the region with the highest prevalence of slums (informal settlements). Both slums and urban areas in the region appear to be growing at an equally rapid rate. As a result, coverage of improved water services is actually falling in Africa's cities.

Another challenge is that of funding. According to a report by the World Bank and African Development Bank, existing spending on water supply and sanitation is nowhere near enough to meet the MDGs – there is a funding gap of US$9,3-billion a year. International funding has dwindled as a consequence of the global recession, and many African countries are finding it difficult to find the finances needed to advance the rollout of improved services.

Outgoing President of the African Ministers Council on Water (AMCOW), Bruno Jean-Richard Itoua, called on international donors to assist Africa to meet its targets. "We are speaking with one voice [through AMCOW], we know what we can bring to the table and what it is we need. African countries mean business, but we need funding to see it through."

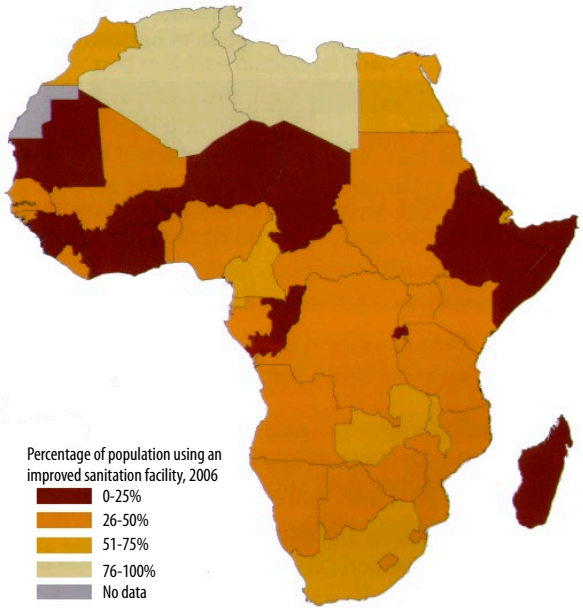
AMCOW is supporting water and sanitation projects through the African Water Facility (AWF), which aims to mobilise financial resources for water sector development. Created in 2004, the AWF is hosted by the African Development Bank. To date, €110-million has been raised to support projects in 25 countries.

According to Itoua, African countries also needed to look internally for funding. "We realise that we cannot only rely on donor funding. There needs to be national commitment first and foremost. Finance ministers must be brought into discussions in order to enhance national spending on water and sanitation."

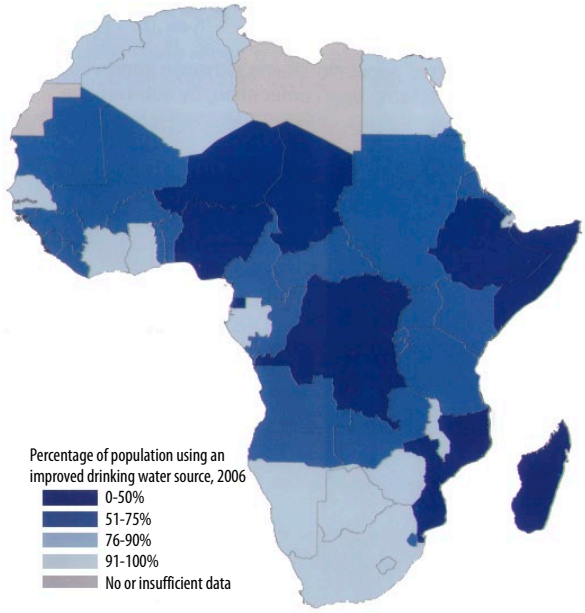
Meeting the MDGs will require greater cooperation between African countries. Nearly all of Africa's surface water resources are contained in its 64 international river basins. These river basins are already home to 77% of Africa's population. "Most international basins are without any shared agreements on equitable use or environmental protection," noted Sonjica. "As a result, procedures for avoiding or resolving international disputes over water are largely lacking."

Amplifying existing challenges is the issue of climate change. Africa as a whole is responsible for only 3% to 5% of global emissions of greenhouse gases, however, is set to be hit hardest by the effects on global climate changes. "Water is where climate change makes its first impacts. Combined with rapidly growing demand for water, the increasing impacts of climate change are creating an alarming scenario," said HRH Prince William. "Water will increasingly shape international relations and security arrangements in Africa."

Despite the hurdles ahead, Itoua remained positive that Africa would largely meet the MDGs. "Admittedly we were off to a slow start in this marathon to improve our people's access to water and sanitation. However, with six years to go we are ready to take the lead, sprinting to the finish."



Coverage with improved sanitation facilities, 2006 (Source: WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation).



Coverage with improved drinking water sources, 2006 (Source: WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation).

WATER Kidz

WATER – The lifeblood of the human body

We all need water to live. Humans can survive a month without food, but only a week without water. Why is water so healthy for us?

Every cell from the simplest to the most complicated one is made up mostly of water. This includes the human body. Exactly how much water you are made up of depends on your age. Babies' bodies contain about 78% water. This reduces to 65% in your average one-year-old. Men's bodies contain more water than women's bodies (60% compared to 55%).

"Children need about 1,5 litres of water a day, while adults need between two and three litres a day (the more your body weight, the more water you need)."

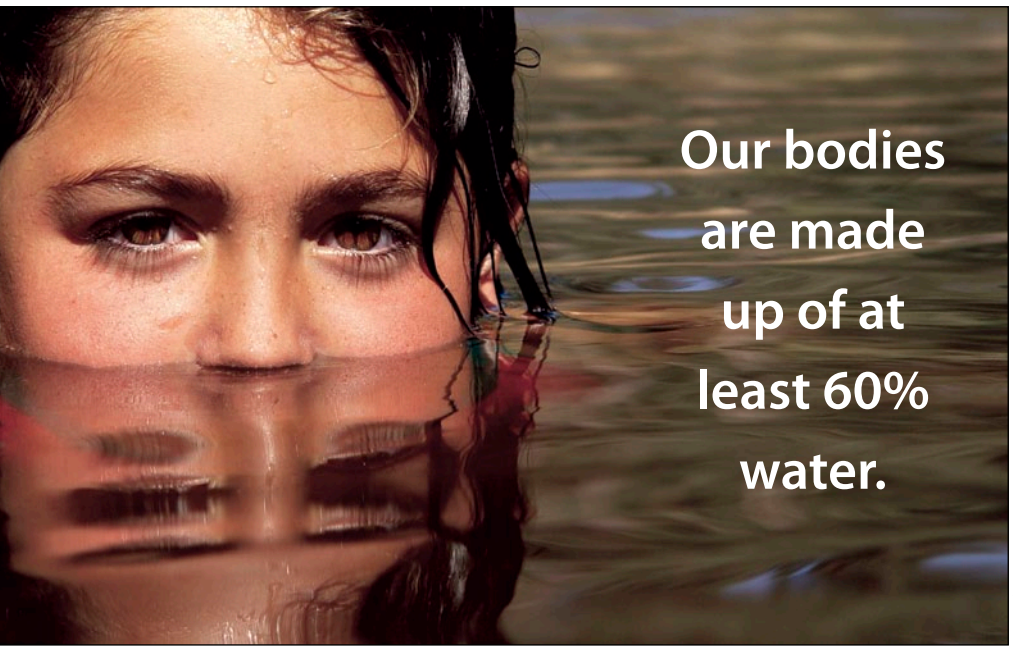
Different parts of our bodies contain varying percentages of water. Our brains, our most important organ, are composed of about 70% water, our blood more than 80% and our lungs and liver about 90%. Even our bones are more than 20% water!

Since the human body is made primarily of water, it is essential that we consume enough fluids on a daily basis to avoid dehydration. Human bodies are perfectly designed and engineered to operate off fuel. This fuel is the food we eat, and the liquids we consume.

We need lots of water to keep our bodies functioning optimally, and keep us healthy. Children need about 1,5 litres of water a day, while adults need between two and three litres a day (the more your body weight, the more water you need).

THE IMPORTANCE OF WATER TO HUMAN HEALTH

We take in most of our water by drinking, but most solids foods also contain water. The unique properties of water



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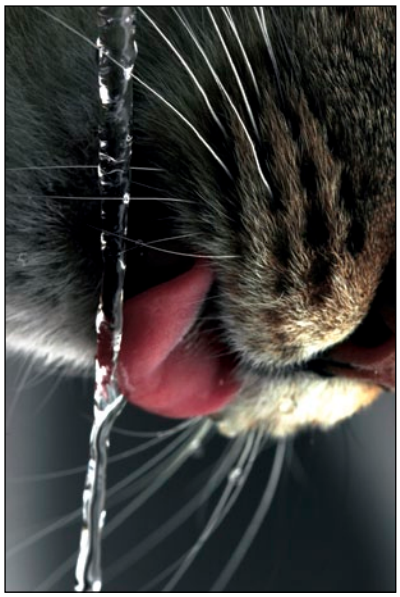

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All living creatures require water to survive.

are what make it so basic and essential to life. One of the most important things water does is to help us digest our food. The excellent ability of water to dissolve many substances allows our cells to use valuable nutrients, mineral and chemicals in biological processes. Water also assists in other essential functions, like bathing the cells and tissues, carrying oxygen around the body; helping to cleanse the blood as it passes through the kidneys; and helping to remove carbon dioxide and waste products.

Water is also responsible for regulating body temperature. If your temperature becomes too high (when, for example, you are outside during a hot day) water stored in the body is used to bring the temperature back to a normal level. If you do not consume enough water, this natural temperature regulation cannot occur.

But all of this water does not stay in our bodies forever. In fact, the human body loses about 1,6 litres of water a

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***Left**: Drinking water moisturises our skins from the inside out.*
***Above**: Water is an essential part of our everyday lives.*

DID YOU KNOW?

- A tomato is 93% water
- Spinach is 92% water
- A watermelon is 92% water
- Cabbage is 90% water
- Milk is 90% water
- Carrots are 87% water
- A pineapple is 85% water
- Apples are 85% water
- Potatoes are 80% water
- Grapes are 80% water
- A living tree is 75% water
- A banana is 74% water
- A chicken is 70% water
- Beef is 61%
- Hot dogs are 56% water.
- Bread is 35% water

day through urine (1,2 litres); breath and sweat (0,2 litres) and faeces (0,2 litres). Remember, you will lose more water if it is hot or if you are exercising.

When you do not drink enough water, your body can become dehydrated.

When we become dehydrated, the body instinctively begins to ration water to each organ. The brain, being the most important organ, gets the most water. The skin, being the least important, is rationed the least amount of water.

TEN GOOD REASONS TO DRINK WATER

- It reduces your risk of a heart attack.
- Dehydration can cause impaired concentration, headaches, irritability and fatigue.
- Water can prevent kidney stones and reduce your chances of bladder infections, kidney and urinary tract infections.
- Perspiration is your body's natural air-conditioning mechanism. And to sweat you need plenty of water.
- Water makes up a large part of the fluid that lubricates and cushions your joints and muscles.
- Water helps constipation by adding fluid to the colon and bulk to stools.
- Water helps you get better when you are ill by helping to control a fever, by replacing lost fluids and thinning out mucus.
- Drinking water moisturises your skin from the inside out and helps your skin to maintain its elasticity and suppleness.
- Water will keep your body systems, including metabolism and digestion, working properly and give you the energy (and hydration) necessary for exercise.
- By helping to flush out toxins, appropriate water intake lessens the burden on your kidneys and liver.

SA's first capillary UF membrane plant inaugurated

South Africa's first advanced capillary ultrafiltration (UF) membrane manufacturing facility has been officially inaugurated in Somerset West. The membranes, being produced under licence from the Water Research Commission (WRC) and Stellenbosch University by black-economic empowerment firm Ikusasa Water, are specifically suitable to the local market and environment. Ikusasa Water is currently constructing an 800 000 ℓ/day membrane water treatment plant for Overberg Water. The firm has also developed small, mobile water treatment plants, especially suitable for rural or emergency applications.

Dean of Science at Stellenbosch University Prof Eugene Cloete and WRC Director: Water Use and Waste Management Jay Bhagwan unveil the plaque at Ikusasa's capillary UF membrane manufacturing plant in Somerset West.

All photographs by Lani van Vuuren

WRC Director: Water Use and Waste Management Jay Bhagwan and Regional Head of DWA Western Cape Rashid Khan take a closer look at the membrane manufacturing process. Khan has welcomed the plant, saying the Western Cape is increasingly considering desalination as a way of augmenting water supplies.

Ikusasa Water Marketing Manager Dr Gerhard Offringa explains the functioning of the firm's mobile water treatment unit. Units can produce between 200 and 400 ℓ/h per module installed. A similar unit has been supplied to Cape Winelands municipality for use in emergencies.

Rozane Carls of Ikusasa Water keeps a close eye on the manufacturing process. The capillary membranes are produced through a process of diffusion-induced phase separation.

A close-up of a capillary UF membrane module. An average-sized module contains about 1 750 capillaries.

Water Demand Management in SADC

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

Programme Objectives

Promoting greater acceptance and consolidation of pro-poor WDM practices.

Implementing WDM activities.

Creating confidence among credit institutions to fund WDM projects.

Programme Services

Support Services: Promoting a favourable environment in which WDM actions can take place.

Project Development Services: Assisting clients in preparing bankable WDM projects.

Finance Facilitation Services: Supporting innovative and sustainable financing mechanisms.

Please contact the Programme Implementation Unit (PIU) for further information on the WDM Programme.

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DBSA Sida

WDM
WATER DEMAND MANAGEMENT

Water Research Commission

The Water Research Commission (WRC) is South Africa's dynamic hub for water-centred knowledge, innovation and intellectual capital. The WRC provides leadership for water research development in:

- Water Resource Management
- Water-Linked Ecosystems
- Water Use and Waste Management
- Water Utilisation in Agriculture
- Water-Centred Knowledge

Impact areas address the following key issues:

- Water and Society
- Water and Economy
- Water and the Environment
- Water and Health

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