

THE
WATER WHEEL

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**Evaporation
in the
Spotlight**





Water Research Commission

Invests in the creation, dissemination and application of knowledge in five Key Strategic Areas (KSAs)

KSA 5 Water-Centred Knowledge

KSA 1 Water Resource Management



KSA 2 Water-Linked Ecosystems

KSA 3 Water Use and Waste Management

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SOUTH AFRICA'S WATER KNOWLEDGE HUB





Cover: Alistair Clulow adjusts the RM Young Windsentry sonic anemometer's position during the field work on *Chromolaena odorata* in the Hluhluwe Nature Reserve as part of a WRC-funded project on evaporation monitoring. See article on p 12.

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Take care when diverting

I saw your piece on Grootvlei Mine and the Blesbokspruit in the recent *Water Wheel* (Project Progresses to Reduce Ingress at Grootvlei, May/June 2006). If, in fact, Blesbokspruit is diverted, somebody should really look into its impact on the mobilization of trace metals from the wetland due to resultant change in chemical conditions (especially that of uranium).

Dr Alakendra Roychoudhury, Cape Town

So many scientists so many opinions

Ek het Robert Blyth se brief oor klimaatsverandering, en spesifiek reënvalpatrone, in *Water Wheel* (Mei/Junie 2006) met groot belangstelling gelees.

Ek is hoegenaamd nie 'n weerkundige nie, maar het oor die jare interessante standpunte hieroor van kenners gehoor. Tydens 'n besoek aan die US Water Conservation Laboratory in Phoenix, Arizona, 'n woestyn/semi-woestyn gebied, in 1983 was die navorsers se hooftema dat die geweldige lae koolstofdioksiedkonsentrasie in die atmosfeer die grootste beperkende faktor in gewasproduksie is. Veral in gebiede met lae reënval word beide

opbrengste en watergebruiksdoeltreffendheid baie verhoog deur verhoogde koolstofdioksiedkonsentrasies in die atmosfeer.

Hulle het vir my die groot positiewe effek daarvan in veldproewe met katoen gaan wys. Hulle het ook vir my 'n afskrif gegee van 'n klein artikel met die title: "What did the Phoenix scientist say to the American Academy of Sciences? – Keep an open mind". Daar was by die artikel 'n cartoon van 'n mannetjie met 'n ritsluiters, half oopgerits, dwarsoor sy voorkop.

In 1995 was ek by 'n vergadering van die werkgroep van die World Reference Base for Soil Resources (waarvan ek lid was) in Kiel, Duitsland. 'n Paar manne het daar aangekom van 'n voorafgaande vergadering oor die veragte invloed van aardverwarming. Iemand wou by een van hulle weet wat die slotsom van die vergadering was. Die antwoord was eenvoudig dat daar soveel standpunte was as wat daar wetenskaplikes was maar die media rapporteer net een kant.

In die laat 1980s het 'n wetenskaplike uit Israel deur middel van historiese data gewys dat die lande van die middelbreedtegrade, soos die Sahel en Suid-Afrika se somer-reëngebiede, baie hoer reënval gaan kry as aardverwarming plaasvind. 'n Klompie jare

gelede is daar kort voor Kersefees 'n program hieroor op 50/50 uitgesaai. In die program is historiese reënvaldata van Prof Tyson se groep vir Suid-Afrika oor historiese temperatuurdata vanaf Amerika aangepas. Die twee stelle het perfek oor mekaar gepas. Die probleem is natuurlik dat die gebiede en lande van die hoë breedtegrade, soos Suid-Afrika se winter-reëngebied en Noord-Amerika en Europa, ver minder reën gaan kry en eintlik woestyne word.

Prof Giel Laker, Pretoria

'Us' vs 'them'

The letter in the May/June 2006 edition (*Climate Change Research Still Foggy*) refers. While peer review is often a robust process I am at a loss to understand the vitriol and the cheap shots employed in his letter regarding climatology, climatologists, the Water Research Commission (WRC) and environmentalists. Who are the "us" that climatologists are playing games with "to get more research funding?" Why the implied slur on the referees, typically senior scientists, who assess proposals put to the WRC for funding?

Regarding the "challenge to climatologists" – what exactly does he want the climatologists to do? Simply say "Whoops – sorry guys we actually did not know what we were talking about and we must thank Mr Blyth for putting us right"? Does he have evidence that the increasing CO₂ levels in the atmosphere have nothing to do with human activities? Is he aware that present average temperatures and atmospheric levels of carbon dioxide and methane have no parallels in the last half million years? I also reject with contempt the implication in the last sentence regarding the demand that "environmentalists and climatologists need to...play open cards with the public" – one thing one cannot do in science is lie or conceal evidence – you will ultimately be caught out. Unfortunately for Mr Blyth this requires evidence not bluster.

Prof AT Forbes, KwaZulu-Natal





Groundwater article ‘mis-leading’

Your groundwater article “Licence to Limit” (*Water Wheel*, March/April 2006) is highly misleading in many respects.

The statement that “almost 95% of boreholes drilled in the country will require licensing” is entirely false. The borehole yield allowed under the General Authorisation (GA) is in many cases more than two orders of magnitude higher than that suggested in your article.

The GA (m³/ha-a) should be multiplied by the number of hectares of property in order to arrive at the volume permitted under that authorisation. Farms of hundreds and even thousands of hectares are common in this country. In making the statement quoted above however, it was assumed that all properties in South Africa are only one hectare in size.

The effect this has is illustrated in the following example. Where the GA is 400 m³/ha-a, a borehole yield of 12,7 ℓ/s

(24 hours per day, 365 days per year) is permitted on a 1 000-hectare farm without a license. On a small 100 hectare farm 1,3 ℓ/s (24 hours per day 365 days per year) is permitted. In this case your article would have quoted less than 0.06 ℓ/s (10 hours per day on only 200 days per year) as being permissible without a licence in both these farms cases. Your article then uses this faulty logic, as a basis to conclude that nearly all boreholes drilled in this country will require licensing.

Other misleading aspects of the article relate to Schedule 1 use.

Your article correctly explains that it is permissible to abstract groundwater for Schedule 1 use even if the volume used exceeds the General Authorisation. This is precisely so that small groundwater users can access reasonable quantities of groundwater without the administrative burden of a licensing process. It was, however, incorrectly suggested in the article that windpumps

erected after 1998 will require a licence. Windpumps are most commonly used to abstract groundwater for stock watering and (reasonable) domestic purposes. This type of use is classified as “Schedule 1” use and therefore does not require any Departmental authorisation.

One cannot simply conclude, as your article does, that the volume permitted under General Authorisation is too conservative if it is less than that required by Schedule 1 users. This situation invariably occurs in situations where there are small properties (e.g. smallholdings). It is in this circumstance that there is in fact a very real danger of overexploitation because borehole density can become too high. As a result the recharge area to each borehole is inadequate to sustainably supply the volumes required by the Schedule 1 users. Contrary to your articles assertion that the General Authorisation limits are too low, the Department will in fact need to be vigilant to ensure that overexploitation does not take place in these circumstances.

Yes, there is no doubt that the national General Authorisations set by the Department can and will be improved upon using more detailed local information. In the interim, however, the combined application of the existing GA’s and Schedule 1 use are in practise nowhere near as restricting as your article makes out.

Mike Smart, Cape Town

Mine-water project inspiring

This is to congratulate you on the article on mine-water reclamation (*the Water Wheel*, May/June 2006). Very inspiring, at least the mines have something to contribute back to the environment and meeting mankind’s potable water needs.

Ike Herbst, Swaziland

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New handbook makes water treatment clear



The Water Research Commission, with input from the Water Institute of Southern Africa, has published a *Handbook for the Operation of Water Treatment Works*.

Rather than being an instruction manual or task list, the handbook's purpose is to provide comprehensive information specifically on all aspects related to the treatment of water for domestic use. According to the authors, sufficient background and process descriptions are provided to enable a proper understanding of the functioning of the different processes and on aspects such as the suitability of processes for different types of water and the limitations of different processes.

To order the handbook (WRC Report No TT265/06) contact Publications at Tel: (012) 330-0340 or E-mail: publications@wrc.org.za

Agreement to improve shared basin management

A signed agreement between the Southern African Development Community (SADC) and the United States Agency for International Development (USAID) could see the improved management of selected shared rivers basins in southern Africa. The agreement, signed in April, seeks to promote integrated management of shared water resources to help alleviate poverty, enhance equity, and promote and protect biodiversity.

It is reported that the agreement provides a framework for coordination and collaboration in the water sector that includes an ongoing programme to improve management of the Okavango Basin; and new activities jointly identified with SADC that support



implementation of the Revised Protocol on Shared Watercourses.

SADC and USAID will assist river basin institutions in providing more effective services for river basin planning, biodiversity protection and conflict mitigation as well as helping selected communities to manage watershed resources.

SA & France join hands for water

A new research collaboration initiative between South Africa and France hopes to build much needed capacity in the local water science sector.

The Joint South Africa-French Network for Research in Water Science & Technology or SAFe Water was officially launched earlier this year. The programme aims to support the development of and cooperation in water science and technology between South African and French research teams. Each country has set aside R2,4-million over the next four years for the programme.

Three strategic themes have been

identified, namely hydrometeorology, water quality and treatment, and water management. It is hoped that joint research projects will be established under these themes this year. The programme will enable researchers to use specialised facilities in each other's countries and help researchers to submit joint research proposals to funding bodies such as the European Union, among others.

The Water Research Commission (WRC) is acting as the implementing agent for the programme. According to Dr Innocent Msibi, WRC Director: Water-centred Knowledge, the programme should go a long way in alleviating some of the capacity shortages experienced in the South Africa water science community at present. "It has long been recognised that the local water science fraternity is ageing. Through SAFe Water we hope to bring at least 36 new young researchers from all backgrounds into the fold," he told *the Water Wheel*.

- For more information, visit www.wrc.org.za or www.nrf.ac.za

Funds sought for irrigation schemes

The Eastern Cape government is organising a donor conference to attract funds for its plans to revive several irrigation schemes in the province.

According to government news agency BuaNews, the provincial Department of

Agriculture has budgeted R30-million this year for the revitalisation of irrigation schemes in Tyefu, Keiskammahoek, Zanyokwe, Qamata, Ncora and Shiloh. However, departmental spokesperson Yam Yankee reports that additional funds were required in the medium term.

Sustainability course for teachers

EThekwini Water and Sanitation has been working in partnership with the Wildlife and Environment Society of South Africa and Rhodes University over the past year to develop an accredited professional development course for teachers.

The course, funded by the Development Bank of Southern Africa, has been named 'Schools and Sustainability' and has been registered at Rhodes University as a 12-credit short course aligned to a module of the Advanced Certificate in Environmental Education.

The course focuses on integrating environment into the curriculum and develop skills such as lesson planning within the

Revised National Curriculum Statement, developing and adapting learning support materials, assessment, active learning and whole school development. The course was successfully piloted with teachers from Durban during 2004, with a second group of teachers successfully completing the course in 2005.

At this stage the course is only available in KwaZulu-Natal, but plans are being put in place to extend it to other parts of the country.

For more information, contact Teddy Gounden at Tel: (031) 311-8667 or E-mail: teddygo@dmws.durban.gov.za

The first group of teachers to graduate from the new Schools and Sustainability course.



New website for African researchers

A new website has been launched to help African scientists take part in water research funded by the European Union (EU). African Water (www.africanwater.net) is a two-year project to increase involvement of African researchers in the water-related components of EU Framework Programme 7,

which will be officially launched next year. Promoted by the EU Water Initiative's Research Working Group the website provides African-specific information about participation in FP7. It carries newsletters, and electronic news bulletins, including the latest information about the framework programme.

R3,1-m windfall for Limpopo project

The Vaalbank land care project in the greater Marble Hall area has received a R3,1-million windfall from the Department of Environmental Affairs & Tourism (DEAT).

The funds will be applied in removing alien plants, fencing ploughing fields and

erecting grazing camps to reduce soil erosion, reports government news agency BuaNews. DEAT has also earmarked R5-million for Limpopo's Sekhukhune district this year for reforestation projects.

Water by numbers

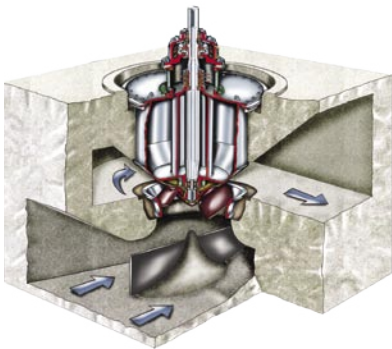
- ◆ **R400-million** – The value of the Gariep Bulk Water Scheme, which has been launched in Middelburg, in the Eastern Cape. The project involves drawing water from the Gariep Dam to serve communities in Middelburg, Hofmeyr and surrounds.
- ◆ **65%** – The percentage of water consumers in Nairobi, Kenya, who have experienced corruption at the Nairobi Water and Sewerage Company, according to a study by the firm.
- ◆ **R50-million** – This is what will reportedly be spent by chemical firms Bayer/Lanxess to remove hexavalent chromium that has polluted groundwater in eThekweni's Merebank area.
- ◆ **81%** – The percentage of South Africans who have access to safe basic water, according to the Department of Water Affairs & Forestry (DWAF).
- ◆ **20** – The number of years before the world's equatorial ice fields will be gone, according to UK scientists.
- ◆ **1 800** – The number of leaks repaired in the poorest neighbourhoods of Cape Town following the launch of the metro's leak repair programme last year. This has saved the city more than R1-million over four months.
- ◆ **R30-million** – The funds the North West government received from National Treasury for sanitation this financial year.
- ◆ **3 500** – The average number of sewer blockages experienced monthly by Johannesburg Water.
- ◆ **986** – The estimated number of sewage treatment plants in South Africa
- ◆ **37** – The estimated number of settlements believed to be illegally situated on top of Rand Water pipes.
- ◆ **4** – The estimated number of years to remove the 300 000 t of contaminated soil at the AECL site near Somerset West. The soil was contaminated while fertilisers and explosives were being manufactured on site. Traces of arsenic and other toxins have also been found in nearby groundwater.
- ◆ **R25-million** – DWAF's budgeted support for emerging farmers for the present financial year.

Giant pumps for UK

The KSB Group has supplied SEZ hydraulic systems with drives for six huge concrete volute casing pumps for the St Germans Pumping Station replacement project, in the UK.

The new structure, situated 7 km south of King's Lynn in Cambridgeshire, will replace the 70-year-old like-named pumping station, which reportedly no longer meets modern flood-protection standards.

Each pump will raise some 17 000 l/s to a head of roughly five metres. Their impellers, with a maximum diameter of 2.65 m, will only have to turn at 120 revolutions a minute. Each unit will have a drive rating of 1 250 kW. The new pumps' casings are made of concrete instead of metal.



With a diameter of 2,65 m, the impellers produced for the St Germans Pumping Stations are the largest ever built by KSB.

Back-to-back orders for Biwater

Biwater South Africa is undertaking a R25,2-million mechanical and electrical contract for Phase Two of the extension of the Potsdam Wastewater Treatment Works, in Cape Town.

Work to upgrade the ageing sewage treatment plant, which was originally constructed in the 1950s, started in 2004. The plant, which serves the Blaauwberg area, has been operating beyond its design capacity.

The Potsdam works in its present configuration comprises two streams, one being treated by a biofilter system and the other through an activated sludge process. Biwater South Africa is responsible for all the mechanical and electrical work on the present extension.

The company reports that the present extension project comprises construction of

a raw water pump station, a biological reactor complete with ten aerators ranging from 55 kW to 110 kW in size, 12 mixers, recycle pumps, dissolved oxygen measurement and control. There are four clarifiers each with a diameter of 35 m as well as a return activated sludge pump station.

One of the greatest challenges on the project is the interface with the existing works which needs to stay in operation at all times. This contract is one of at least four Biwater South Africa has received in the last few months. The largest of these is for an 18 Ml/day activated sludge plant followed by a membrane bioreactor at the Zandvliet Sewage Treatment Plant. This plant is one of the main installations treating municipal effluent from the City of Cape Town.

Thousands to benefit from groundwater strike

Groundwater might prove the sustainable solution for residents of rural village Lusikisiki, in the Eastern Cape, after a R2-million study by the Department of Water Affairs & Forestry (DWA) indicated massive underground water reserves in the area.

The Lusikisiki Groundwater Feasibility Study was part of commissioned company

SRK Consulting's task which included undertaking exploration work to assess underground water resources in an area stretching from Port St Johns on the east coast to Mkambati on the Msikaba River, and inland as far as Flagstaff. The area is part of the Oliver Tambo District Municipality.

Water Diary

DRY SANITATION AUGUST 16-19

The Second International Dry Toilet Conference will be held in Tampere, Finland. Themes include, inter alia, historical aspects of dry toilet use; architecture, construction, maintenance and logistics of dry sanitation; and regulatory framework of dry sanitation. *Enquiries: Global Dry Toilet Club of Finland; E-mail: secretary2006@drytoilet.org; Visit: www.drytoilet.org/dt.06.html*

WORLD WATER ISSUES AUGUST 20-26

The Stockholm International Water Institute's (SIWI's) World Water Week will be themed 'Beyond the River – Sharing Benefits and Responsibilities'. The conference will examine the sharing of benefits and responsibilities in particular as they relate to livelihood improvement, land-based activities within a river basin, and society's ability to cope

with natural disasters. *Enquiries: SIWI Secretariat, Tel: +46 8 522 139 60; Fax: +46 8 522 139 61; E-mail: siwi@siwi.org. Web: www.worldwater-week.org or www.siwi.org*

AGRICULTURAL ENGINEERING SEPTEMBER 3-7

The World Congress on Agricultural Engineering for a Better World will be held in Bonn, Germany. More than 800 participants from all over the world are expected to share their experiences in science and research, as well as on product developments and practical application of agricultural engineering. *E-mail: info@2006cigr.org; Web: www.2006cigr.org*

RIVER MANAGEMENT SEPTEMBER 4-7

The Ninth International River Symposium focuses on river management and the integration of

science, business, institutions and the community in managing the problems facing rivers, waterways and catchments around the world. This year the symposium will particularly explore 'Managing Rivers with Climate Change and Expanding Populations'. It takes place in Brisbane, Australia. *Enquiries: Lynette Maxwell, Tel: +61 (0)7 3846 7444; E-mail: lynette@riverfestival.com.au; Visit: www.riversymposium.com*

WASTE MANAGEMENT SEPTEMBER 5-8

WasteCon 2006, the biennial conference and exhibition hosted by the Institute of Waste Management of Southern Africa (IWMSA) will be held in Somerset West. *Enquiries: Claire McKinnon; Tel: (021) 400-2822; F: (021) 400-4302; E-mail: wastecon06@netactive.co.za*

Modern satellite imagery, known as Landsat Linear Mapping, has been used to highlight geological deformations below the surface, explained SRK Consulting associate Gert Nel. Interpretation of this information on the surface using electro-magnetic and magnetic techniques helped define 24 drilling targets around prominent satellite lineaments associated with dolerite intrusions. After 18 exploration holes had been drilled, one provided an airlift yield of 85 ℓ/s, and two each of 22 ℓ/s.

“These groundwater reserves could provide up to 50 000 people in the area with at least a basic supply of potable water.”

The former borehole was drilled in the fractured sandstone of the Msikaba Formation by Cilliers Drilling, and was tested by AB Pumps, both Eastern Cape contractors. Subsequent tests have shown that the borehole is capable of providing a sustainable delivery of 11 ℓ/s of good quality water.

“The finds have been exceptional and the present objective is to find an underground water reserve source fairly close to the existing water supply infrastructure serving Lusikisiki and neighbouring areas,” commented Alan Brown, DWAF chief engineer: options analysis for the Southern Cape. These groundwater reserves could provide up to 50 000 people in the area with at least a basic supply of potable water.”

Cost recovery system for villages

Consulting engineering firm African EPA has successfully implemented a pilot cost recovery scheme in Aganang, in Limpopo.

According to African EPA’s Onno Fortuin, while the project brief appeared simple enough at first perusal – the installation of water meters and ancillary works in four communities within the Aganang municipality – the overall success of the project would be measured against the successful implementation of a cost recovery system in the villages.

Investigations revealed that the people of Aganang were overwhelmingly in favour of paying for a higher level of supply on the condition that the bulk supply was reliable. The four communities obtained water from the same source – the Hout River Regional Water Supply Scheme. It was decided to include three additional villages, which were also linked to this scheme, in the cost recovery programme.

A comprehensive social facilitation process was implemented and contributed greatly towards the overall success of the project, said Fortuin. One village within the supply area was identified as a pilot project. The water supply to the village had to be assured from a nearby reservoir.

A new water committee was established within the community and provided with the necessary training. A household register was also compiled and thereafter training focused on a workable cost-recovery system that could be implemented in the pilot village.

After having the different options explained to them, community members were given the option of choosing the type of yard connection they preferred. The cost recovery system will be tested within the pilot village and then be implemented progressively in the remaining villages of the Aganang supply scheme.

Cost recovery has been successfully piloted in Aganang, Limpopo.



Water on the Web

www.asiawaterwire.org

This is a regular news resource on a diverse range of water issues. Many of the articles are the product of reporting on the ground by local journalists.

www.gemstat.org

GEMStat is a global water online database which was launched in 2005 to strengthen the scientific basis for global and regional water assessments, indicators and early warning. It is designed to share surface and groundwater quality data sets from the GEMS/Water Global Network, including over 1 400 stations, two million records and over 100 parameters. Between March and December 2005,

4 319 visitors from around the world access the database.

www.hip.watsan.net

The Hygiene Improvement Project (HIP) is a five-year project, funded by USAID to improve hygiene practices in about five countries. The website aims to facilitate people working in hygiene improvement to cultivate a culture of knowledge sharing and to serve as a resource for country hygiene networks.

www.iclei.org

ICLEI was founded in 1990 as the International Council for Local Environmental Initiatives. The council was established when more than 200 local governments from 43 countries

convened at the inaugural conference, at the United Nations in New York. The organisation provides technical consulting, training and information services to build capacity, share knowledge and support local government in the implementation of sustainable development at the local level.

www.negowat.org

The Negotiating Peri-urban Water Conflicts (NEGOWAT) project (2003-2006) is a multi-partner research project financed by the European Union, DFID of the UK and ASPA of Brazil. In Chennai, India; Sao Paulo, Brazil; and Cochabamba, Bolivia; the project focuses on developing tools to better understand water-related competition and conflicts.



Tsunami effects still felt in Sri Lanka

The effects of the 2004 tsunami will long still be felt in south-Asian countries such as Sri Lanka, where supplies groundwater are badly contaminated by salt, reports water resource scientists.

The scientists, hailing from the Sri Lanka, Denmark, and the US, surveyed the coastal groundwater resources of Sri Lanka to develop an understanding of the impacts of the tsunami and to provide recommendations for the future of coastal water resources in south Asia. They found that in Sri Lanka alone, an estimated 40 000 drinking water wells were either destroyed or contaminated. Seawater filled domestic open dug wells and also entered the aquifers via direct infiltration during the first flooding waves and later as ponded seawater infiltrated through the permeable sands that are typical of coastal aquifers.

Widespread pumping of wells to remove seawater was effective in some areas, but

overpumping has led to upcoming of the saltwater interface and rising salinity. It is estimated that groundwater recharge from several monsoon seasons will reduce salinity of many sandy Sri Lankan coastal aquifers.

However, the continued sustainability of these small and fragile aquifers for potable water will be difficult because of the rapid growth of human activities that results in more intensive groundwater pumping and increased pollution.

- To access the full report published by the American Geophysical Union, go to <http://www.agu.org/pubs/crossref/2006.../2006WR004876.shtml>

Africa holds record for city growth

Sub-Saharan Africa has the highest informal settlement and urban growth rate, according to a new report released by UN-Habitat.

Africa's informal settlements grow by 4,53% a year, nearly twice that of Southern Asia. In turn, the urban growth rate is 4,58% a year, according to the *State of the World's Cities Report 2006/07*.

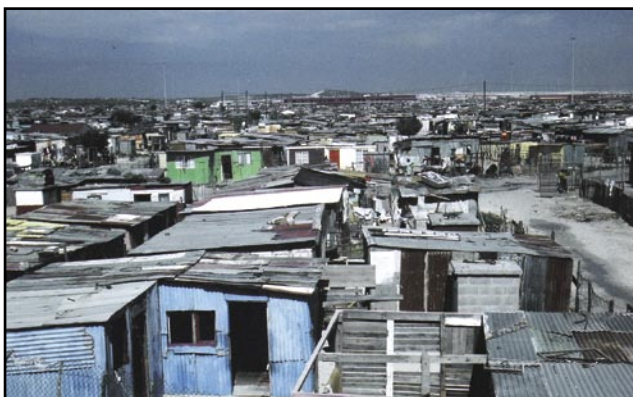
In 2007, for the first time in world history, the world's urban populations will exceed the rural population. Unfortunately, many city dwellers end up in informal

settlements where they, more often than not, are exposed to extreme poverty and disease without proper access to basic services. In sub-Saharan Africa, for example, the so-called slum population accounts for more than 70% of the urban population.

In fact, the UN-Habitat report shows that slum dwellers are as badly if not worse off than their rural cousins in terms of health, literacy and prosperity, contradicting general assumptions. The world's one billion slum dwellers are more likely to die earlier, experience more hunger and disease, attain

less education and have fewer chances of employment than those urban residents that do not reside in an informal settlement.

- To access the report, go to www.unhabitat.org



Satellites to reveal mystery of the clouds

US space agency NASA has launched two research satellites to help scientists refine computer models that forecast the weather and chart global climate change.

The satellites, dubbed CloudSat and CALIPSO, will provide a new three-dimensional perspective on Earth's clouds and airborne particles (aerosols). The satellites answer questions about how clouds and aerosols form, evolve and affect water supply, climate, weather and air quality.

NASA reports that CloudSat's cloud-profiling radar is more than 1 000 times more sensitive than a typical weather radar. It can detect clouds and distinguish between cloud particles and precipitation. Although only about 1% of Earth's water is held in clouds, it plays a crucial role in the planet's weather.

In turn, CALIPSO's polarisation lidar instrument can detect aerosol particles and can distinguish between aerosol and cloud particles.

- To follow the progress of the two satellites, visit www.nasa.gov/cloudsat



Water Franchise Pilot on the Cards

South Africa could see the implementation of a franchising pilot project in the future following an announcement by the Water Research Commission (WRC) that it is continuing research into the application of this business model in the water services sector.



According to Jay Bhagwan, Director: Water Use and Waste Management at the WRC, initial research into franchising as an institutional option for water services operation and management,

published in 2005, found that the franchising concept and its success in the commercial sector showed many characteristics which could alleviate problems encountered in municipal water services delivery. At the same time, franchising would have the added advantages of stimulating and supporting small business and black economic empowerment activities. Bhagwan was speaking at the Biennial Conference of the Water Institute of Southern Africa, held in Durban earlier this year.

“In the rural areas, where a few water services authorities can afford to employ sufficiently qualified staff of their own, it would be a significant advantage to have this level of expertise available.”

It is believed that franchisee water services providers would have a better incentive to perform than, for example, in-house water services authority personnel would usually have, while enjoying the benefit of the franchisor's expert guidance and quality assurance. In turn, since the costs are spread over a network of franchisees, the franchisor will be able to provide resources normally only available to larger water services providers. “In the rural areas, where a few water services authorities can afford to employ sufficiently qualified staff of their own, it would be a significant advantage to have this level of expertise available,” said Bhagwan.

At present, there is little experience of water services franchising anywhere in the world, and none in South Africa. However, as the challenge grows for water services providers to provide sustainable services the concept of franchising is sparking international interest. A recent World Bank discussion paper suggested that franchising shows great promise, especially in respect of water services to small towns and to multi-village schemes.

As Bhagwan pointed out, “there is a need for alternative institutional models and concepts that are more suited to sustaining ongoing operation of water services and that are friendly to small and micro businesses, rather than for large service arrangements.”

The new WRC funded study, being undertaken jointly by CSIR, Amanz'abantu Services and Viva Metsi, is aimed at reviewing statutory, procurement and other issues which could impact on water services franchising. It will also identify elements in the water services delivery chain which offer the greatest scope for franchising. Pilot projects will be initiated to test the business concept in the South African water services sector. Ultimately, it is hoped to establish different franchise models for the sector with guidelines for setting up of water franchising.

Bhagwan was quick to note that, despite its potential, franchising would be by no means

Franchising of commercial goods and services is growing rapidly in South Africa. Nearly 400 franchised systems currently operate through more than 26 000 franchising outlets in the country.

WHAT IS FRANCHISING?

Franchising is a way of using tried and tested methods to accelerate the development of a business. The right is granted by a business entity (the franchisor) to a smaller entity (the franchisee) to use a business method or system. In return, the smaller entity pays fees to the larger. The assistance that the franchisor gives with setting up the franchisee's business, as well as ongoing training of the franchisee and quality control of the goods and services are usually also part of the business deal.

free of many of the issues that equally affect other water services delivery alternatives. It is another institutional option, rather than the ultimate solution. “Franchising would be just as dependent on the criteria for sustainable operations being in place, and just as dependent as current delivery institutions are on any external sources of finance.”

- To order the initial WRC report on franchising (**Report No KV 161/05**), contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za



Building an Evaporation Monitoring Toolkit



Evaporation, one of the largest components of the hydrological cycle, remains one of the most challenging processes to quantify. Now a study funded by the Water Research Commission (WRC) is exploring ways of estimating evaporation with increasing precision.

Lani van Vuuren reports.

The National Water Act, which proposes licensing of consumptive uses of water that result in streamflow reduction, implicitly requires that such uses be estimated with an acceptable degree of accuracy. Evaporation (including evaporation from open water surfaces, moist soil, wet foliage and

transpiration by vegetation) is responsible for the majority of competitive uses of water, yet its exact quantification remains elusive.

Often required, evaporation estimation is usually estimated applying appropriate algorithms in numerical models in conjunction with the

dynamic estimation of 'wetness' of evaporating media or surfaces through continuous simulation of the water balance. Most evaporation estimation techniques have been around since the 1940s, but only in the last 20 years or so has technology (including hardware and software) enabled these, together with more recent measurement techniques, to come into their own as reasonably affordable and practically applicable methodologies.

SUITE OF TECHNOLOGIES

The techniques applied in South Africa over the past two decades include energy balance, water balance and micrometeorological techniques, lysimetry, porometry, stem steady state and heat pulse velocity, cut stem technique, as well as semi-empirical and empirical methods. According to Dr Caren Jarman of CSIR, leader of the WRC evaporation estimation project, the theoretical base of some of these techniques differs greatly.

In addition, these methods operate on different spatial and time scales. Time scales vary from two to 60 minute intervals or from daily or weekly intervals to longer time periods. They also differ in what they measure: evaporation, transpiration or evapotranspiration. "These issues of scale, difficulties relating to input data availability and problems of local validation may contribute to the lack of confidence in evaporation estimates," Dr Jarman told *the Water Wheel*.

Achieving more accurate evaporation estimates is crucial. When using rainfall and evaporation estimates to deduce rates of surface runoff, streamflow and groundwater recharge, for example, a 10% error in evaporation estimates could easily translate to errors of 85% and 170% in streamflow and recharge estimation, respectively.

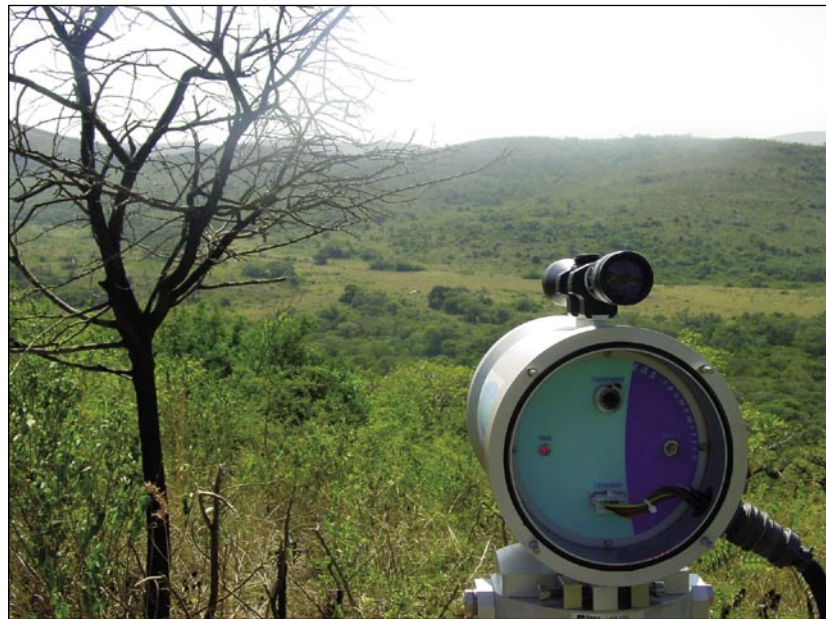
Dr Jarmain noted that it was not a question of whether a technique in itself was accurate or not. Rather the accuracy element lies in whether the technique has been applied correctly and under suitable conditions, as each technique has certain requirements that need to be met for accurate measurement.

A possible solution is the complementary use of modelling and measurement techniques. In this project, a collaborative effort between CSIR, the School of Environmental Sciences at the University of KwaZulu-Natal (UKZN), and the Department of Soil, Crop and Climate Sciences at the University of the Free State (UFS), different ways of estimating evaporation are being assessed, and the application of these to different land uses investigated. Ultimately, the project team hopes to develop and test guidelines on estimating evaporation accurately from different land uses or for different water resource management applications, in cases combining different technologies.

TESTING THE TOOLS

Initially, the project team used literature reviews and the results from an inception workshop to select land uses and vegetation types that could be used in the research. It was decided to focus on complex vegetation types, characterised by heterogeneous, species-rich and sometimes multi-layered vegetation.

To date, three research sites have been used. The first is a tall riparian *Podocarpus falcatus* (yellowwood) plantation located in Limpopo, while the second is a young stand of *Jatropha curcas* trees as part of an agroforestry trial in KwaZulu-Natal. The third is a Coastal bushveld/ grassland infested with *Chromolaena odorata* (triffid weed or 'paraffienbos') stand also situated in northern KwaZulu-Natal.



The large aperture scintillometer receiver sensor installed above a mixed stand of *Chromolaena odorata* and Coastal bushveld/grassland.



Right: Post-graduate students Michael Mengistu of the University of KwaZulu-Natal and Angelo Mockie of the University of the Free State install a RM Young sonic anemometer on to a mast at the *Chromolaena odorata* site in the Hluhluwe Nature Reserve.

Several methods are being applied at each site, including eddy covariance (a method measuring water vapour, carbon dioxide and heat flux); surface renewal (measuring the change in heat content of air by expressing

evaporation as the change in the heat energy content of air with time per unit area); sapflow measurements (using the heat pulse velocity technique); and scintillometry (measuring atmospheric optical disturbances or



*The surface layer scintillometer for the first time ever in South Africa installed above a complex vegetation type in South Africa: a *Chromolaena odorata* and Coastal bushveld/grassland mix in the Hluhluwe Nature Reserve.*



Most of the equipment requires high frequency measurements. Data is either stored on a datalogger, laptop or desktop computer. Seen here are the desktop computer and other electronics controlling evaporation measurements by the in situ Flux eddy covariance system.

scintillations caused by fluctuations of the relative index of air).

In the near future the team will also be undertaking field work in a grassland or shrubland and at a species-rich tree site. As part of this study the

team will investigate a method for determining heat storage within tree canopies, which is normally not accounted for in the shortened energy balance equation used in several evaporation estimation techniques. Field work will also be carried out at

TERMINOLOGY

Evaporation: This is the physical process by which a liquid or solid is transferred to the gaseous state.

Transpiration: This can be defined as evaporation of water that has passed through the plant. Transpiration comprises vaporisation of liquid water contained in the plant tissues and vapour removal to the atmosphere.

Total evaporation: This can be defined as the total process of water movement into the atmosphere. Soil surface evaporation and transpiration occur simultaneously and are determined by the atmospheric evaporative demand, soil and canopy characteristics. Also referred to as **evapotranspiration**.

a sugarcane site, where the team will have the opportunity to test micrometeorological techniques against lysimeters, providing an independent measure of evaporation.

“Based on the results from the present project’s field work, combined with results from research conducted over the last 20 years around evaporation estimation we will develop an expert system aimed at aiding in the selection of the correct technique for an application, the correct use of the technique as well as rigorous data analysis,” said Dr Jarman.

According to Dr Renias Dube, research manager at the WRC, this project will improve the quantification of evaporation in most hydrological models as well as water resource assessment models. “Evaporation is currently one of the most poorly quantified components of the water budget,” he noted.

Due to the lack of expertise in this specialised field in South Africa the project also features a strong




Gill Sonic anemometer and Li-Cor gas analyser (dominant white, left) as part of an eddy covariance system installed at the top of a telescopic mast at the Podocarpus falcatus research site in Tzaneen, in addition to the thermocouple and net irradiance sensors (right).



A telescopic mast is used to install the equipment high enough above the Podocarpus falcatus canopy at Tzaneen. Here project team members Drs Colin Everson, Caren Jarman and Peter Dye can be seen in action, mounting sensors to the mast.

capacity building focus. Post-graduate students from the universities of KwaZulu-Natal and the Free State have been involved in the field work under the supervision of Prof Mike Savage, head of UKZN's School of Environmental Sciences and Prof Sue Walked from UFS. In addition, a University of Zululand Honours student, Dumisani Shezi, has been appointed as an intern to the project and is registered for an M.Sc degree at UKZN. Two training workshops around evaporation estimation technologies and terminologies have also been presented to date.

The research project should be completed in 2008.

- For more information, visit the project website, <http://fred.csir.co.za/extra/project/evapmon/> 

EVAPORATION MEASURING TECHNIQUES

Scintillometer: This is a scientific device used to measure atmospheric optical disturbances called scintillations, which are caused by fluctuations of the refractive index of air. The air's refractive index is influenced by temperature, humidity and pressure. The device thus allows measurements of the transfer of heat between the Earth's surface and the air above it called the "sensible heat flux". Both the large aperture scintillometer and surface layer scintillometer have been used in South Africa.

Lysimeter: This device collects water from the pore spaces of soils and determines the soluble constituent removed in the drainage. A lysimeter is often regarded as the standard for evaporation measurement.

Eddy covariance: This is a statistical method measuring water vapour, carbon dioxide and heat flux.

Surface renewal: This method involves measuring the change in heat content of air by expressing evaporation as the change in the heat energy content of air with time per unit area.

Cut-stem technique: This is mainly useful for determining the transpiration from a single tree or part of a plant. This technique has been applied mainly in forestry.

Empirical methods: Many empirical and semi-empirical methods exist for estimating evaporation, mainly from bare soil. Of these the Penman-Monteith method is the most well known.

Sonic anemometry: Measures wind speed via sound pulse travel-time differences.



As more South African cities and towns feel the pinch of drought and excessive demand, alternative water sources, such as the sea are becoming increasingly attractive. Desalination, once considered an expensive, experimental technology is now being considered by many a municipality. Lani van Vuuren reports.

There is increasing evidence that desalination presents a viable option for drinking water supply from alternative water sources in South Africa to supplement the country's dwindling water resources. Both capital and operating costs of desalination plants have reduced significantly in the last two decades, mainly due to the improvements made in the membrane technology available, making it an increasingly attractive option.

To date, reliable information regarding desalination has been scattered among various sources. This, in addition to the fact that the South African desalination industry is still

in its infancy in respect of drinking water supply, has made it difficult for water services providers to establish whether the use of desalination is an option, what the costs are and which technology to apply. Local authorities are specifically faced with the uncertainty where information regarding desalination is only supplied through suppliers, providing only a tariff per unit of water supplied, on which to base their decision.

Now the Faculty of Engineering at the University of Stellenbosch, in a project funded by the Department of Water Affairs & Forestry and managed by the Water Research Commission (WRC), has compiled

a desalination guide to assist in this regard. Kobus du Plessis of the university acted as the project leader. "The recent severe drought in the Cape Town region stimulated the debate around the application of desalination to augment conventional water supplies," WRC research manager Dr Gerhard Offringa tells *the Water Wheel*. "Through this renewed interest in desalination the need for reliable information regarding the pros and cons of applying this technology in the South African context was identified."

The guide, which is in the final stages of preparation, will provide municipal decision makers with

crucial information regarding the technologies that can be implemented in South Africa to treat saline water (seawater and brackish groundwater) to drinking water standards. It provides guidelines to identify the pre-treatment necessary and will assist with the decision-making process regarding the operational, maintenance, management and environmental aspects related to the selection and use of these technologies.

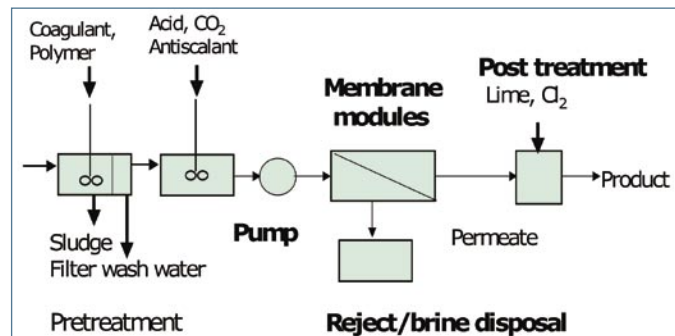
“Due to its substantially lower energy use, reverse osmosis is expected to have a much lower lifecycle cost than thermal distillation and contributes much less to greenhouse gases.”

“Of particular importance for the South African application was to identify the level of skills required for daily operation of the desalination plants, the level of skills required to provide technical back-up and service, and to identify and advise on the competencies, training needs and capacity building required at operator and management levels,” notes Chris Swartz of Chris Swartz Water Utilisation Engineers, who cooperated with the University of Stellenbosch in compiling the guide.

OPTIMUM TECHNOLOGY

While thermal distillation systems still account for the majority of the world’s seawater desalination capacity, it is believed the membrane-based reverse osmosis (RO) systems, which are rapidly gaining ground, are more suited to South African conditions. Due to its substantially lower energy use, RO is expected to have a much lower lifecycle cost than thermal distillation and contributes much less to greenhouse gases. All existing desalination plants in South Africa use RO technology. The guide therefore also focuses exclusively on RO technology.

A typical membrane process



It explains that there are many aspects to consider when contemplating the use of desalination technology. For example, compared to conventional municipal water treatment, desalination processes are energy intensive. No assessment of a desalination process is thus complete without proper understanding of the energy requirements and the available sources and cost of energy. Interestingly cost comparison between conventional treatment and desalination for various sized plants are provided.

Another important aspect is the type of feed or raw water source. This will determine the type of technology required. South Africa has three seawater zones with different water

qualities of which the West Coast water, roughly located between Cape Agulhas and the mouth of the Orange River, is believed to be the most expensive and difficult to treat. In turn, the quality of brackish inland water will need to be determined before an optimum treatment technology is selected. Groundwater exploitation potential maps as well as groundwater quality maps are included in the guide.

Also of importance is what to do with regards to the fouling of membranes. Fouling or the deposition of solid substances on the surface of the membrane can be one of the most crippling effects of desalination processes as it affects both the amount of water produced and the quality of the water. Pre-treatment is usually applied to reduce fouling of the membranes.



In certain areas in South Africa small-scale desalination plants have proved to be more cost-effective than transporting freshwater over long distances. One such a plant treating saline groundwater is situated at Bitterfontein, in the Western Cape.



As the technology becomes increasingly affordable water services authorities, especially those situated at the coast, have shown progressively more interest in augmenting their water resources through desalination.

ENVIRONMENTAL CONSIDERATIONS

During the desalination process, it is inevitable that waste streams are generated, which should be managed suitably. The treatment and disposal of these residuals may result in significant costs for the water services provider. The most important and largest waste stream from any desalination plant is the brine which contains high concentrations of salts and other concentrated impurities that may be found in the feed water, and which should be disposed of in a safe and acceptable way.

The most common brine disposal options are ocean disposal (in the case of seawater desalination), surface

water discharge, sewer discharge, deep-well injection (not applied in South Africa at present), evaporation ponds, land application and co-disposal with wastewater treatment plant effluent or power plant cooling water. Swartz points out that when considering desalination as an alternative option to conventional water supply it is important to carefully take into account all the environmental costs associated with the development and operation of desalination plants.

SMOOTH OPERATION

Operating a desalination plant is not necessarily more difficult than operating a conventional water treatment plant, but a lack of adequate control measures during the

operational phase can be very costly in terms of membrane life expectancy and therefore operational cost. The maintenance cost for desalination is normally also slightly higher than that of conventional treatment plants due to the higher pressure pumps and membrane cleaning processes required.

“The most important and largest waste stream from any desalination plant is the brine which contains high concentrations of salts and other concentrated impurities that may be found in the feed water, and which should be disposed of in a safe and acceptable way.”

“Perhaps the most important aspect of the operation of any desalination plant is the availability of accurate data on which decisions regarding the operational aspects can be based,” reports Swartz. “If a specific plant is operated by an external company, then the water services authority must have access to all the relevant data.”

TRAINED STAFF

With regards to human resources, the day-to-day operations of desalination plants do not require any special formal qualified staff. However, plant operators should be well trained and capable of acquiring the skills necessary to perform daily operations of the plant and to report any deviations from normal operating parameters. Certain maintenance tasks, such as chemical cleaning of membranes, need to be performed under the control and guidance of a knowledgeable supervisor or technician.


It is of utmost importance that sufficient funds and labour be made available to undertake preventative maintenance. In addition, technical support is necessary to ensure that any deviations from normal

Cost estimates for seawater reverse osmosis desalination plants (excluding distribution systems)

Plant & raw water type	Capacity (Mℓ/d)	Feed-water TDS (mg/ℓ)	Feed-water temp (°C)	Order of magnitude capital cost (R/kℓ)	O&M costs (R/kℓ)	Capital redemption (R/kℓ)	Unit production cost (R/kℓ)
West Coast	5	36 000	9	63	4,00	4,40	8,40
	50	36 000	9	530	3,30	3,70	7,00
South Coast	5	36 000	16	46	3,30	3,20	6,50
	50	36 000	16	394	2,80	2,80	5,60
East Coast	5	36 000	21	40	3,00	2,80	5,80
	50	36 000	21	338	2,60	2,40	5,00

Note: These cost estimates should be used as a guideline for planning purposes only.

operating regimes are addressed rapidly and effectively so that service delivery (both volume and quality) is not compromised.

This is the first time in South Africa that a publication of this kind has been produced. It is believed that it will go a long way in assisting informed decisions regarding the technology. 

DESALINATION IN THE WORLD

According to the International Desalination Association, there are more than 17 300 desalination units with a total capacity of about 37,75-million m³/day worldwide. Desalination is already used in 125 countries around the world.

At present, the largest desalination plant using reverse osmosis (RO), the

technology favoured in South Africa, is located in Ashkelon, Israel. This seawater RO plant, which started production last year, holds 40 000 membrane elements in 32 RO treatment trains over four floors, and uses optimised, multi-stage RO and boron removal procedures. At full capacity, the plant will produce about 274 000 m³/day.

Construction of Umgeni RO Plant Imminent

Plans for the construction of a 1,5 Mℓ/day desalination plant at Zinkwazi, on the KwaZulu-Natal North Coast, are progressing steadily.

At the time of writing the award of the multimillion Rand main construction tender was imminent. The desalination plant is expected to bring welcome relief to the small tourist town once completed in 2007.

Bulk water supplier Umgeni Water is funding the project. Costs will be recovered in the long run through the sale of the water to the Ilembe District Municipality.

Like other towns on the North Coast Zinkwazi has benefited from a recent property development boom. Apart from luxury housing the town has also seen the construction of a new hotel in recent months. However, the influx of people has brought a sharp rise in the demand for water. In addition to recent droughts, this has placed increased pressure on the town's water supplies, which are still dependent on groundwater resources.

Umgeni Water's Graham Metcalf, who is leading the desalination project, explains that the borehole pumps have a maximum capacity of 850 kℓ/day. This has proved inefficient especially during the hot, dry peak holiday season.



The small town of Zinkwazi, on the KwaZulu-Natal North Coast.

An investigation into augmenting the Zinkwazi's water supplies ruled out the drilling of additional boreholes as this proved to be unsustainable in the long term. Metcalf told *the Water Wheel* that in this niche application the desalination option turned out to be more cost effective than extending Umgeni Water's existing bulk water pipeline which ends at KwaDukuza. "Desalinating seawater remains an alternative option, and we will certainly not be constructing membrane plants all over the place in the near future, but in this case the technology proved ideal."


Thorough investigations resulted in the selection of reverse osmosis as the preferred desalination technology. This process basically involves pushing the seawater through a membrane filter that traps the impurities on one side and allows clean water to

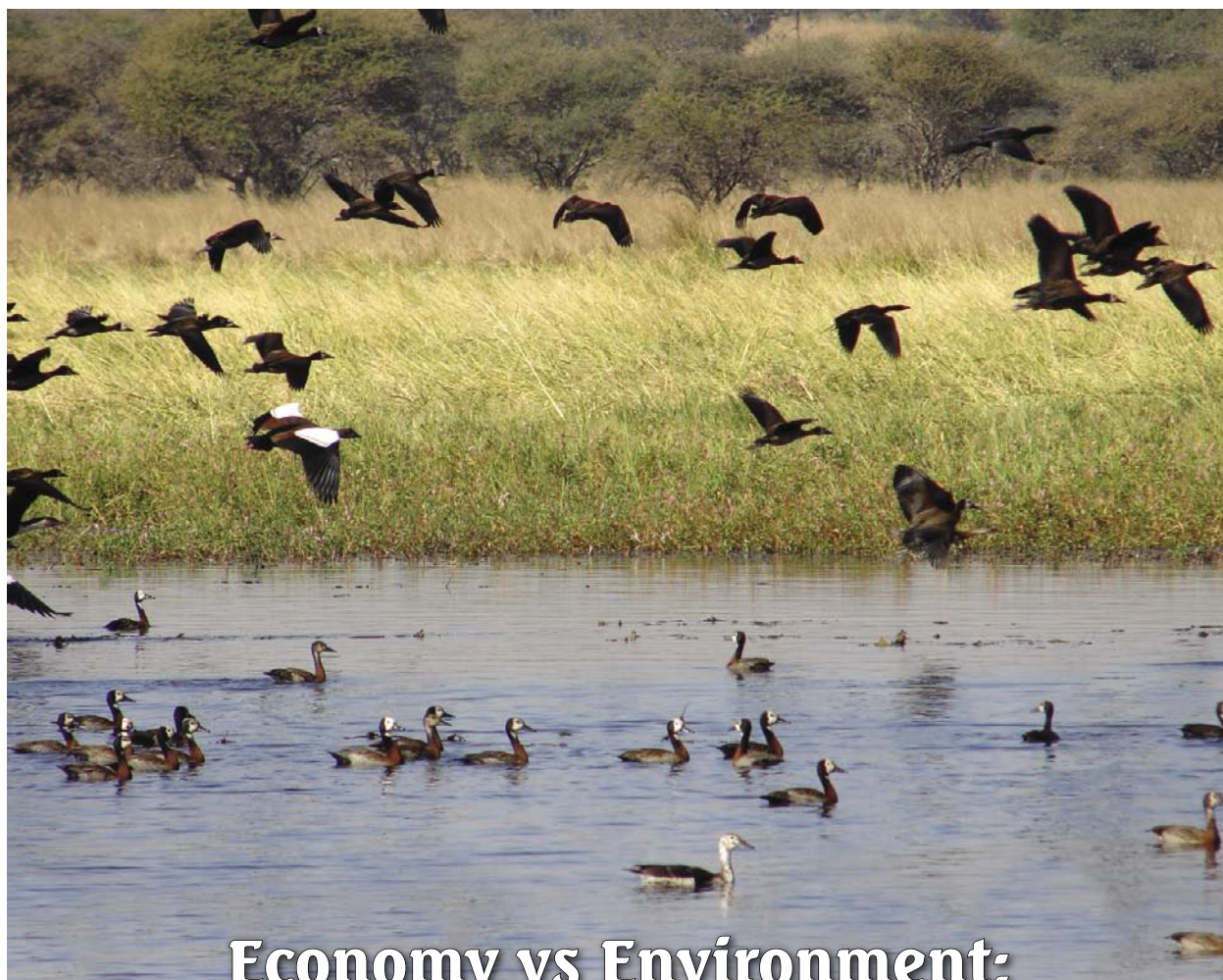
be obtained from the other side. The most suitable pre-treatment technology is yet to be determined. The final product will be piped to the town's existing reservoir.

All environmental precautions have been taken and an environmental impact assessment has been undertaken. The compact plant will be located about 800 m from the nearest residence on Tongaat-Hulett property, and no

remarkable environmental impact is foreseen. "All precautions have been taken to ensure that the natural surroundings are disturbed as little as possible," said Metcalf.

The most important environmental consideration has been the disposal of the brine or saline waste product from the desalination process. Metcalf reported that the brine will be returned to the sea. Investigations showed that the brine would dissipate within about 20 m² in calm seas.

This is not the only desalination plant planned for KwaZulu-Natal. Another facility to treat seawater for drinking water is in the pipeline for the Blythedale Coastal Resort, north of Ballito. It has been reported that this facility will provide up to 8 Mℓ/day for 4 000 resort homes. 



Economy vs Environment: How Do We Protect Our Rivers?

The official launch of the national Biodiversity Strategy and Action Plan earlier this year underlined the importance of safeguarding the country's natural resources.

The report notes with particular concern that South Africa's rivers are poorly protected, and that the present status of many of these freshwater ecosystems are perturbing. Lani van Vuuren reports.

South Africa is a water-scarce country and, unsurprisingly, most of its freshwater resources are heavily utilised. All of the country's main rivers have been developed to some extent. In fact, the first National Spatial Biodiversity Assessment highlights the fact that

the country's river ecosystems are in a much poorer state overall than its terrestrial ecosystems.

The assessment of South Africa's main rivers (which make up about 45% of rivers in the country) found that 47% are moderately modified, while

23% can be considered irreversibly transformed in terms of their ability to support biodiversity, and are deemed unsuitable for conservation. Of the 120 main river types identified 84% are threatened – 54% critically endangered, 18% endangered and 12% vulnerable.

LONGITUDINAL NATURE

Protecting freshwater ecosystems has been historically challenging. According to Dr Dirk Roux of CSIR Natural Resources and the Environment, while protected areas provide a partial stop to freshwater habitat degradation and associated biodiversity loss, the design of protected areas is generally biased towards terrestrial biodiversity features, with freshwater ecosystems being addressed only incidentally as part of their inclusion with terrestrial reserves.

“Our biodiversity heritage is valuable first and foremost in ecological terms, but it also has an economic value that is often underestimated. If intelligently mobilised, it can serve the cause of development and poverty alleviation.”

**Marthinus van Schalkwyk,
Minister of Environmental
Affairs & Tourism**

Another constraint is the longitudinal nature of rivers, which makes it difficult to include entire catchments or river lengths within formally protected areas. Conserving inland water ecosystems requires management of whole catchments, and it is seldom feasible to incorporate entire catchments into protected areas.

In fact, over 90% of all main rivers in the country fall completely outside Type 1 protected areas (national parks and nature reserves), while half of the remaining rivers form boundaries of protected areas. Thus, less than 5% of the main rivers in South Africa fall within protected areas, receiving protection on both sides.



The main impacts on South Africa’s rivers include over-abstraction of water, impacts of dams, pollution, alien invasive organisms and inappropriate land management (such as the destruction of natural vegetation along riverbanks).



ECONOMY VS ENVIRONMENT

There is no doubt that South Africa’s hard-working rivers will continue to do so, as underscored by this year’s theme for National Water Week,

“Water for Growth & Development”. As Dr Roux points out trade-offs are inevitably required between protecting inland water ecosystems (achieving biodiversity conservation) and achieving socio-economic development. “The question is how many



Being among the 30 most water-scarce countries in the world means South Africa has to balance carefully its economic development versus the safeguarding of its freshwater ecosystems.

inland water ecosystems should reflect a high level of protection (natural and good states) to claim that South Africa is effectively conserving the biodiversity associated with these systems? Also which ecosystems are most suited for, and will give the best returns when included in a national design for inland water conservation."

To date, national conservation targets for inland water ecosystems have not been addressed in national policy and legislation. There is no operational guidance regarding the desirable number of ecosystems to be conserved or the mechanisms through which conservation should be achieved.

The fate of the country's water resources relies on an integrated approach to managing water and land to achieve ecological and socio-economic sustainability, notes Dr Roux. "We need to pay increased attention to managing rivers for meeting immediate social and economic needs as well as maintaining their long-term functioning to meet the needs of future generations."

NATIONAL TARGETS

Dr Roux explains that there are several core objectives which are imperative to achieving inland biodiversity conservation. The first is to set quantitative conservation targets. Internationally, it has been recommended that a minimum of 20% of a country's natural aquatic resources should be protected.

These targets should preferably be set and endorsed at national level. Provincial and local governments make daily decisions about land use based on the political boundaries of their particular jurisdictions, clarifies Dr Roux. "These political demarcations rarely if ever follow natural patterns of biodiversity occurrence. Without appropriate information at relevant spatial scales, provincial and local governments may unknowingly make decisions that result in the degradation or destruction of some of the best examples of the country or region's ecosystems."

These national targets can then be cascaded down to sub-national implementation levels. It is also

essential to review these targets over time as our understanding of the effects of human activity on biodiversity grows.

BIODIVERSITY FOR TODAY & TOMORROW

The second objective is to select freshwater ecosystems for conservation that are representative of the full spectrum of inland water biodiversity that exists in South Africa. Surface water resources are a manifestation of the landscapes that they drain. Catchment geology, climate, vegetation types, and landscape change dictate the character of inland water ecosystems in terms of flow pattern, channel morphology, temperature and nutrient regimes and substratum (bedrock). These variables, in turn, control the biological attributes of water resources. Accordingly, inland water biodiversity can be represented, at least at a coarse level, by the diversity of the landscape in which they occur.

Both the present and future conservation of freshwater ecosystems need to be ensured. "Conserving species and habitats provides a snapshot of the biodiversity that currently exists. If we wish this biodiversity to persist and naturally evolve over time, we also need to be certain that populations, communities and ecosystems that are both viable and of high ecological integrity are selected; natural ecological processes and disturbance regimes such as floods are operating within their natural ranges of variability, and the size of a conservation design is sufficient to allow recovery from natural disturbances," notes Dr Roux.

Another objective is to establish a network of inland water conservation areas. Rather than being areas where no use of the resource is allowed, these areas would be based on a philosophy of multiple land-use options that support a conservation objective (such as non-transformational



The protection of terrestrial ecosystems has historically taken precedence over the protection of inland freshwater ecosystems. Less than 5% of the main rivers in South Africa fall within protected areas.

agriculture). To protect the functional elements of freshwater ecosystems, whole river systems should, wherever possible, be selected for contributing towards the national conservation target.

Lastly, the value of a conservation design can only be realised through its effective application. Dr Roux explains: "For freshwater biodiversity conservation to be practiced in reality requires the translation of science into awareness, political will and necessary capacities. Stakeholders, including the public, need to have the necessary knowledge as well as the emotional and financial commitment for conservation of rivers to succeed. It is therefore critical that all stakeholders be part of the decision-making process right from the start."

Dr Roux adds that conservation of inland water biodiversity will not receive due attention and resources if it is not reflected as a line function in the business plans and budgets of responsible agencies. Cooperative governance is also crucial. "No single organisation can claim the ability to

implement an inland water conservation plan in all its facets on its own. The integrated nature of inland water conservation planning and implementation requires the combination of a highly diverse and specialised cluster of skills, and spans the mandates of a number of sectors and spheres of governments."

The value of South Africa's freshwater biodiversity must never be underestimated. It is only through a long and complex process, with commitment from all stakeholders, that the right mechanisms will be put in place to safeguard our precious natural resources for future generations.

For more information:

- *South African National Spatial Biodiversity Assessment 2004: Summary Report and River Component* (www.sanbi.org.za/biodiversity/nsba)
- To view the South African National Biodiversity Strategy & Action Plan go to www.deat.gov.za
- *Discussion Paper on Cross-Sector Policy Objectives for Conserving South Africa's*

HOW ARE RIVERS CLASSIFIED?



The classes of the water resources classification system, as proposed by the National Water Resources Strategy are described as follows:

- ◆ **Natural** – Human activity has caused no or minimal changes to the historically natural structure and functioning of biological communities, hydrological characteristics, chemical concentrations and the bed, banks and channel of the resource.
- ◆ **Moderately used or impacted** – Resource conditions are slightly to moderately altered from the Natural class due to the impact of human activity and water use.
- ◆ **Heavily used or impacted** – Resource conditions are significantly changed from the Natural class due to human activity and water use, but are nonetheless ecologically sustainable.
- ◆ **Unacceptably degraded** – Water resources that are ecologically unsustainable due to over-exploitation.

Inland Water Biodiversity (WRC Report No **TT 276/06**), enquiries: Tel: (012) 330-0340, publications@wrc.org.za 



Courtesy of SA Tourism

Rivers feed body and soul

Material dependency of rural communities on rivers is well documented, however, little is known about the spiritual connection people have with rivers.

While rural and peri-urban communities' traditional cultural connections to river systems might be waning under the influences of Western civilisation, new emerging connections are taking their place based on contemporary belief systems, a new report published by the Water Research Commission (WRC) points out. Building on these existing and new connections could go a long way in safeguarding the country's rivers. Lani van Vuuren reports.

The report is based on a WRC-funded project undertaken under the auspices of the University of KwaZulu-Natal's Institute of Natural Resources in Salem, a peri-urban community outside Durban. This traditional area has an estimated population of 20 000.

A survey was undertaken among

residents to determine their socio-economic and cultural dependence on the adjacent uMlazi River. According to project leader Dr Joan Jaganyi, this research initiative sought to improve understanding of the relationships between the needs of rural households, the river system and sustainable use, especially as it pertains to determination of the Reserve.

RURAL COMMUNITIES AND RIVERS

In Africa, belief systems and values play an important role in the way people (especially rural communities) respond to their environment. In the past belief systems of certain rural communities have facilitated the safeguarding of river systems.

It is reported that in southern Africa, in particular, pools, rivers and expanses of water have been regarded with a mixture of awe, fear and reverence by indigenous communities.

However, these belief systems have not escaped western influences and, as a result, some rural communities no longer appreciate some of their traditional beliefs, especially those that are far removed from realities.

Meanwhile, modern South African water law makes provision for reserving a quantity of water of appropriate quality to meet the basic needs people have for water and to sustain aquatic ecosystem functioning (the Reserve). This encourages the needs of rural people to be perceived in material terms, for example, water, fish and construction materials, yet it commonly fails to take into account remaining spiritual needs.

TRADITIONAL VS MODERN BELIEFS

The Salem survey showed that certain traditional values pertaining to rivers are indeed alive and well. While 70% of the respondents claimed to use the uMlazi River frequently for material needs, such as washing, bathing and watering livestock, more than half (47%) of the respondents said they used the river for traditional ceremonies.


This suggests that even if provision were made to accommodate other activities such as bathing, and watering livestock distant from the river, a majority of the people would still use the river. According to the research, the fact that users who go the river for traditional activities are drawn from all age classes and genders implies that traditional practices are still important, notwithstanding the changes that have been and are still being experienced by the community.

About 73% of respondents acknowledged belief systems related to rivers. They described these as the presence of water spirits that manifests as crabs, mysterious snakes at times, or creatures with half-human, half-fish physical features. A further 65% of respondents identified rituals related to the river. Of these the majority identified modern baptism rituals performed under the growing Zion Christian Church.

River resources play a central role in the spirituality of the Zionist. This is found in baptism, and adherents to the church believe that without baptism one cannot become a member of the church. Hence, in the absence of a river, and more particularly a river that exists in a condition that is acceptable, certain aspects of worship will be greatly affected.

Thus, the report argues, while there may be a declining prospect for using traditional belief systems to strengthen the commitment of civil society to river system management, there might be growing opportunities to seek connection between emerging religious belief systems and river management.

Importantly, these norms and values connecting people to their rivers underpin behaviour that can support responsible management of the use of river resources. The majority of people questioned at Salem showed concern about the condition of the uMlazi River, but they were unclear of the role they could play in protecting the river.

It is important then that these relationships with rivers should be considered in terms of the Reserve not only because such determinations may hold negative consequences for these people, but also because the opportunity exists to mobilise these constituencies in co-management of river systems. 

TRADITIONAL CEREMONIES STILL CONDUCTED AT UMLAZI RIVER

- ◆ **Umemulo:** A traditional ceremony to celebrate the good behaviour of young Zulu girls who have maintained their virginity to the 'marrying age'. This involves bathing in the river and the initiates return from the river wearing reeds or traditional attire. The belief is that once a young girl has undergone this ceremony she will achieve a successful marriage.
- ◆ **Umsenga:** This is a reed dance, whereby young girls go to the river, cut reeds and take to the Inkosi's or Chief's palace as a gesture of honour and respect. These reeds would be used to thatch houses or make crafts, mats and so on after the ceremony. The Umsenga ceremony also provides an opportunity for the Chief to see the young girls in the community and to choose another wife.
- ◆ **Unomkhubulwane:** A ceremony that involves women in the community going to the river to ask the goddess of the river (Unomkhubulwane) to give a blessing for a good harvest. They do this by throwing seeds into the river.
- ◆ **Weddings:** The bride and her entourage go to the river first thing in the morning to bathe before the main ceremony. This signifies a belief that this removes evil spirits and is a blessing to the ceremony, and brings luck to the marriage.
- ◆ **Death:** Bereaved mourners (usually family members of the deceased) assemble at the river as a sign of cleansing so that another death does not happen in the family.

Regional Masters Degree Programme



Building Capacity for Water Resources Management in Southern Africa

in Integrated Water Resources Management 2007

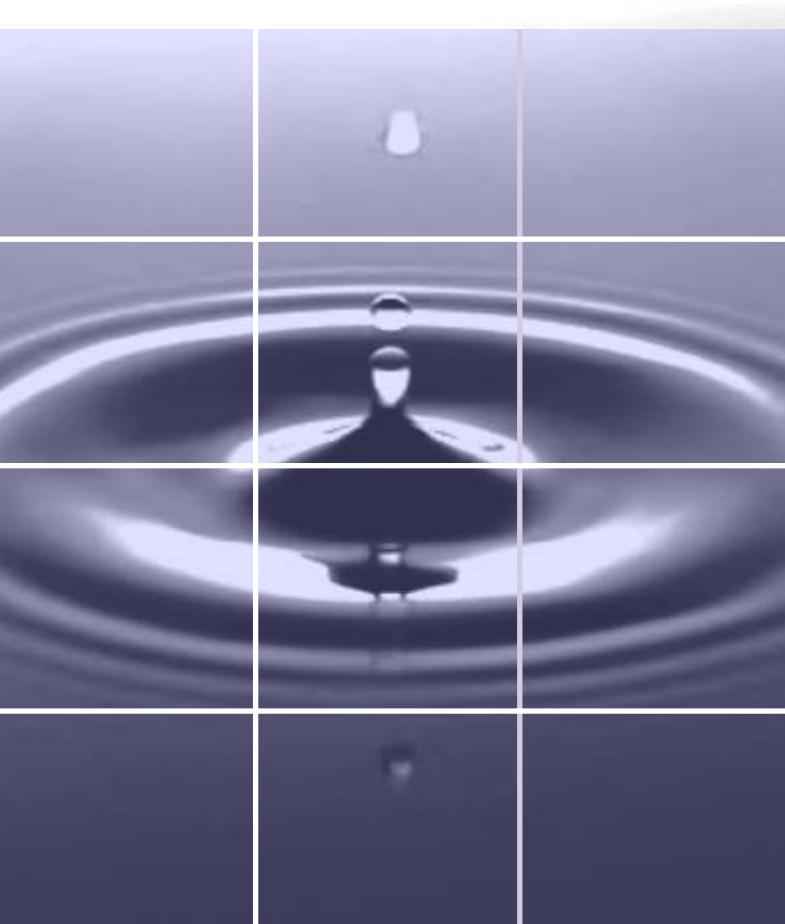
Applications are herewith invited for admission to the regional Masters programme in Integrated Water Resources Management to be offered in 2007 by WaterNet member institutions.

Structure of the programme

The programme comprises a compulsory core consisting of six modules, followed by a specialisation consisting of three modules and two electives.

The compulsory modules are:

Principles of IWRM; Principles of Hydrology; Socio-Economic Aspects of Water and Environmental Resources; Principles of Aquatic Ecology and Environmental Management; Policies, Laws and Institutions; Project.



The specialisations are:

Specialisation 1: Water Resources Management

- Water Analysis and Planning
- GIS and Database Management
- Catchment Management

Specialisation 2: Hydrology

- Hydrogeology
- Remote Sensing and GIS
- River Engineering

Specialisation 3: Water and Environment

- Environmental Impact Assessment
- Water Quality Management
- Environmental Water Requirements

Specialisation 4: Water for People

- Water Supply and Sanitation
- Utility Management
- Waste Water Management

Specialisation 5: Water and Society

- Water and Security
- Environmental Education
- Water and Development

Specialisation 6: Water and Land

- Agricultural Water Management
- Wetlands, Ecology and Management
- Catchment Management

Financial assistance

WaterNet will offer scholarships to selected successful applicants. The scholarship covers tuition, fees, travel, accommodation, and reasonable living expenses.

How to apply

The initial application is made to the WaterNet Secretariat, who will then pass the application to the relevant member institution.

The application should include:

- An application letter in which first and second choices of specialisation are clearly indicated.
- A short curriculum vitae with academic background and professional experience.
- A one-page essay motivating why you should be selected for the Masters programme and the reason for your choice of specialisation.
- Copies of degree transcripts and certificates.
- A letter of support from your employer.

Applications will only be considered upon submission of all of the above requisites.

Submit the application in electronic form to waternet@eng.uz.ac.zw or in hardcopy to WaterNet, PO Box MP 600, Mount Pleasant, Harare, Zimbabwe. **Applications should reach WaterNet on or before 15 September 2006. (PS: Please clearly distinguish your first name, other name(s), and surname in your application.)**

Only the successful applicants will be contacted. If you have not been contacted by the end of January 2007, please consider your application unsuccessful.

For any further information, please contact the WaterNet Secretariat.

T: +263-4-333248 or 336725
F: +263-4-336740
E: waternet@eng.uz.ac.zw
I: www.waternetonline.org



Pinpointing the Need for Water

By mapping the areas that suffer most from so-called water poverty, national authorities could identify which local municipalities to target in terms of financial and institutional support to ensure the most effective use of scarce resources. So says James Cullis, who led a Water Research Commission funded study into the subject.

Speaking at the biennial conference of the Water Institute of Southern Africa held in Durban in May, Cullis explained that water poverty refers to several components, including the physical availability of a water resource (the resource component); the extent of access of that resource for human consumption (access); the effectiveness of people's ability to manage water (capacity); the ways in which water is used for different purposes (use); and the integrity of the related environment (environment).

"Water poverty mapping combines these components with the flexibility of geographic information systems mapping and geographic targeting to provide decision makers with a policy tool that describes the spatial distribution of water poverty and the underlying causes of this water poverty within an area," Cullis told delegates.

WHAT IS WATER POVERTY MAPPING?

Water poverty mapping can be defined as the mapping of water poverty indicators aggregated to a suitable spatial scale for the purpose of identifying areas of high levels of water poverty so as to assist in the targeting of water-related policies and infrastructure to ensure the most effective use of scarce resources to meet the development objectives of the country.



A policy tool aimed at determining which areas need to be targeted in terms of institutional and financial support has been tested in a project funded by the Water Research Commission.

It is believed that at a regional or national level, the Department of Water Affairs & Forestry and other national institutions could make use of water poverty maps for strategic and regulatory purposes, such as the allocation of financial resources to local municipalities for the development of domestic water supply infrastructure or in determining the most equitable allocation of water resources between competing users in a catchment. Strategic level water poverty maps would also be useful to track the general state of poverty.

A simple water poverty map was produced of the Eastern Cape. The exercise revealed that the Quakeni Local Municipality is the most water-poor local municipality in the area. The municipality scored particularly low in terms of the capacity and environmental components. It is therefore recommended that resources should be targeted at this local authority.

"The resource and access components, while not the lowest are very low and probably the greatest area for concern," noted Cullis. "The lack

of available resource is probably due to the deficiency of storage capacity in the area, which, like to low access component, is most likely a legacy of the apartheid era funding for water supply infrastructure in the area."

It appears then that the best way to address water poverty in the area would be to consider increasing the available resource through increasing the yield and by improving the

level of service delivery in the area, reported Cullis. "It is, however, important to note that the capacity component is quite low, which could have implications on the type of service provision considered for the area. It may therefore be necessary to also ensure increased employment in the area to help fund any water supply development project. It is also important that the capacity of the water services authority to address water poverty be assessed before funding is allocated to the local municipality."

In general, the municipalities with the lowest water poverty index tend to be the predominantly rural municipalities located in the former Transkei, while those with the highest water poverty index tend to be the more urban municipalities.

- To access the report, *Water Poverty Mapping: Development and Introduction using a Case Study at the Local Municipal Scale for the Eastern Cape* (WRC Report No: TT 250/05), contact Publications at Tel: (012) 330-0340 or E-mail: publications@wrc.org.za

The Orange – River of Diamonds

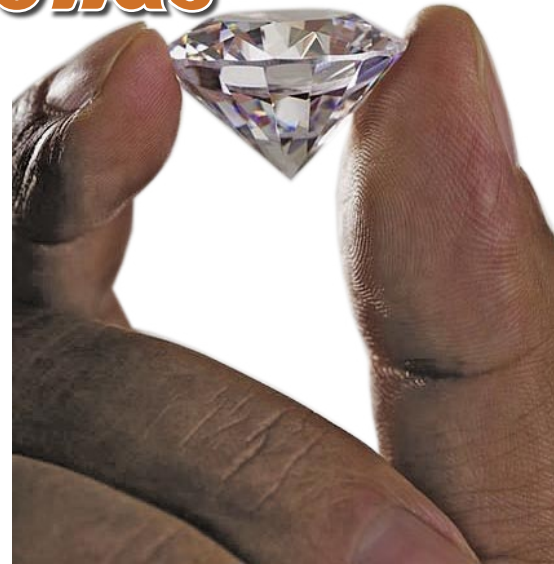
Known as the Gariiep or 'the Great River' by the indigenous Nama people, the Orange River when viewed for the first time, is said to be an impressive sight.

At more than 2 000 kilometres long, the Orange River is the longest river in South Africa. The river is a political and geographical divide, separating Namibia from South Africa and the massive sand dunes of the lower Namib Desert from the swept-rock moonscape of northwestern Namaqualand. The Orange River basin is the largest of all the so-called international river basins in southern Africa, both in terms of physical size, and in terms of volume of water (mean annual rainfall) involved. The river has a total catchment area of about 1 000 000 square kilometres of which almost 600 000 square kilometres is inside South Africa, with the remainder in Lesotho, Botswana and Namibia.

Along with its main tributary, the Vaal, the river conveys nearly 23% of the total surface water of South Africa.

The Orange River catchment varies dramatically both in climate and topography from east to west. To the east, at the source of the Orange River high in the Lesotho Highlands, the precipitation, some of which occurs as snow, can exceed 2 000 millimetres a year in places which, together with the relatively shallow soil cover and low evaporation results in significant run-off.

As the river progresses towards the west, the lush pastures of Lesotho are gradually transformed into harsh but impressive desert areas where only the most drought resistant plants can grow. It is reported that the desert areas of the lower Orange basin are among the driest in the world with an average rainfall of less



than 50 millimetres a year an annual potential evaporation of more than 3 000 millimetres in some areas. The river eventually connects with the Atlantic Ocean at Oranjemund. There are many deposits of alluvial diamonds along the Orange River. In fact, the first diamond discovery in Africa was made on the banks of the river in 1867.

Arguably the most dramatic point on the river occurs at the Augrabies Falls where the mighty Orange plunges 56 metres in a deafening and breathtaking explosion of power. Legend has it that the biggest cache of diamonds in the world lies in the swirl-hole eroded into the granite at the foot of the waterfall by the thundering waters. The name of the falls is derived from the Nama name meaning 'Place of Big Noise'.

The Orange River is the most developed of all the rivers in southern Africa. Historically, the average runoff from the total basin was more than 12 000 million cubic metres a year, but extensive developments over the



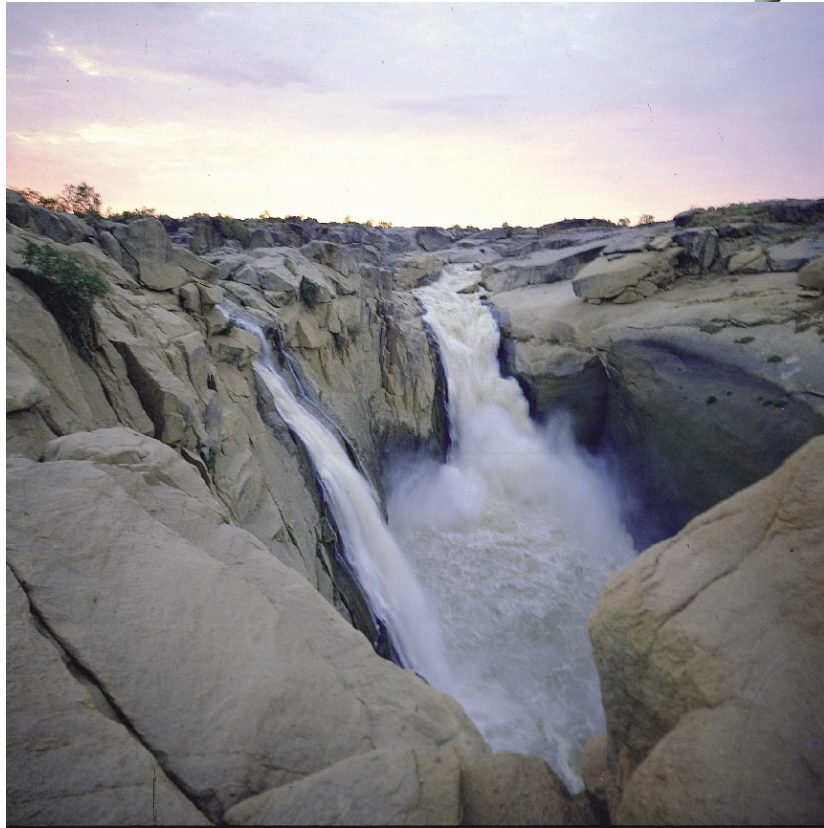
Courtesy of SA Tourism

decades have resulted in the runoff reaching the river mouth being much less. The first time the Orange was dammed was in 1929, when Buchu-berg Dam was built.

Today, there are at least 29 dams in the basin with a storage capacity of more than 12 million cubic metres. The largest of these is the Gariep Dam with a storage capacity of 5 600 million cubic metres (also South Africa's largest dam), and the Vanderkloof Dam, with a storage capacity of 3 200 million cubic metres. More recently the Katse and Mohale dams have been constructed as part of the Lesotho Highlands Water Project to bring much needed water to Gauteng.

The Gariep Dam forms the central structure of the original Orange River Project which involves the supply of water to parts of the Vaal, Fish and Sundays catchments as well as to irrigation along the Orange River itself.

Another major construction is the Orange-Fish tunnel which diverts water from the Gariep Dam towards the Eastern Cape with a maximum capacity of 54 cubic metres a second. The main purpose of the tunnel is to divert water to the Eastern Cape for irrigation, urban and industrial use. At 82,45 metres long, this is the longest tunnel in the world. The Orange-Fish



Courtesy of SA Tourism

tunnel, which is 405 metres below ground level at its deepest point, took 12 years to construct, and was officially opened by then Prime Minister BJ Vorster on 22 August 1975. The tunnel has a diameter of 5,3 m, large enough for a train to drive through.

Development in the Orange River Basin, it seems, has still not come to an end. In August 2005, the Namibian

government and South Africa's Department of Water Affairs & Forestry announced that the possibility of building a dam on the Lower Orange River is being studied. In the same month, Lesotho and South Africa announced that the second phase of the LHWP is under investigation. ♦



Courtesy of SA Tourism

WHAT'S IN A NAME?

Contrary to popular belief, the Orange River was not named after the reddish orange colour of its silt-laden water. It was, in fact, named in 1779 by Colonel Robert Gordon, the commander of the garrison of the Dutch East India Company during a reconnaissance into the interior, in honour of the Dutch Royal House of Orange.

Knowledge Exchange at WISA

The Water Research Commission (WRC) was again one of the key sponsors of the biennial conference of the Water Institute of Southern Africa. WRC research project leaders, research managers and directors were involved in no less than 70 presentations and workshops for the duration of the conference. The conference, which was held at the Durban International Convention Centre, is southern Africa's primary forum for water professionals in the region to meet and exchange information on water and sanitation related issues.



Left: WRC CEO Dr Rivka Kfir was one of the keynote speakers at the conference.

Middle: Entertainment with a message at the WISA conference in Durban.

Right: The WRC stand, where several of the organisation's research reports and other publications were made available, proved popular.



The UK Foundation for Water Research's (FWR's) Review of Current Knowledge (ROCK) publications are available from the Water Research Commission.

The FWR is an independent, not-for-profit organisation that shares and disseminates knowledge about water, wastewater and research into related environmental issues. ROCKs, which are revised continually, focus on water environment topics of general interest.

ROCK titles include *World Water Storage in Man-Made Reservoirs*; *Cyanobacterial Toxins in the Water Environment*; *Household Chemicals and the Water Environment*; and *Urban Drainage & the Water Environment: a Sustainable Future?*

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