

# THE WATER WHEEL

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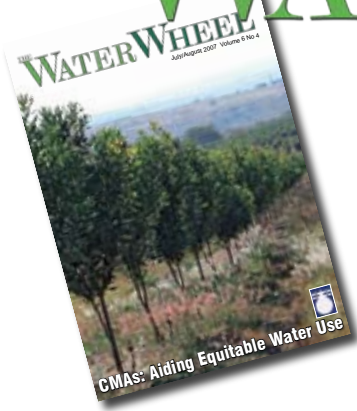
September/October 2007 Volume 6 No 5

**Designing Strong Bridges  
for Troubled Waters**





# THE WATER WHEEL



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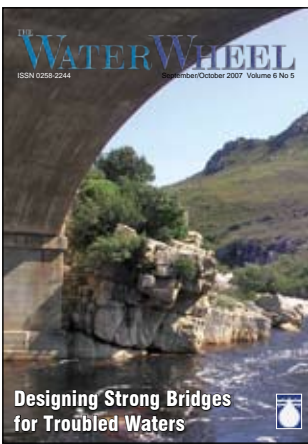
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*Cover: Research sheds light on river scour. See page 12.*

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**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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## LETTERS TO THE EDITOR

### **The Catch in Catchment Management**

I never thought I would admit this. But it would be very bad for my health to ignore it any longer. I'm having sleepless nights over work. Even worse: my ex-work.

I write this letter as a passionate water scientist, a tired writer and a proud citizen of our beautiful country. While still at the Department of Water Affairs & Forestry (DWAF), the water-worry already started. But it was only when I moved "outside" the hierarchy and politics that I realised there are much more practical challenges in our country than in our wildest dreams.

From time to time we read/hear some familiar clichés about water: "By the year 2080 we will run out of fresh water", or "make every drop count" and even "water is precious". But somehow that goes in the one ear and out the other one... It's time to wake up. To start managing our water resources.

DWAF has committed themselves in their five-year Strategic Plan for 2006/06

– 2010/11 to have all Catchment Management Agencies (CMAs) established by the end of 2010 (the Soccer World Cup isn't everything!) A third of the 19 CMAs have been established already. Which is a good start. Put it together with the *February 2007 Guidelines for the development of Catchment Management Strategies: Towards equity, efficiency and sustainability* by DWAF and you have a very good start. But now we are challenged with the Catch.

It's this catch in catchment management that keeps me awake at night. And I have no idea who are 'we', 'they' or 'us' in this scenario. But we need to do something about this catch very urgently. Within the CMA (and the Advisory Committee, Catchment Management Committee and Water User Associations) there will be positions for people with specific expertise/knowledge/experience/enthusiasm for the proper functioning of these institutions. There will be 19 CMAs. With even more committees. And yes, even more WUAs.

I know for a fact and acknowledge that there already are people in the areas that have some of the skills needed to make this water management model work. People who have lived in a specific area all his/her life, current Irrigation Boards and WUAs and knowledgeable community members that can contribute immensely.

But somebody has to take these supporting guidelines and help give direction to these institutions. As much as DWAF would like to do that (I think), they do not have the capacity at all. However, they will probably continue to provide a supporting function where needed.

We probably could go on a "brain gain" campaign, but I reckon there is no need for that. But there is one need that we MUST address: the need to start providing these water institutions with capable, function specific water managers. An initiative that will basically ask just two questions: What skills/expertise will we need in our CMAs, WUAs? How can our tertiary institutions provide that? I'm positive that many of our universities and technikons are very close to equipping students with the relevant skills and knowledge. It just needs a bit of scrubbing here and adding there. This might be a much bigger, concerted effort than it sounds like, but surely not impossible by a long shot.

So what about practicing water managers that have almost forgotten about being a student? Luckily there are some of them around! With specifically designed short courses (and longer ones!) continuous education can equip any current water practitioners with specifically required skills to serve in these institutions or play a major supporting role. Unfortunately our potential 'pool' of water practitioners are – let's say – quite shallow (not in mindset, but in numbers). Therefore the dire need and urgent drive needed for equipping future students with the skills we



Letters must be addressed to The Editor and can be faxed to (012) 331-2565 or E-mailed to [laniv@wrc.org.za](mailto:laniv@wrc.org.za). Letters are published at the editor's discretion, and may be edited for length. Letters are strictly the opinion of the author(s) only and do not necessarily reflect the considered opinions of the members of *the Water Wheel* or the WRC.



need to make sure we give due support to our National Water Act.

What's the use of having an impressive pass-rate at a tertiary institution if we can't make an impressive impact on the outside? Talk about job creation; here we have jobs piling up with an opportunity to fill them with competent, equipped people. Are we going to catch this challenge, or will this ball just fall

on the ground and roll down the hill; into the dry riverbed?

**Marlese Nel, Cape Town**

**Diatoms can be alien too**

Your article on diatoms being used in water quality monitoring is informative and fascinating (*Water Wheel* May/June 2007).

Unfortunately, Dr Taylor's remark about

diatoms "cannot be relocated to a new river or propagated as part of captive breeding programmes" is blatantly untrue. If it had not already been happening for millennia – before the emergence of the Bipedal Brachiating Ape – Dr Taylor's distinction between endemic and cosmopolitan (a term preferable to alien) would not make sense.

**Ben Dekker, Port St Johns**

**Water Diary (Also see p 7)**

**APPROPRIATE TECHNOLOGIES**

**SEPTEMBER 3-4**

WISA is hosting an Appropriate Technologies Conference at the BMW Pavilion Conference Centre, V&A Waterfront, Cape Town. *Enquiries: Taryn van Rooyen, Tel: (011) 463-5085; Fax: (011) 463-3265; E-mail: [conference@soafrica.com](mailto:conference@soafrica.com)*

**AQUACULTURE**

**OCTOBER 9-10**

Aquaculture Innovations is offering an aquaculture training course in Pretoria. The course is aimed at people who have an interest in the

industry, but require more information prior to investing. *Enquiries: Tel: (046) 622-3690; Fax: (046) 622-4868; E-mail: [info@aquaafrica.co.za](mailto:info@aquaafrica.co.za)*

**WASTEWATER REUSE**

**OCTOBER 9-12**

The 6<sup>th</sup> IWA specialised conference on Wastewater Reclamation and Reuse for Sustainability will be held in Antwerp, Belgium. Themes include water reuse and the water cycle, advances in water reclamation techniques, and best practice in water reclamation and reuse. *Enquiries: Dr Bart de Heyder;*

*Aquafin; Tel: +32 3 450 4078; Fax: +32 3 450 4444; E-mail: [info@wrrs2007.org](mailto:info@wrrs2007.org); Visit: [www.wrrs2007.org/](http://www.wrrs2007.org/)*

**BIOACCUMULATION SURVEYS**

**OCTOBER 15-19**

The Department of Zoology at the University of Johannesburg is offering a course on Monitoring Contaminant Levels in Freshwater Fish for Contaminant Bioaccumulation Surveys and Human Consumption at the UJ Island on the Vaal Dam. *Enquiries: Prof Annemarie Oldewage, Fax: (011) 559-2286, E-mail: [aoldewage@uj.ac.za](mailto:aoldewage@uj.ac.za)*

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## Saving water everybody's business

Managing water resources to ensure their sustainability requires concerted efforts from governments, industries, communities and the individual. So says newly inaugurated President of the Water Institute of Southern Africa, Prof Fred Otieno.

Advocating the principles of integrated water resources management (IWRM), he said it was an effort which required long-term perspectives and collective will aimed at providing better lives for present and future generations of people. An especially strong commitment was needed from those serving the water sector.

Pointing out the many water challenges faced by governments of the world, Prof Otieno said that water should be regarded as a finite resource having an economic value with significant social and economic implications reflecting the importance of meeting

basic needs. "All too often, water is treated as an infinite free good, rather than as the precious water resource that it is. Even where supplies are plentiful, they are increasingly at risk from pollution and rising demand."

"To ensure the overall sustainable development of our world, continuous access to clean water is critical," he continued. "Without clean water, not only will public health suffer because of poor hygiene and sanitation, agricultural and industrial activities will also get disrupted. This may eventually lead to the disintegration of the very societies that we and our forefathers have so painstakingly built up."

According to Prof Otieno, society must take heed of the statement in the United Nations Millennium Declaration to stop unsustainable exploitation of water resources by developing appropriate water management strategies at all levels.



*Newly elected WISA Vice President Dr Heidi Snyman with WISA President Prof Fred Otieno.*

## City promises improved services



The City of Tshwane has set aside R39,85-million for the eradication of water backlogs in its medium-term revenue and expenditure framework.

The planned expenditure forms part of the city's plan to improve service delivery, especially in areas north of Pretoria. "There

will be a bulk sewer network established at Klip-Kruisfontein phase 3 to the value of R150 000," reported Dr Ndivho Lukhwareni, Head of Public Works and Infrastructure Development. "Various wards have been earmarked to benefit from new water connections." He added that R16,4-million would be spent on the Klip-Kruisfontein bulk water supply reservoir.

The City has also promised to come up with major stormwater drainage systems. This followed the floods that occurred over the past. Among the areas that will benefit from this will be Soshanguve South and Akasia.

## Water tops municipal agenda

Ehlanzeni District Municipality, in Mpumalanga, has budgeted R25-million for the provision of potable water in the coming financial year.

According to Mayor Constance Mkhonto, water tops the municipality's agenda this year. She said a water and sanitation

blueprint had already been developed to guide the implementation of all water projects.

In addition, R6,5-million has been budgeted towards the eradication of remaining bucket toilets in the district. The municipality also intends developed a roads and storm-water drainage system blueprint.

## Gauteng moves towards basic services targets

The Department of Local Government in Gauteng has reported that it is "making great strides" towards delivering services to residents, particularly the poor.

Delivering her budget vote earlier this year, Local Government MEC Qedani Mahlangu said 96% of all households on Gauteng's indigent register receive free basic water while all the households received free basic electricity.

"Gauteng is on course to meet the 2008 target for basic water supply and 2010 target for basic sanitation," she said. The water delivery backlog has been reduced from 603 000 households in 2003 to 262 000 households in 2006, while the sanitation backlog has been reduced from 706 000 households to 438 000 households during the same period.

Mahlangu said that the province's efforts were challenged by the migration of people from other provinces and countries to Gauteng, placing "serious strain" on service delivery and resources.

## Science can help species survive

African countries will need to harness and apply science and technology to conserve and use biodiversity in a sustainable manner.

This is according to Science & Technology Minister Mosibudi Mangena, who said South Africa's biodiversity has enormous potential for transforming Africa's agricultural and industrial activities into systems which can contribute to economic change and poverty reduction. Speaking at the 21<sup>st</sup> Annual Congress of the Society for Conservation Biology earlier this year, the minister noted: "South Africa is home to a large number of unique species of plants and animals, as well as ecosystems constituting the continent's natural wealth."

"Cause for concern is that this biodiversity is being lost at an alarming rate, making conservation and promotion of the sustainable use of our biodiversity a pressing challenge that African countries have committed themselves to addressing." Mangena reported that conservation and sustainable use are knowledge-intensive activities, and cannot be attained without investments in the generation of new scientific knowledge and the application of technological innovation.

The minister also called on the delegates attending the summit to address the imminent threat of global climate change, which in South Africa is predicted to have the potential of driving thousands of species to extinction.



## Its 'business unusual' as target nears to eradicate buckets

With only a few months remaining to the bucket eradication target date, provincial and local governments need to adopt a 'business unusual approach' in order to deal with remaining backlogs, according to Minister of Water Affairs & Forestry, Lindiwe Hendricks.

An estimated 109 000 households in established formal settlements still make use of the bucket sanitation system. The Free State continues to retain the largest sum of buckets (74% of total backlog), followed by the Eastern Cape (16%). The remainder of the backlog is shared between the Northern Cape (6%), the North West (3%), and the Western Cape (1%).

"As there are other significant development projects underway, such as preparations for the 2010 Soccer World Cup, housing delivery, as well as other significant water and sanitation targets, we must appreciate the tremendous pressure and competition on the limited resources across the delivery chain," said Hendricks. She raised some of the challenges faced by provincial and local government in eradicating the remaining bucket toilets, including lack of skills and finance, challenges around procurement and community buy-in, as well as the demand for waterborne sanitation despite the availability of cheaper

alternative technologies, such as urine diversion toilets.

With regards to the latter challenge, the Minister said: "Communication and the use of appropriate communication methods are critical in addressing this challenge. Some municipalities have effectively implemented alternative solutions which could be upgraded at a later stage. However, any solution must be based on clear feasibility studies to ensure its appropriateness and sustainability. My department is ready with technical expertise around this matter and alternative technology options."

### Water Diary (continued)

#### MINING

##### OCTOBER 17 & 18

The Chamber of Mines is hosting a Sustainable Development Conference with the theme 'Delivering on Our Commitments'. The conference will be held at the Intercontinental Sun & Towers Hotel in Sandton, Gauteng. Enquiries: Liz Mbatha, Tel: (011) 498-7424; Fax: 086 050 24751; E-mail: [imbatha@bullion.org.za](mailto:imbatha@bullion.org.za)

#### DESALINATION

##### OCTOBER 21-26

The International Desalination Association

is hosting a World Congress on Desalination and Water Reuse in Gran Canaria, Spain. Themes include thermal desalination design improvements; alternative desalination techniques; and desalination and the environment. Enquiries: Tel: +1-978-8870-410; E-mail: [info@idadesal.org](mailto:info@idadesal.org); Visit: [www.idadesal.org/it-worldcongress\\_001.aspx](http://www.idadesal.org/it-worldcongress_001.aspx)

#### AQUACULTURE

##### OCTOBER 22-25

The Eighth Conference of the Aquaculture Association of Southern Africa will be held at the Cape Town International Convention

Centre. The theme is 'Linking Resources to Markets Through Technology'. Enquiries: Tel: (012) 807-6720; Fax: (012) 807-4946; E-mail: [info@aasa-aqua.co.za](mailto:info@aasa-aqua.co.za)

#### MUNICIPAL ENGINEERING

##### OCTOBER 24-26

The 2007 Conference of the Institute of Municipal Engineering of South Africa (IMESA) will take place at the International Convention Centre, in Durban, KwaZulu-Natal. The theme is 'Sustainable Municipal Engineering 2010 and Beyond'. Enquiries: Cilla Taylor, Tel: (012) 667-3681; Fax: (012) 667-3680; E-mail: [confplan@iafrica.com](mailto:confplan@iafrica.com)





## No more bottled water for city staff

Municipal staff in San Francisco, US, have been banned from drinking bottled water by Mayor Gavin Newsom.

Newsom, who said "it cost too much" has barred city departments, agencies and contractors from using city funds to serve water in plastic bottles and in larger dispensers when tap water is available. It is estimated that San Francisco could save US\$500 000 a year under this directive.

## Study puts rain-water tanks ahead of desalination

Rainwater tanks are not only cost competitive with desalination, it is five times more energy efficient.

This is according to a report commissioned by the Nature Conservation Council, Australian Conservation Foundation (ACF) and Environment Victoria. The report, *The Economics of Rainwater Tanks and Alternative Water Supply Options*, prepared by economics Marsden Jacob Associates, focused on the cost effectiveness and ability of rainwater tanks to provide water in the urban centres of Sydney, Melbourne and South-east Queensland.

The study compared the yield and levelised cost (i.e. the cost per kilolitre supplied) of various long-term water source options against the potential yield and cost of rainwater tanks. Prof Ian Lower of the ACF said that governments should seriously consider rainwater tanks as an alternative source of water. "There is a very big saving in putting in rainwater tanks instead of infrastructure."

## Get over the 'poo taboo' – expert warns

Capturing urine for recycling phosphorus and treating solid human waste for recycling can greatly assist in preserving dwindling water supplies, according to Associate Professor Cynthia Mitchell of the University of Technology Sydney's Institute for Sustainable Futures, in Australia.

Addressing a gathering of water and waste stakeholders earlier this year she said it was time for people to put their 'poo taboo' aside and adopt radical new approaches to sanitation. "Not enough is being done to manage human waste sustainably or to save taxpayers dollars on maintaining ineffective infrastructure. It is money down the toilet."

Urine is high in phosphorus, a finite resource that is essential to life and continued food production and traditionally has been mined from the ground. The world is fast running out of mined phosphorus, bad news for areas which need fertilisers to grow food.

Urine may be the answer. Cities are becoming phosphorus 'hotspots' because of urine in sewage, and rapidly increasing urban populations, while global ground reserves of phosphorus are unlikely to last more than 50 to 100 years.

"Urine will soon be too precious to flush down the loo," noted Prof Mitchell. "Already in parts of Europe urine separating toilets are being introduced. Sweden has set a national target that 605 of phosphorus in organic waste, including sewage, must be recycled. At least 30% of that goes to fertilise agricultural land."

## China-Australia unite on climate research

Australian and Chinese research institutions have signed a two-year collaboration agreement to investigate climate and rainfall linkages between the two countries.

The agreement was signed by CSIRO, the Australian Greenhouse office and the

## Olive pips help clean water

The Department of Chemical Engineering of the University of Granada has found a new application for 'useless' olive pips, usually left over after olives are processed – the elimination of chrome from industrial wastewater.



The process uses biosorption, a physical and chemical process which enables certain types of biomass, in this case olive pips or stones, to retain the hard metals found in industrial wastewater. According to Dr Germán Tenorio Rivas, a member of the research group, olive stones have the capacity to retain metallic ions on their surface. "This is due to the difference in

electrical charges. Olive stones are negatively charged, whereas metal is positively charged. That is the reason why they come together, thanks to ionic attraction."

It is believed that biosorption can be a good substitute for

conventional processes such as precipitation, which are far more complex and expensive. Dr Rivas explains: "Unlike these processes, the use of olive stones as a biosorption mechanism produces no subproducts which are then difficult to deal with, for example, metal concentrated mud." Two products are obtained during this process: water free of pollutants and the olive stones with the retained metal.



Institute of Atmospheric Physics of the Chinese Academy of Science.

"The objective of this project is to improve understanding of the interaction of the Australian and East Asian monsoon systems," reports CSIRO Environmental Statistician Dr Bronwyn Harch. "This research will

give us more information about the impacts of climate change, especially in the areas of agriculture and water resource management."

The East Asian summer monsoon carries moist air from the Indian and Pacific Oceans to East Asia. The monsoonal flow interacts with the Australian winter monsoon.

## Protect water, protect lives

More than 13 million lives can be saved annually by reducing environmental risks such as pollution, unsafe water, ultraviolet radiation and climate change.

So says the World Health Organisation (WHO) in its first country-by-country analysis of the impact of environmental factors on health. The organisation reports that in some countries, more than a third of the disease burden could be prevented through environmental improvements. The worst affected countries include Angola, Burkina Faso, Mali and Afghanistan.

In 23 countries worldwide, more than 10% of deaths are due to just two environmental factors: unsafe water, including poor sanitation and hygiene; and indoor air pollution due to solid fuel use for cooking. Around the world, children under five are the main victims and make up 74% of deaths due to diarrhoeal disease and lower respiratory infections.

Low-income countries suffer the most from environmental health factors, losing about 20 times for healthy years of life per person per year than high-income countries. However, the data show that no country is immune from the environmental impact on



health. Even in countries with better environmental conditions, almost one sixth of the disease burden could be prevented.

"These country estimates are a first step towards assisting national decision-makers in the sectors of health and environment to set priorities for preventative action," said Susanne Weber-Mosdorf, WHO Assistant Director-General for Sustainable Development and Healthy Environments.

## Zambezi fish disease mystery cracked

Scientists have identified the mystery disease that killed fish in parts of the Zambezi River last year, online news agency SciDev.Net reports.

The disease has been identified as Epizootic Ulcerative Syndrome (EUS), caused by a fungal pathogen. Infected fish develop large sores and die from secondary

infections. This is reportedly the first known outbreak of the disease in Africa. However, it is still uncertain how the pathogen landed up in the Zambezi, which flows through eight southern African countries. EUS also affects fish in Australia, the US, and countries in Asia. When EUS broke out in Asia in the 1970s, about 80% of the fish population died.

### Water by numbers

- **350 000 ha** – The number of hectares the government of Zimbabwe is planning to put under irrigation as part of its Accelerated National Irrigation Development Programme, *the Herald* reports.
- **33 ℓ** – The average volume of water consumed through the washing of clothes in a top loader machine using 130 ℓ per wash cycle (family of four).
- **200** – The estimated number of fish species wiped out in East Africa's Lake Victoria by the introduction of the predatory Nile Perch.
- **47.9 million** – The latest estimate of South Africa's total population. According to Statistics South Africa, population growth has slowed to 6.4% since 2001. KwaZulu-Natal still has the largest share of the total population (20.9%), followed by Gauteng (20.2%).
- **R5.3-billion** – The budget of the Department of Water Affairs & Forestry (DWAF).
- **500 kℓ/day** – The planned capacity of the pilot desalination plant to be constructed at Cape Town's V&A Waterfront.
- **16 000** – The number of staff employed by DWAF.
- **3.2 million** – The estimated number of toilets which need to be constructed over the next four years for government to meet its sanitation target.
- **163** – The number of boreholes handed over to the Zambian government by Japan to improve access to safe water in the African country's Northern Province.
- **US\$2.2-million** – The funds donated by Sweden to the Okavango River Basin Water Commission to set up its Secretariat in Maun, Botswana. The Commission, formed through an agreement between Angola, Botswana and Namibia, is aimed at managing the Okavango River basin in a coordinated and sustainable manner.
- **2 068** – The number of sites at which DWAF has established an electronic system for monitoring drinking water quality to date. According to Minister Lindiwe Hendricks, 55% of municipalities are reporting on their water quality to DWAF every month.

## Power station to have new water plant soon

A rnot Power Station's new multimillion Rand cooling water treatment plant will be completed by October.

The new plant, designed, constructed and commissioned by VWS Envig, is part of a general upgrade of the 31-year-old Mpumalanga power station, situated near Middelburg. The water treatment solutions service provider announced that it had won an R18-million contract from Eskom earlier this year.

According to VWS Envig manager: project management Steve Lawrence, the plant will remove hardness, alkalinity and turbidity from the process water used in the power station's cooling towers. "We are employing our patented Multiflo process to ensure that this plant performs efficiently and reliably," he said. "Cooling tower water will be clarified and softened by undergoing coagulation and flocculation prior to clarification and settling. The system has a small footprint, and requires lower capital and operational cost than conventional clarifiers."

## WSP Africa manager retires

P iers Cross has retired as manager of the Water and Sanitation Program – Africa in Nairobi, Kenya.

Cross served in various capacities and locations of the WSP, including programme manager

at its head office in Washington, regional team leader of WSP South Asia in Delhi and global coordinator of the International Network for Water and Waste Management. In 1993, he was the founder and first CE of Mvula Trust.



SRK Consulting has been awarded the ISO 9001:2000 certification for quality management. Brian Middleton, MD of the company, and Sue King, SRK quality manager and information specialist, pose with the certificate.



## New instrumentation launched

H ach Corporation, a specialist manufacturer of instrumentation and kits for the municipal and industrial markets, launched its new LDO dissolved oxygen technology in August.

In a statement the company reports that this technology will provide cost savings to wastewater treatment plant power usage by enabling the optimisation of the aeration process, a large power cost to treatment plant operators. The instrumentation and kits manufactured by the company globally are used for the analysis of water, whether it be for field, laboratory or process measurement in wastewater, drinking water or groundwater.

## Chlorine tank extended at Heidelberg works

A multimillion Rand project to extend the chlorine contact tank at ERWAT's Heidelberg Wastewater Treatment Plant, was to be completed in August.

The project comprised extensions to the existing chlorine contact tank to increase its disinfection capabilities and capacity from 23 m<sup>2</sup> to 88 m<sup>2</sup>. This modification allows for better chlorine mixing with the final effluent while increasing the retention time to 30 minutes on average weather flow.

The modifications included pipe work connections, sumps, sluice valves, operational gate valves and concrete chamber boxes.

## Bringing research to rural communities

C SIR is participating in an international research consortium aimed at enabling people in rural areas to participate fully in the research and technology development activities that potentially affect their lives.

Funded by the European Union's Framework Programme 6, the consortium comprises 30 partners from 15 countries. Titled 'Collaboration@Rural: a Collaborative Platform for Working and Living in Rural Areas', the three-year project provides a collaborative programme for research institutions and rural communities. It aims to develop effective methodologies for the implementation of rural living laboratories within rural economies.

"Rural living labs are user-centric, real-life research and development contexts, involving people, businesses and public players in the co-creation of services enhancing rural development," explained CSIR researcher Johan Maritz. "The concept is about research institutions setting up long-term relationships with the inhabitants of the real-world context in a way that will ensure active participation by the latter in the research and development process."



## New water booklet makes a mark

The Water Research Commission (WRC), in partnership with the Department of Water Affairs & Forestry (DWA), have published a new, user-friendly booklet to raise awareness of the importance of maintaining a balance between using water for social and economic development and protecting water for healthy ecosystem functioning.

*Watermark: the Lasting Impression of the Ecological Reserve*, explores the rationale behind the Ecological Reserve, the volume of water required by the natural system to function adequately. The Ecological Reserve forms one part of the Reserve, the other being the Basic Human Needs Reserve or the water allocated for human consumption before any other water can be assigned. The booklet illustrates in simple language how defining and implementing the Ecological Reserve will help to ensure the adequate supply of water in the years to come.

**“Just as a human being would eventually dehydrate and die without this basic fluid, so would the country’s water resources without an Ecological Reserve.”**

South African water policy and the concepts around water allocation are explained. Other topics covered include the role of water in the economy; water quality and environmental flow; the link between flow and biodiversity; pollution and waste disposal; as well as balancing use with sustainability.

WRC research manager Dr Stanley Liphadzi explains that enduring misconceptions over the need for the Ecological Reserve prompted the development of the booklet. “DWA and WRC were concerned over the perception among members of the public that setting aside water for ecological needs necessarily means less water for people for the sake of *goggas* and fish.”

While the Ecological Reserve is not intended to protect the aquatic ecosystem at the expense of development, it does ensure that water resources are afforded a level of protection that will ensure sustainable development. Like the human body, South Africa’s water resources need to retain a certain amount of water for a sustained level of ecological function. Just as a human being would eventually dehydrate and die without this basic fluid, so would the country’s water resources without an Ecological Reserve.

Easy-to-read *Watermark* lays a good foundation for beginners to the concept of environmental water allocation and how it supports government’s priorities of poverty alleviation and job creation. “The booklet portrays the relationship between the health of an aquatic ecosystem and economic and social prosperity,” notes Dr Liphadzi. “It illustrates how we can achieve sustainable development (in harmony with social, economic and environmental expectations) if we take care of our water resources in such a way that they can keep on providing

the goods and services we require.”

The booklet is aimed at the general public, provincial and local decision-makers, non-governmental and community-based organisations. It is hoped that the booklet will assist in the making of better informed development decisions in the future. “Maintaining a healthy aquatic ecosystem is the only way in which we can ensure a long-lasting development and supply of goods and services that will be enjoyed by generations to come,” concludes Dr Liphadzi.

- Copies of *Watermark* (WRC Report No TT 307/07) can be obtained by contacting WRC Publications at Tel: (012) 330-0340 or E-mail: [orders@wrc.org.za](mailto:orders@wrc.org.za)



### Water on the Web

[www.didyouknow.org](http://www.didyouknow.org)

The ‘Did You Know’ website offers interesting and fun facts on anything under the sun, from sports to inventions to war and disputes. The website also offers a water category. Find out more about the availability of water in the world, hydro-politics, desertification and other water-related topics.

[www.schools.watsan.net](http://www.schools.watsan.net)

The WASH in Schools website comes from the joint School Sanitation & Hygiene Foundation website of IRC and UNICEF, which was launched in 1999. This website serves as an information exchange platform for sector professionals working in the field of water, sanitation & hygiene in schools. There are projects, case studies, and other resources materials available on the site.

[www.splash.bradford.ac.uk/home/](http://www.splash.bradford.ac.uk/home/)

This website presents the outputs from recent research on water governance and related topics by members of the Water Research Group at Bradford University, in the UK. It seeks to inform users, researchers and policymakers of current understanding around the key issues in water governance and to point the way ahead for future research and application.



# Bridging Scour Knowledge Through Research

***Mounting evidence suggests that South Africa should prepare itself for more extreme weather events, such as floods, in future due to global climate change. This could lead to increased erosion or scouring of riverbeds at engineering structures – a major cause of structural damage to bridges and fluvial structures in South Africa. Lani van Vuuren reports.***

Scour is a worldwide phenomenon and of great concern especially to civil engineers. Any structure placed in a river, whether of natural or human origin, will tend to promote scour and deposition due to a sudden change in the flow direction or high velocity flow. Such obstacles can include a boulder, an island, a sharp bend, or a pipe or road bridge pier.

Local scour causes holes to be dug around structures – such as bridge piers and abutments – which are built on or below the riverbed. These holes

can be exceptionally deep, e.g. they can easily run to 20 m to 30 m. Scour can also result in the sand around the pier being removed to such a depth that the pier ends up being supported on nothing. Because of this the pier will fail and the structure will collapse.

Unfortunately, designing for scour is not a mature science. Scour is difficult to detect and the maximum scour depths attained under peak flood conditions cannot be measured with ease. This is mainly due to the complexity and, thus, unpredictability, of



the natural river system. As a result, there is still no universally agreed design procedure that can cope with all the observed scour and deposition phenomena.

The Water Research Commission (WRC) recently published a report on the extent of local scour in rivers in South Africa. This report is based on years of research by the University of Cape Town's Department of Civil Engineering. The report provides a snapshot of the present status of local scour in South Africa.

As project leader Prof Neil Armitage points out, in general, because rivers in South Africa tend to be relatively small, scour tends to be more of a maintenance issue rather than a serious hazard. Severe scour damage is seldom evident at bridges under normal flow conditions. "There are exceptions; major floods will almost always cause scour around bridge piers and abutments – unless they are founded on extremely hard material such as rock or concrete. The undermining of bridges due to scour is a common failure mechanism," he tells *the Water Wheel*. Still, the

potential cost of maintenance should not be underestimated, as this is another expense provincial and local authorities would have to budget for.

**EXTENT OF THE PROBLEM**

An investigation into present local scour (due to the sudden change in the flow direction around a solid obstruction in the river) and constriction scour (erosion due to the fact that the flow has to speed up to get through a smaller flow area) damage was undertaken at 105 provincially maintained road bridges across the country. Local scour was observed at 60% of the bridges while constriction scour was observed at 44% of them. The local and constriction scouring were combined at 37% of the sites investigated.

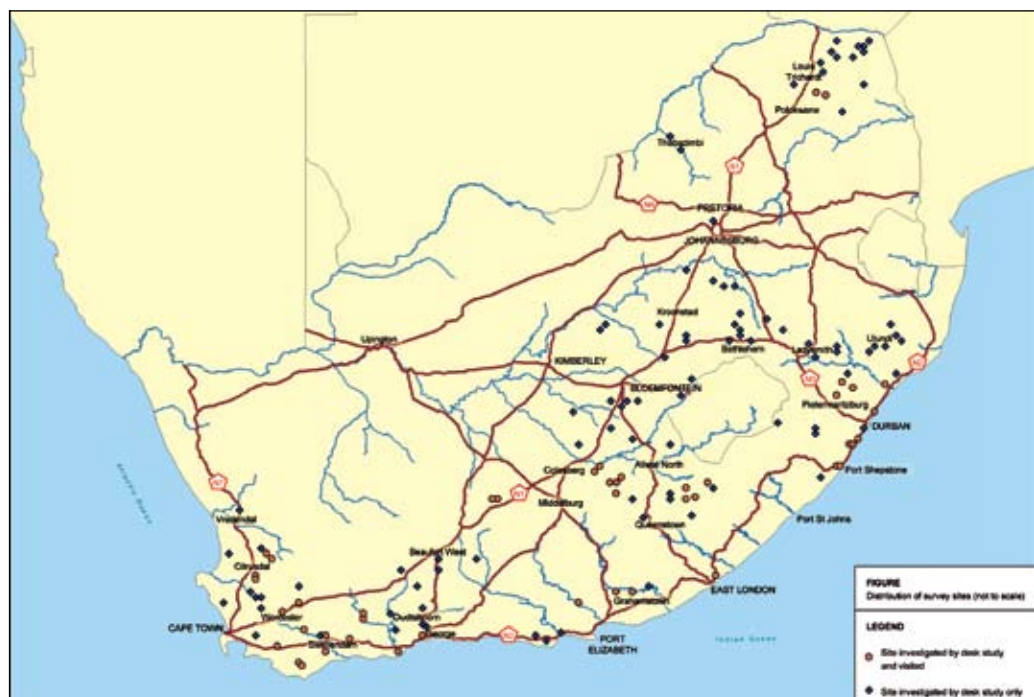
An estimate of the direct cost of repair to scour-related damage at these bridges is about R22-million a year. This cost excludes the damage incurred in extreme flood events and the economic costs associated with the disruption caused by the failure of major transport links. Inclusion of

scour damage during extreme flood events may increase the estimate to more than R25-million a year.

**“Major floods will almost always cause scour around bridge piers and abutments – unless they are founded on extremely hard material such as rock or concrete.”**

The problem was found to be most acute in KwaZulu-Natal, which has the largest number of fast-flowing rivers. Probably the best known example of a bridge failure due to scour was the collapse of the John Ross Bridge on the N2 over the Tukhela River in the 1987 Natal floods. Interestingly, about 120 bridges were destroyed or severely damaged during these floods, causing substantial losses to the economy. About 42% of the calculated annual repair costs in the country are on bridges in this province.

*Distribution of survey sites*





*This bridge in the town of Heidelberg, Western Cape, failed as the foundations were undermined. The fact that piers on the upstream side failed suggests that local scour was responsible.*

Scour damage to bridge foundations is certainly not limited to structures in rural areas. Urban streams receiving fast-flowing water from impermeable surfaces, concrete pipes and lined channels also encounter scour problems. During the February 2000 floods, for example, bridges in many golf courses in Gauteng were affected by flood damage.

Pipelines attached to road and rail bridges are also affected by damage associated by bridges. Basic water supply to rural communities,

## HISTORICAL SCOUR-RELATED BRIDGE FAILURES IN SOUTH AFRICA

- ◆ In 1868, floods caused the failure of the iron plate girder Queens Bridge over the Umgeni River near Durban.
- ◆ During the 1959 floods in Natal, one pier on the Lovu River sank by 2,74 m and three bridge spans were destroyed.
- ◆ The damage caused to bridges by the 1976 Natal floods was estimated at R50-million (R1 020-million in 2005 values).
- ◆ Scour at the Pondoland Bridge on the Mzimvubu River at Port St Johns due to the 1978 flood caused the failure of one pier and the collapse of two spans.
- ◆ The N1 Route from Cape Town to Beit Bridge has been seriously disrupted by floods on five occasions over the past 42 years.
- ◆ About 200 bridges and other drainage structures were washed away or severely damaged during floods in Limpopo in 2000. The value of damage to provincial roads and bridges in the province was estimated at R1 269-million.

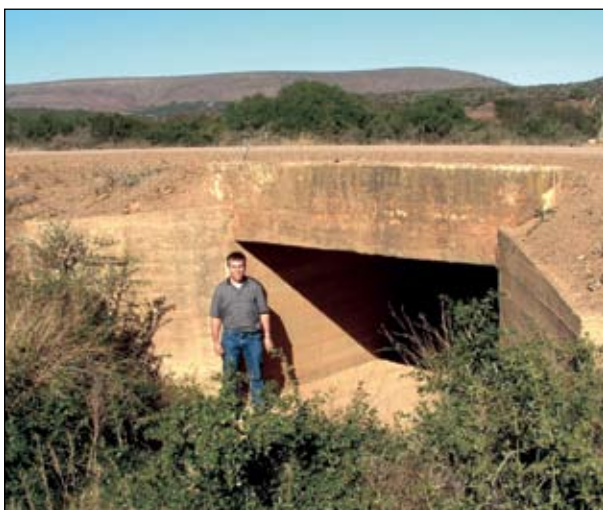
particularly in Limpopo and Mpumalanga, was severely disrupted by the February 2000 floods.

## DESIGNING FOR SCOUR

Prof Armitage points out that there are three basic methods to predict scour in a river system. The first is through empirical relationships developed by river observations of data collected in the field – or from simple physical models in the laboratory. The second is from scale (physical) models in the laboratory while the third is through

numerical modelling using Computational Fluid Dynamics (CFD).

“The cheapest is using empirical relationships, however, real rivers seldom look like the ones from which the data was gathered, so this leads to great inaccuracies (greater than 100% error is common). On the other hand, scale models are expensive to set up and run, require a lot of space, suffer from scale effects (e.g. surface tension may cause distortions in the model but not in the full scale),” he explains.



*Constriction of the flow at this culvert near Riebeeck East, northwest of Grahamstown, in the Eastern Cape, has led to high velocity water exiting the downstream end. The riverbed has been severely scoured for a long distance downstream.*





*The Palmiet River in the main stream of Grabouw, in the Western Cape, no longer flows parallel to the bridge piers. This may have initiated scouring under the bridge and exposure of the piles.*



*The piles of this bridge near the Mzimkulu River mouth have been exposed to a significant depth.*

As a result CFD is rapidly gaining ground, especially due to the rapid increase in computing power. CFD is a computer program that attempts to model the behaviour of water by solving the basic equations of motion at every point (or surface) on a grid that encompasses the entire river volume. Ideally, the equations are simultaneously solved in all three directions (forwards, sideways and downwards). Often, to make the computations simpler, they are only solved in two dimensions – usually forwards and sideways.

**“There is a pressing need for the development of appropriate tools to enable the designers of the future to make the optimal use of limited resources.”**

While reality remains so complicated that it is unlikely that any computer will ever be able to perfectly simulate it, it is now possible to get a reasonable prediction of the sort of behaviour one can expect under a variety of conditions, without leaving one's desk. “One great advantage of numerical modelling is that it is

possible to see the likely effect of small changes by simply making small changes in the data set. There is no need to reconstruct a large physical model,” explains Prof Armitage.

Running times will, however, remain long for the foreseeable future. Most models take several hours to run to completion; many take days. Faster computers – with more memory – theoretically help, but usually this additional capacity is put to use to improve the accuracy of the model. “In the end, it becomes a trade off between run time and accuracy,” says Prof Armitage. The hope remains, however, that numerical modelling will soon become a viable option to model the scouring processes around engineering structures.

### **DEALING WITH CAPACITY CONSTRAINTS**

The need for appropriate modelling tools is especially important considering that the role of engineering departments in many government institutions is changing from design to regulatory. This means that they are employing fewer and possibly less experienced engineers, resulting in years of accumulated wisdom in design being gradually lost. This

has resulted in a pressing need for the development of appropriate tools to enable the designers of the future to make the optimal use of limited resources.

Unfortunately, these capacity constraints have left many government departments without adequate personnel who understand the problem of scouring. According to Prof Armitage, there is a need to ensure that bridge foundations are designed very conservatively. “In the end, it is the bridge designers who have to ensure that bridges will stand up in flood conditions, however, very few bridge designers nowadays have more than an elementary knowledge of scour.”

While international interest in the scouring phenomenon is gaining, the waning of local interest and, as a result, decreased research support, has steered experts such as Prof Armitage in other research directions. It is hoped that it will not take a spectacular failure for decision makers to realise the importance of tackling the challenge of river scouring.

(To order the report, WRC Report No **KV 185/07**, contact Publications at Tel: (012) 330-0340 or E-mail: [orders@wrc.org.za](mailto:orders@wrc.org.za)) 



Verona Veltman

# Start Saving or Start Paying Report Warns

***Unless South Africans want to see billions of Rands being spent on alternative water sources in the near future, such as the importation of water from the Zambezi River and the towing of icebergs, they will have to start saving water right now. This is the message from the Department of Environmental and Tourism's (DEAT's) latest state of the environment report.***

According to the *DEAT South African Environment Outlook*, officially launched earlier this year, there has been significant progress in the development of the country's policy and legal framework dealing with water resources since 1994. This includes the implementation of the National Water Act, the Water Services Act, and the National Water Resources Strategy, which has been recognised internationally

for its groundbreaking approach towards integrated water resources management.

A range of management tools is being developed, such as the establishment of catchment management agencies, while institutional restructuring is separating water supply from resource protection functions. However, the historical lack of capacity and financial

resources within the regulating bodies has led to inconsistent management and a lack of widespread enforcement.

Local government, in particular, faces many challenges, and for the most part does not yet have the skills or resources to integrate environmental considerations (including the protection of aquatic ecosystems) into development planning, or to



implement new statutory responsibilities. All of this has led to South Africans now having less water available, of poorer quality than before.

## FROM DAMS TO DEMAND MANAGEMENT

Most of South Africa's present water requirements are provided by surface water supplies (rivers and dams). Generally, these surface water resources are highly developed over the country, with about 320 major dams having a total capacity of more than 32 400 million m<sup>3</sup>, which is some 66% of the total mean annual runoff.

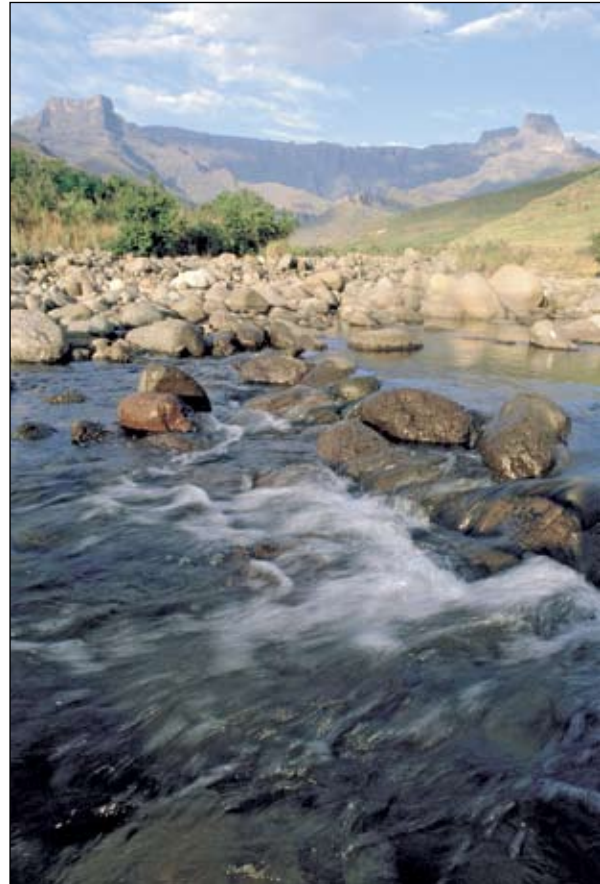
To date, present demands for water have been met mainly through large engineering projects requiring substantial capital investments in infrastructure. There is a noteworthy amount of water transfer between water management areas (WMAs), which can have adverse ecological impacts, for example, the introduction of non-endemic species to new catchments.

Evidence indicates deficits in available water in more than half of the WMAs, although there is a theoretical surplus in the country as a whole. In many areas, present levels of water use make no allowance for the need to sustain the ecological viability of the resource (the so-called ecological reserve).

With more people flocking to South Africa's cities, water demand in especially urban centres is expected to grow. Demand is expected to rise particularly from the main metropolitan centres where most economic growth is taking place. Further strong growth is also expected in the mining sector, with water demand for mineral exploitation concentrated in the country's northern regions.

Another potential growth area is power generation, with Eskom having announced an ambitious long-term programme comprising

*While generally the upper reaches of river systems remain in a good to fair state of health, concern has been expressed over the quality of lower reaches.*



Courtesy of SA Tourism

the construction of several new power stations, and the de-mothballing of older stations.

### **“Climate change has the potential to make a significant impact on the availability of and requirements for water in South Africa.”**

Much has been done to conserve water in agriculture – which uses more than 60% of the country's water resources. Although irrigated areas have increased in the last few years, the demand for irrigation water has remained constant. This appears to be the result of better consultation within the agricultural sector, improved irrigation practices and scheduling, a gradual increase in

tariffs (with associated reduction in subsidies), the introduction of compulsory licensing, as well as better training of irrigators.

To augment water supplies in South Africa, consideration has been given to other options and less conventional sources, including long distance importation of water from locations such as the Zambezi River, rainfall augmentation by cloud seeding, large-scale seawater desalination, shipping freshwater from the mouths of large rivers and towing icebergs. However, as the DEAT report points out, although these options are technically feasible, there are various environmental, political, legal and economic considerations attached to each. Present scientific understanding and costs preclude these options from being feasible.

“A concerted move to water conservation and water demand



Verona Veltman

*Unless South Africans start saving water earnestly, large engineering projects, such as importing water from the Zambezi or towing icebergs, could become a reality in the near future.*



Verona Veltman

management is required, and adequate resources need to be mobilised to fund public awareness and education programmes," the authors of *South African Environment Outlook* point out. Promotion of the recycling of wastewater, especially treated sewage and mine-water, is also advocated.

**"South Africans now have less water available, of poorer quality than before."**

The report points to the fact that South Africa's groundwater resources – which play a particularly important role in the country's rural areas – have not received enough attention. "Most of the nine million people supplied with water since 1994 have been supplied from groundwater resources. Yet there has been limited investment in the assessment and management of the country's groundwater resources. More research, especially on the issue of groundwater recharge, is required to improve our knowledge of this valuable resource."

### **WATER QUALITY: A MIXED BAG**

According to the DEAT report, water quality in the country is variable, with an overall deterioration since the last state of environment report (released in 1999). It is reported that the health of river ecosystems are generally declining, with effluent pollution continuing to grow.

Data gathered through national initiatives such as the River Health Programme show that the health of river ecosystems are generally good to fair in the upper reaches and tributaries, but fair to poor in the lower reaches, with most river systems in urban areas in poor condition.

It is not only the country's rivers that are affected. About 50% of South Africa's wetlands have been destroyed or converted, and the ongoing lack of recognition and degradation of these wetland systems constitutes a significant opportunity cost, the DEAT report points out.

### **AN UNCERTAIN FUTURE**

Climate change has the potential to make a significant impact on the availability of and requirements for water in South Africa. Rising temperatures and increasing variability of rainfall will generally affect surface waters, increasing drought in some regions and causing floods in others, as well as influencing groundwater recharge.

There is likely to be a general decrease of 5% to 10% of present rainfall, with longer dry spells in the interior and northeastern areas of the country coupled with more frequent and severe flood events. The probable effect is greater evapotranspiration and more stress on arid and marginal zones.

Wetting is generally expected over the eastern half of the country, particularly in the east coast regions. Parts of the Eastern Cape interior may experience increased late summer rainfall. Drying is expected in the west





Although irrigated areas have increased in the last few years, the demand for irrigation water has remained constant.

of the country, particularly around the Western Cape, which seems to be facing a shorter rainfall season, and in the far northern area of the country.

**“The health of river ecosystems are generally declining, with effluent pollution continuing to grow.”**

Runoff is highly dependent on changes in rainfall, and groundwater recharge even more so. Parts of South Africa could experience reductions in runoff and/or stream flow of up to 10%, which could be evident in the western parts of the country as soon as 2015. Even if the average rainfall were to remain the same, increased variability of stream flow would result in reduced natural yields and reliability, and an increase in the unit cost of water from dams.

Should warmer climatic conditions prevail, the water requirements of plants, and therefore irrigation requirements, would also increase. A decrease in water availability will also



Courtesy of WRP

Deteriorating water quality is having adverse effects on health in some areas, compounded by the lack of sanitation and the non-functioning of a number of basic water supply schemes.




Demand for water from the power generation sector is expected to increase.

affect water quality, further limiting the extent to which water may be used and developed.

The DEAT report notes that interaction is needed among all water-dependent sectors to ensure that all available measures are considered, so as to adapt to changing

circumstances and reduce vulnerability. No development or investment decisions should be made that neglect to take into account the actual or potential effects of climate change on water resources.

- To access the report go to [www.deat.gov.za](http://www.deat.gov.za) 



# Poor Decisions of the Past may Cost Cape its

## 'Living Gold'

All photographs taken from TT 302/07

*Imprudent introductions of invasive alien fish species in Western Cape waters may cost the country some of its most rare endemic fish species if no immediate action is taken.*

*This has emerged from the latest report on the State of Yellowfishes in South Africa.*

*Lani van Vuuren reports.*

Referred to as the continent's 'living gold' African yellowfish are striking creatures well known and valued for their beauty and as a food source. According to Prof Paul Skelton, MD of the South African Institute of Aquatic Biodiversity, yellowfishes are endemic to Africa, and constitute a lineage of about 80 large cyprinid fish species with some well defined traits and characteristics.

The most outstanding feature of the African yellowfish lineage is the high number (about 150) of cell chromosomes – a fact only recently discovered (most cyprinid

species have around 50 chromosomes in each cell). The large size and fighting spirit of some species make them excellent game fish. There are adults that grow beyond 150 mm standard length, with larger species attaining a length of about a metre, and a mass as much as 30 kg.

These fish occur in all the larger rivers in sub-Saharan Africa, including the Nile, Congo, Zambezi, as well as in the Great Rift and other lakes of East Africa. They extend south as far as KwaZulu-Natal in the east and the Orange and Clanwilliam Olifants in the west.

The new report, compiled by the Yellowfish Working Group (YWG), was sponsored by the Department of Environmental Affairs & Tourism, the River Health Programme and the Water Research Commission. Assessing the state of the nine yellowfish species that occur in South Africa, the report highlights the plight of these indigenous fish, especially those found in the Western Cape, which are facing near extinction.

Of the nine South African yellowfish species, four are classified in the World Conservation Union Red Data list as 'threatened', while several others are not in a healthy state. As Bill Mincher, chair of the YWG points

out, “Considering that yellowfish take five to seven years to reach sexual maturity and the rate at which pollution is increasing, we simply do not have the time to allow matters to perpetuate.”

**RARE OLIFANTS-DORING SPECIES DISAPPEARING**

No other river system in South Africa has as many endemic fish as the Olifants-Doring River system and its tributaries. Eight of its ten indigenous fish species are endemic to the system, all of which are threatened, including the Clanwilliam yellowfish (*Labeobarbus capensis*) and the Clanwilliam sawfin (*Barbus serra*).

The Clanwilliam yellowfish is considered the Western Cape’s premier freshwater game fish and South Africa’s second-largest yellowfish, attaining 11 kg in weight. Unfortunately, few anglers have the pleasure nowadays of outwitting and landing this powerful fish as only a small number of adult Clanwilliam yellowfish are still present in the Olifants and Doring rivers and their first-order tributaries, reports Dean Impson, a freshwater fish scientist at CapeNature.

The population and distribution range of the Clanwilliam yellowfish have declined drastically over the last 50 years. It is said that up to the 1950s they provided excellent sport for anglers, and being excellent eating were a popular source of protein for farmers and their employees.

The Clanwilliam sawfin occur in large shoals, often in the company of Clanwilliam yellowfish. Like other yellowfish, sawfin are supremely adapted to life in rivers. They are found in a variety of aquatic habitats from fast shallow runs to deep pools, depending on free movement between these habitats for feeding, breeding or resting.

According to Bill Paxton, a freshwater ecologist based at the University of

**“Considering that yellowfish take five to seven years to reach sexual maturity and the rate at which pollution is increasing, we simply do not have the time to allow matters to perpetuate.”**

Cape Town’s Research Unit, recent surveys have confirmed that sawfin numbers throughout the catchment are dangerously low and populations are few. Sawfin appear to have disappeared altogether from the main stem of the Olifants River within the last 30 to 40 years. “Perhaps one of the most disturbing findings is that there are neither young recruits in the Doring River main stem, nor for a considerable distance upstream of tributary confluences.”

Legal and illegal introductions of alien fish to the Olifants-Doring River system have largely been blamed for the disappearance of the endemic fish species. Largemouth and smallmouth bass were introduced by anglers

between the 1930s and 1940s and, finding a ready source of food in the indigenous fry, they quickly spread through the rivers gradually replacing indigenous populations wherever habitat conditions proved suitable and their movements were not restricted by natural barriers.

These are not the only invasive alien fish to be found in the Olifants-Doring River system. Bluegill sunfish, carp, Mozambique tilapia, sharptooth catfish, banded tilapia, rainbow and brown trout have all been legally or illegally introduced.

Other factors contributing to the demise of indigenous fish in the catchment include increased



*Smallmouth bass have devastated Western Cape yellowfishes.*



*Rainbow trout have severely affected whitefish in several Western Cape rivers.*



**ALIEN SPECIES FOUND IN WESTERN CAPE RIVERS**

Species	Scientific name	Approx date introduced	Legal introduction?	Impact on indigenous biota
Banded tilapia	<i>Tilapia sparmani</i>	1960	Yes	Primary competitor
Bluegill	<i>Lepomis macrochirus</i>	1950	Yes	Predator and competitor
Brown trout	<i>Salmo trutta</i>	1910	Yes	Predator
Carp	<i>Cyprinus carpio</i>	2000	No	Competitor, degrades habitat
Largemouth bass	<i>Micropterus salmoides</i>	1940	Yes	Predator
Mosquito fish	<i>Gambusia affinis</i>	1950	Yes	Competitor
Mozambique tilapia	<i>Oreochromis mossambicus</i>	2000	No	Primary competitor
Rainbow trout	<i>Oncorhynchus mykiss</i>	1910	Yes	Predator
Sharptooth catfish	<i>Clarias gariepinus</i>	2000	No	Predator and competitor
Smallmouth bass	<i>Micropterus dolomieu</i>	1940	Yes	Predator

Source: RHP: State-of-the-Rivers-Report Olifants/Doring and Sandveld Rivers

water abstraction, and habitat destruction. Dams that have been constructed to store surplus winter water mainly for irrigation purposes hamper spawning migrations of Clanwilliam yellowfish and sawfin while benefiting alien fish. In addition, irresponsible farming practices, such as bulldozing and farming within the floodplain, have led to the wholesale destruction of the riverine habitat and the introduction of

fertilisers and pesticides to the detriment of all wildlife.

**THE ASSASSINATION OF THE WITVIS**

The contemptuous actions of past authorities against indigenous fish in the Berg-Breede River system have cost South Africa dearly. In the 1930s, the Groot Drakenstein Angling Society recommended to

the then Jonkershoek division of the Cape Department of Inland Fisheries that smallmouth bass should be introduced into the river to get rid of the 'witvis pest' so that rainbow trout (introduced 30 years earlier) would have less competition for food.

Ironically, the powerfully built bronze Berg-Breede whitefish (*Barbus adrewi*) or witvis provided excellent sport for anglers and fly fishers up



Clanwilliam yellowfish habitat.



**“Perhaps one of the most disturbing findings is that there are neither young recruits in the Doring River main stem, nor for a considerable distance upstream of tributary confluences.”**

to the 1950s. Coloured communities next to Paarl, particularly enjoyed eating whitefish and caught large quantities when the fish were gathering for spawning or when the river was very low and shallow in late summer.

Within 70 years these once abundant fish have been reduced to an endangered species. Impson reports that historically, this whitefish occurred as two separate populations in the Berg and Breede rivers respectively. However, the Berg River population is now regarded as extinct as no fish have been caught in the river since 1996. “Whitefish in the Breede River catchment are also likely to become extinct within the next 30 years if no corrective action is taken.”

**CORRECTING PAST MISTAKES**

Stakeholders interested in yellowfish conservation in the Western Cape catchments will have to work hard to turn the clock back even just a little, maintains Impson. While there are no conservancies targeting specific indigenous yellowfish in the area, some measures are being taken to halt dwindling numbers.

An ambitious project aimed at removing alien fish (mainly bass) from priority streams (including Rondegat, Krom and Suurvlei rivers) while restoring the habitat and breeding areas of indigenous fish in the Olifants-Doring River system was launched a few



*Modifying riverbeds without written permission from the appropriate authorities is illegal.*



*Endangered sawfin being released.*

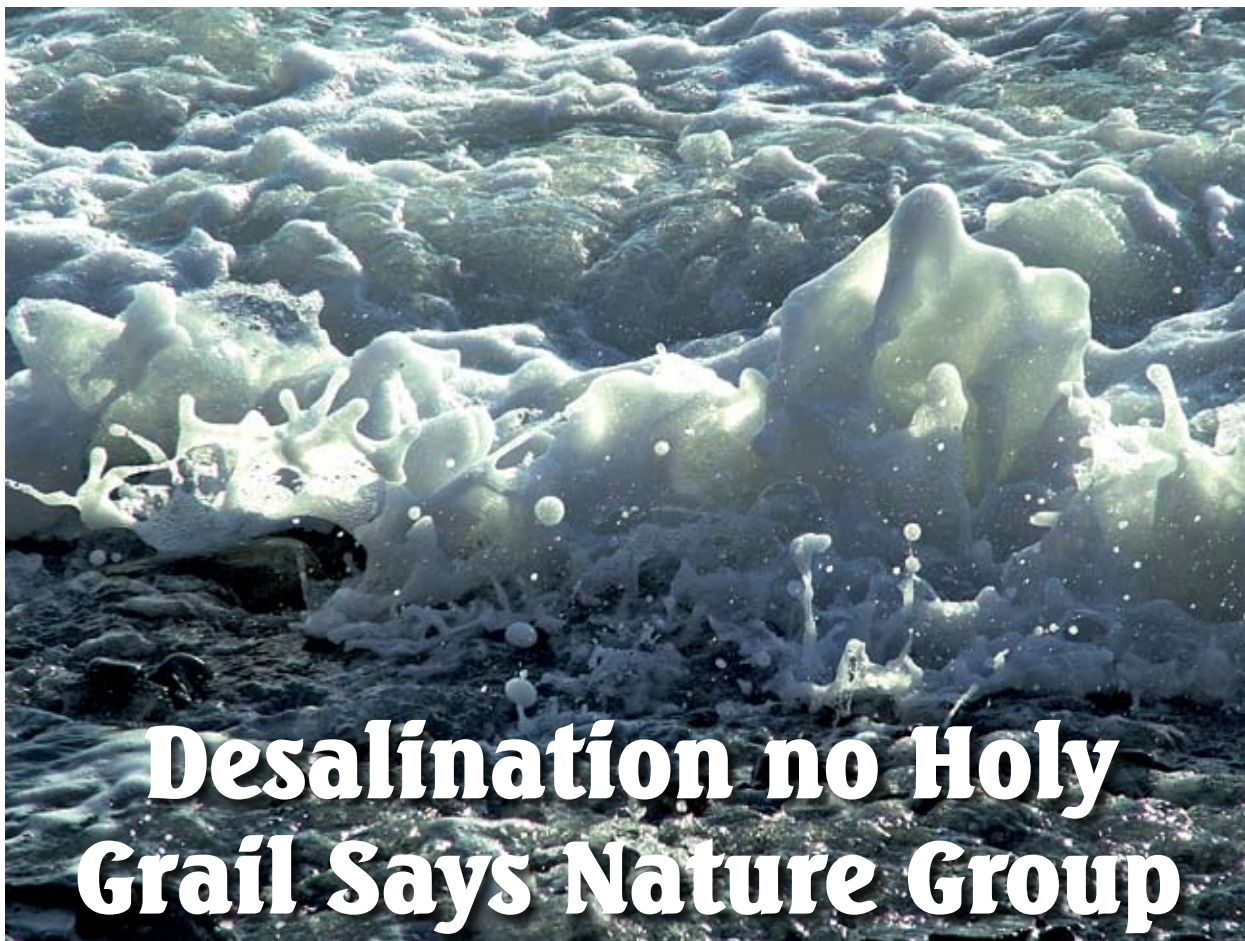
years ago. The project is supported by the Western Cape Bass Anglers Association and the Cape Piscatorial Society.

It is further hoped that indigenous fish will benefit from the recent formation of the Greater Cederberg Biodiversity Corridor; a major internationally funded conservation initiative to better conserve the area.

Farmers and fly fishers have shown increased interest in introducing

whitefish into their dams. Whitefish are said to breed well in dams that have appropriate gravel and rock beds for spawning areas. CapeNature has stocked specimens in about ten dams in the Berg and Breede catchments since 1980.

- To order the report, **State of Yellowfishes in South Africa 2007 (WRC Report No TT 302/07)** contact Publications at Tel: (012) 330-0340; Fax: (012) 331-3565; E-mail: [orders@wrc.org.za](mailto:orders@wrc.org.za) 



# Desalination no Holy Grail Says Nature Group

**Swiss-based environmental organisation WWF has warned against the indiscriminate application of ocean desalination to solve the world's water shortages in a new report. Lani van Vuuren reports.**

According to the report, *Making Water: Desalination – Option or Distraction for a Thirsty World*, seawater desalination is rapidly emerging as one of the major new sources of freshwater for the developed and some areas of the developing world. However, this dramatic upscaling of the industry is occurring against a backdrop of unresolved questions on the potential environmental impacts of large-scale processing of seawater habitat and the discharge of increasing volumes of concentrated brine wastes.

“Seawater desalination may have a place in the world’s future freshwater supplies, but regions still have cheaper, better and complementary ways to supply water that are less

risky to the environment,” reported Jamie Pittock, Director of WWF’s Global Freshwater Programme. Potential impacts of desalination include brine build-up, greenhouse gas emissions, destruction of prized coastal areas and reduced emphasis on conservation of rivers and wetlands.

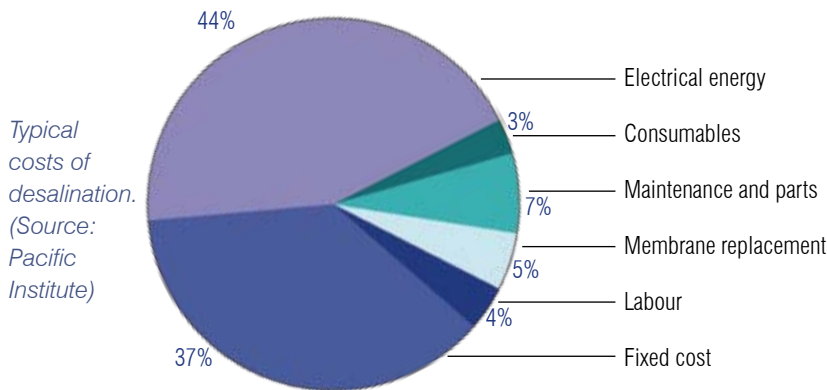
## SURGING DEMAND

At present, there are large plants in operation, in planning or under construction in Europe, North Africa, North America, Australia, China and India among others. In 2004, it was estimated that seawater desalination capacity would increase 100% by 2015, an addition of an additional 31 million m<sup>3</sup>/day.

According to WWF, these forecasts, regarded as bold at the time, seem certain to be exceeded by wide margins. In one example, the forecast was for China and India to be desalinating 650 000 m<sup>3</sup>/day by 2015. But China alone announced plans earlier this year to be desalinating 1 million m<sup>3</sup> of seawater a day by 2010, increasing to 3 million m<sup>3</sup>/day by 2020.

Many of the areas of most intensive desalination activity also have a history of damaging natural water resources, particularly groundwater, said WWF. “Managing water demand and assessing impacts of any large-scale engineering solution are needed early in order to avert





irreversible damage to nature and the cost overruns, often paid by citizens over the long haul.”

### RISING CRITIQUE

The organisation is not the first to cast a shadow of a doubt over seawater desalination technology as the answer to all water scarcity problems. Last year, US-based organisation, the Pacific Institute, published a report criticising the indiscriminate construction of large desalination plants without proper investigations into potential economic and environmental costs.

“While seawater desalination plants are already vital for economic development in many arid and water-short areas of the world, many plants are

overly expensive, inaccurately promoted, poorly designed, inappropriately sited, and ultimately useless,” noted the authors of *Desalination, With a Grain of Salt – a California Perspective*. “To avoid new, expensive errors, policymakers and the public need to take a careful look at the advantages and disadvantages of desalination and develop clear guidance on how to evaluate and judge proposals for new facilities.”

The potential benefits of ocean desalination are great, but the economic, cultural and environmental costs of wide commercialisation remains high. In many parts of the world, alternatives can provide the same freshwater benefits of ocean desalination at far lower economic and environmental costs. These alternatives

### SEAWATER DESALINATION IN SOUTH AFRICA



At present, desalination is practised only in isolated locations in South Africa where small-scale desalination costs less than transporting potable water over long distances. For example, Kenton-on-Sea has been producing desalted drinking water for up to 30 000 people since 1997.

The size of these plants is still nowhere near the scale of seawater desalination plants being constructed or planned in other parts of the world. Indications are, however, that government is considering desalination as a future option. During a speech in November 2006, Minister of Water Affairs & Forestry Lindiwe Hendricks, said: “The desalination of seawater represents a virtually unlimited water resource and, with rapid advances in desalination technology, as well as the depletion of conventional land-based resources, it is an option that we need to explore further, especially for coastal cities.”

Cape Town authorities have been investigating desalination of seawater as a possible water supply option for quite some time, and as the technology becomes more economical and energy-efficient there is little doubt that it will be considered more seriously in future.

### EXPLOSIVE GROWTH IN CHINA

In 2005, China’s desalination capacity was just 120 000 m<sup>3</sup>/day, with plants ranging from 30 m<sup>3</sup>/day to 5 000 m<sup>3</sup>/day. Over the last year, the country has announced plans to desalinate 1 million m<sup>3</sup> of seawater a day by 2010, increasing to 3 million m<sup>3</sup>/day by 2020, in an effort to meet its growing water demands. There is also heavy investment, both Chinese and foreign, in China’s desalination equipment manufacturing capacity. It seems likely that the nation will be a future major player in desalination, particularly in the developing world.



Source: WWF



**DESALINATION TO QUENCH CITY'S THIRST**

Australian authorities announced plans to build one of the world's largest desalination plants as part of a US\$4-billion programme to provide drinking water to the country's second-largest city Melbourne in June. The plant is expected to provide an additional 150 billion litres of water each year to Melbourne by the end of 2011.

The multibillion Dollar reverse osmosis plant will be constructed in the Wonthaggi region. An 85-km pipeline will connect the plant to Melbourne's drinking water supplies. Brine from the treatment process will be piped back into Bass Strait through an underground and undersea tunnel about one kilometre offshore.

The plant will be the largest in Australia and will provide around a third of Melbourne's yearly water needs. Interestingly, it has been reported that greenhouse emissions from the plant will be offset by the purchase of renewable energy, making the plant carbon neutral.

**“Desalination plants should only be constructed where they are found to meet a genuine need to increase water supply and are the best and least damaging method of augmenting water supply.”**

considered on a case-by-case basis in line with integrated approaches to the management of water supply and demand. The organisation proposes an approach similar to that recommended for large dams by the World Commission on Dams that says proponents should first assess the need and then consider all options to select the best solution.

“Desalination plants, accordingly, should only be constructed where they are found to meet a genuine need to increase water supply and are the best and least damaging method of augmenting water supply, after a process of open, exhaustive and fully transparent and in which all alternatives, especially demand side and pollution control measures, are properly considered and fairly costed in their environmental, economic and social impacts. While the sea is clearly the greatest available volume of potential feedstock for water manufacturing, proceeding straight to a desalination plant excludes viable options for sustainable water use in the same way that proceeding straight to a new dam often did in the past.”

include treating low-quality water sources, improving conservation and efficiency, accelerating wastewater recycling and reuse, and implementing smart land-use planning.

**DESALINATION SHOULD NOT BE LIKE DAMS**

WWF expressed concern that large desalination plants could become “the new dams”. “As with any relatively new engineering such as large dams that grew up in the 1950s, the negatives become known when it is too late or too expensive to fix,” said Pittock. What we need most is a new attitude to water not unchecked expansion of water engineering.”

WWF is of the view that seawater desalination has a limited place in water supply, which needs to be

- To download the WWF Report, *Making Water: Desalination – Option or Distraction for a Thirsty World?*, go to <http://assets.panda.org/downloads/desalination-reportjune2007.pdf>
- The Pacific Institute report, *Desalination, With a Grain of Salt – A California Perspective*, is available from [www.pacinst.org/reports/desalination/desalination\\_report.pdf](http://www.pacinst.org/reports/desalination/desalination_report.pdf)



An aerial view of a desalination plant located in Perth, Australia.



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600977/The Water Wheel

## Halting the Scourge of Desertification

**D**esertification has been called 'the greatest environmental challenge of our times'. But what is it and why should we be concerned about it?

Almost 40% of the Earth's total land surface is dryland. These semi-arid areas are defined by their modest water supply (they receive less than 600 millimetres of rain a year). They are not as dry as deserts, although they often border deserts. Drylands are called by many names: plains, grasslands, savannas or steppes.

Dryland ecosystems are especially fragile, and can easily be overused by the people who depend on them, resulting in the degradation of the land. For example, overgrazing by livestock can encourage wind and water erosion, while the collection of firewood reduces or eliminates plants that help to bind the soil. Irresponsible agricultural practices, such as overcultivation, can exhaust the soil, preventing further plant growth.

These poor land management practices can turn productive dryland into

non-productive desert. This is known as desertification. When these practices described above coincide with drought, a regular phenomenon in countries with erratic rainfall, such as South Africa, the rate of desertification increases dramatically.

As vegetation cover and soil layers are reduced, rain drop impact and runoff increases. This means water is lost off the land instead of soaking into the soil to provide moisture for plants. Even long-lived plants that would normally survive droughts die. As protective plant cover disappears,

floods become more frequent and more severe. Desertification is self-reinforcing, in other words, once the process has started, conditions are set for continual deterioration.

Increasing human population and poverty contribute to desertification as poor people may be forced to overuse their environment in the short term, without the ability to plan for the long-term effects of their actions. Where livestock has a social importance beyond food, people might be reluctant to reduce their stock numbers.

### RESTORING THE LAND AT OKHOMBE

In Okhombe, in the northern Drakensberg, KwaZulu-Natal, the local community has been taught how to use its land and water resources better. Overgrazing by cattle and goats has led to widespread erosion in the area. The community does not only lose land that could be used for food production. Huge loads of silt also lands up in nearby rivers and dams. This reduces the capacity of the storage reservoirs and is expensive to remove. To restore some of these degraded areas, people have been showed how to implement erosion control techniques, including placing stone packs inside dongas, planting vetiver grass on contour lines, and building cattle steps. Community-participative monitoring and evaluation projects have also been put in place to help assess whether these techniques are successful.



### USEFUL WEBSITES

[www.deat.gov.za](http://www.deat.gov.za)

[www.botany.uwc.ac.za/Envfacts/facts/desertification.htm](http://www.botany.uwc.ac.za/Envfacts/facts/desertification.htm)

[www.undp.org/drylands/](http://www.undp.org/drylands/)





Courtesy of SA Tourism

Over 90% of the Northern Cape is potentially susceptible to desertification.



Erosion is one of the characteristics of desertification.

### DID YOU KNOW?

- About 3,6 billion of the world's 5,2 billion hectares of useful land for agriculture has suffered erosion and soil degradation.
- A third of all people on Earth – about two billion – are potential victims of desertification's creeping effect. If left unchecked, as many as 50 million people (that is the entire population of South Africa) could be displaced due to severe desertification.



Courtesy of SA Tourism

Overgrazing can lead to the degradation of productive soil.

## KNOW THE LINGO

**Deforestation:** The permanent destruction of indigenous forests and woodlands.


**Desertification:** The process which turns productive dryland into non-productive desert as a result of poor land management.

**Drylands:** Areas usually bordering deserts that have an annual rainfall of less than 600 millimetres.

**Erosion:** The removal of soil by the action of water or wind.

Desertification reduces the ability of land to support life, affecting wild species, domestic animals, agricultural crops and people. Around the world, it is estimated that between 10% and 20% of drylands are already degraded. The greatest impact of desertification is in Africa, as two thirds of the continent comprises desert or drylands. South Africa is losing about 300 to 400 million tons of topsoil every year. Areas such as the Northern Cape are especially prone to desertification.

To halt desertification the number of animals on the land must be reduced, allowing plants to regrow. Soil conditions must be made favourable for plant growth by, for example, mulching. Mulch (a layer of straw, leaves or sawdust covering the soil) reduces evaporation, suppresses weed growth, enriches soil as it rots, and prevents runoff and hence erosion. Reseeding may be necessary in badly degraded areas. Locally-available materials, such as rock packs, can be used to fill up eroded areas.

However, the only realistic large-scale approach is to prevent desertification through good land management in dryland areas. 

# Gaining Knowledge from Open Water

**T**he Water Research Commission is funding a project to find improved ways of estimating evaporation, which remains one of the most challenging components of the hydrological cycle to quantify. Earlier this year the research project team

undertook a field campaign to the Midmar Dam, in KwaZulu-Natal, where evaporation of an open water surface was estimated using a range of techniques. These included the open path in situ flux eddy covariance technique, the surface renewal technique, the

eddy covariance technique based on the energy balance, surface layer scintillometry, and large aperture scintillometry, among others. Sensors for energy balance measurements and thermocouples for the surface renewal techniques were also used.



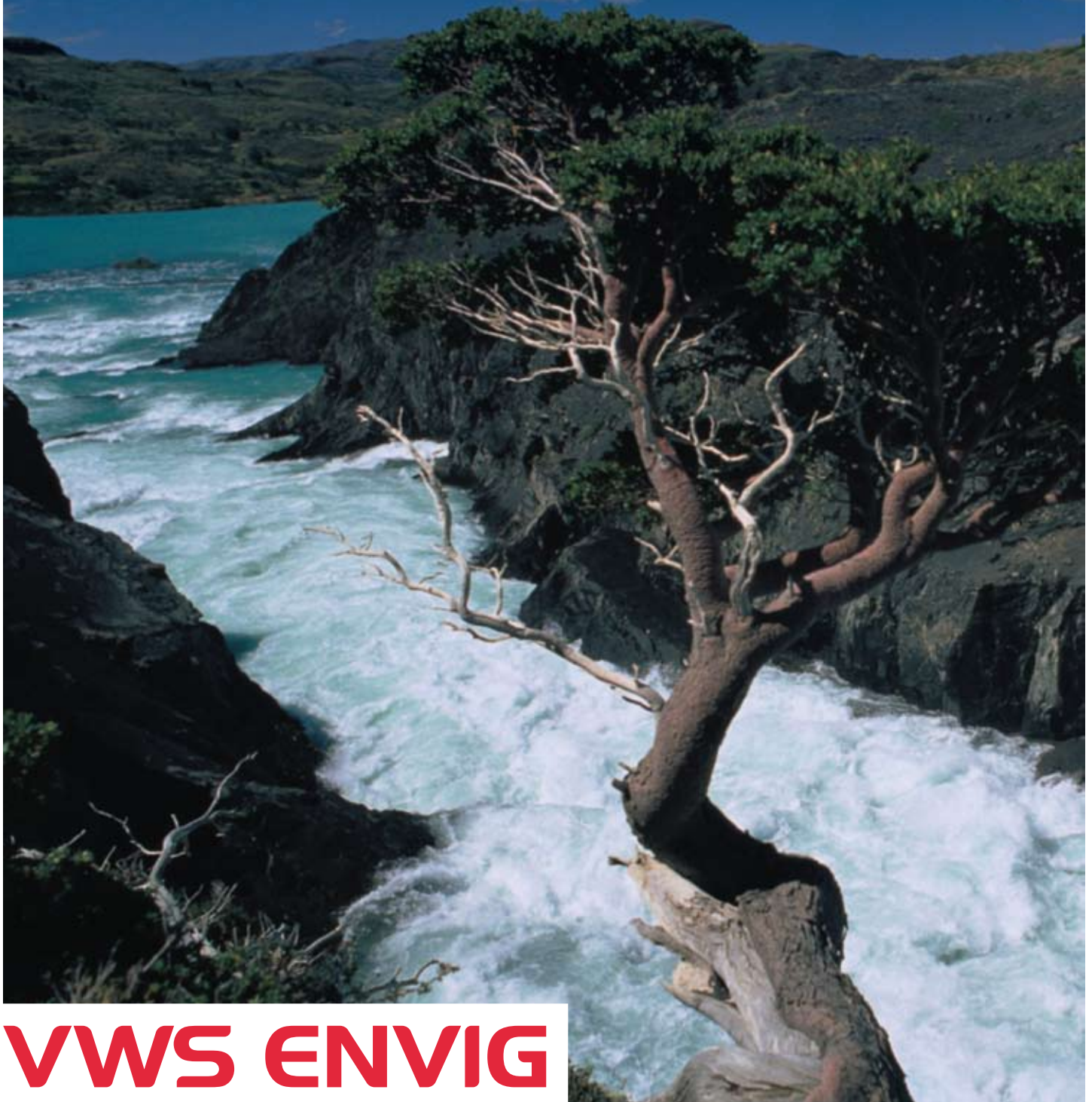
**Top left:** The research team, comprising members from the CSIR, University of KwaZulu-Natal, and the University of the Free State, along with the project reference group, arrive at Midmar Dam.

**Top right:** Prof Michael Savage of the University of KwaZulu-Natal explains the sensible and latent heat flux measurements using scintillometry.

**Left:** The battery-powered evaporation monitoring platform in Midmar Dam.



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