

THE WATER WHEEL

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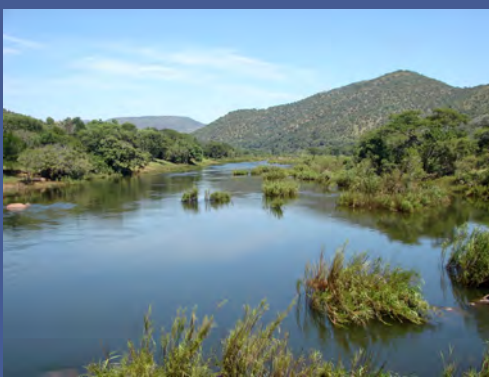


Malaysia



South Africa

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Cover: A new WRC report points to the importance of wetlands to conserve South Africa's medicinal plants. Read the article on page 14. (Cover photograph by Roger de la Harpe/Africa Media Online).





SA'S WATER CHALLENGE – cause for despair or competitive advantage? The choice is ours

The global water conversation has taken a new turn on the back of increased information access and the world reaching a point where it is now impossible to ignore the scarcity of the resource.

It is also important that the dialogue now includes business partners as the World Economic Forum recognises the availability of good quality water as a principal business risk globally. While this is a revelation for most of the developed world, this is not news for most of the developing world, and South Africa in particular. Throughout its history, South Africa has been acutely aware of the fact that it operates in a semi-arid environment with parts of the country already water scarce (with freshwater availability of 1 000 m³/person/year or less) and the average of the country being water stressed (<1 700 m³ /person/year).

Even where the rainfall figures are much more favourable, climate and weather variability has added to availability challenges, with periods of intense flooding interspersed with long dry periods. This has made storage difficult and assurance of supply hard to attain.

In this context it is not surprising that the word 'crisis' is often included in the South African public water discourse. It is important how we interpret this word 'crisis'. Its usual impact is unfortunately one of paralysis and despair. If one borrows from other languages, there is an important change in texture. The word for 'crisis' in Mandarin is *Wei Ji*. It consists

of two distinctive parts, *Wei* means 'a time of danger', and *Ji* denotes 'a time of opportunity'. This is a much more empowering definition of crisis. South Africa's challenge should be that of developing a *Wei Ji* response to find the opportunity in our current crisis that will not only result in more innovative ways in meeting our current water challenges but perhaps, more importantly, structuring a strategy that allows South Africa to develop an international competitive advantage.

Let us illustrate these possibilities with a few examples. During the 2013 National Water Week, Minister of Water & Environmental Affairs, Edna Molewa, released the report of the WRC study on The State of Non-Revenue Water (NRW) in South Africa. This was the first comprehensive study of its kind using data gathered from 132 municipalities representing 75% of the total municipal water supply in the country. The study indicated that the country's NRW was at 36,8%. This represents a combination of actual physical leakage (25,4%) and inadequate financial management (incomplete billing, inadequate collection etc.).

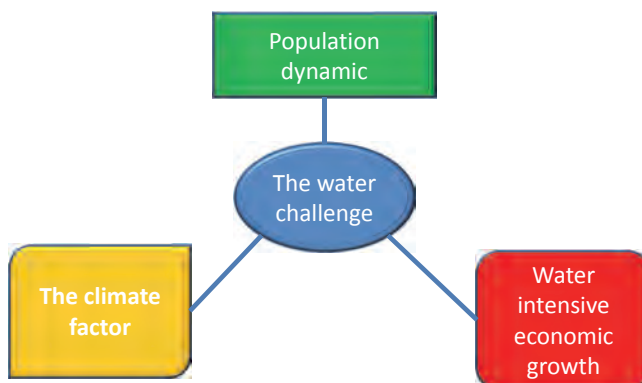
The estimated value of NRW is R7,2-billion per year. How does this represent opportunity? The first thing that the study is telling us is that South Africa is already paying R7,2-billion a year for water we do not get to use, therefore any investment in fixing this problem that is less than R7,2-billion a year is a positive cost-benefit in the medium to long term. It

also says that if this water leakage component of the problem is solved (25,4%), then the energy saving from need to treat and pump the currently lost water will be very significant.

A previous WRC study in the Sebokeng/Evaton municipal area indicated that a reduced demand of 1 million m³/month results in an energy saving of 13 000 MWh/year and a reduction in carbon emissions of 13 000 t in that same period. The NRW for the country is estimated at 1 580 million m³, so the savings in energy and the subsequent emissions impact is very encouraging. But even this does not represent the full potential of the opportunity. South African municipalities, and municipalities in much of the developing world, have the common burden of non-revenue services, be it water or electricity or waste management. In many cases the non-collection burden

also extends to rates and taxes. An ability in South Africa to effectively deal with the financial management dimension of municipal water services would have the important knock-on effect for other services and revenue collection as a whole. This has the important possibility of economically viable (even profitable) municipalities in South Africa, and a model to share with the rest of the developing world.

Another important example is that of acid mine drainage (AMD). AMD has become a crisis of our time as we gain the dis-benefit of more than 200 years of environmentally poor mining practices. The science response to the AMD challenge has been robust, with South Africa on the verge of world leading technologies in this domain. Why is this an international competitiveness opportunity? One of the global problems



The South African Water Problem Tree. The cornerstones of the South African problem tree are the increased demand from a resource of declining quality compounded with the impacts of climate and weather variability. The demand drivers are population growth, changing lifestyles (unfortunately more water intensive), skewed distribution patterns on the back of large-scale urbanisation, and, an industrial growth path trajectory that has a large water footprint. The latter is typical of resource based economies with large mineral deposits.



Initiatives such as the award-winning Emalahleni water reclamation plant situated at Witbank, which desalinates mine-water for resale to the Emalahleni Local Municipality, proves that South Africa possesses the know-how to deal with its water challenges. (Credit: Lani van Vuuren)

that is rapidly coming home to roost is that of salinity and brines. Centuries of production practices both in the industrial and agricultural domains have led to the diminishing quality of our freshwater resources, in particular the problem of salinity. South Africa's ability to expand its AMD science and technology into solutions for salinity and brine will position her for global leadership in this domain.

Similar cases can be developed for point-of use water treatment solutions, low-energy or energy-neutral wastewater treatment solutions, off-grid water and power supply

solutions in rural and peri-urban areas and of course water solutions for climate change adaptation. Global leadership in the water domain is a *Ji* away, if you are wearing the right lenses. The WRC has borrowed these *Ji* lenses in developing its current Corporate Plan 2013/14-2017/18 and is looking forward to realising these and other possibilities together with our partners in this the United Nations Year of International Water Cooperation.

This article is an adaptation of a lecture presented at the University of Cape Town during National Water Week 2013.

Water diary

Water law

Various dates – from April

The South African Institution of Civil Engineering is hosting a series of two-day courses across the country on the Water Law of South Africa. The courses will be held on 23-24 April at Port Elizabeth; 25-26 April at East London; 7-8 May at George; 9-10 May at Cape Town; 29-30 May at Midrand; and 4-5 June at Bloemfontein. The course will be presented by water law specialist Hubert Thompson. *Enquiries: Dawn (SAICE); Email: dawn@saice.org.za*

Wastewater treatment

June 25-28

The 13th World Congress on Anaerobic Digestion will take place in Santiago de Compostela, Spain, with the theme 'Recovering (bio)resources for the world'. Visit: www.ad13.org

Aquatic science

30 June-4 July

The annual conference of the Southern African Society of Aquatic Scientists will be held in Arniston, in the Western Cape. The theme for the conference

is 'Catchments, coastal interfaces and communities'. *Enquiries: Petrie Vogel (Conference Secretariat); Tel: (012) 346-0687; Fax: (012) 346-2929; Email: petrie@savetcon.co.za; visit: www.savetcon.co.za*

Municipal water quality

July 7-11

The Fourth Municipal Water Quality Conference will be held at Sun City with the theme 'Together committed to excellent Water Quality for the future'. Visit: www.wisa.org.za

Young water professionals

July 16-18

The Third Young Water Professionals Conference 2013 will take place in Stellenbosch, Western Cape. The conference is expecting 500 delegates from across Africa and beyond. The conference aims to provide a forum for young researchers and practitioners across the water sector to present and discuss their work and ideas. *Enquiries: Glaudin Kruger (Conference Secretariat); Tel: (028) 316-2905; Email: Kruger@kruger-associates.com or Visit: www.saywp2013conference.com/*

Aquaculture

September 9-13

The 11th Aquaculture conference of the Aquaculture Association of Southern Africa (AASA) will be held in Stellenbosch in collaboration with the Department of Agriculture, Forestry & Fisheries. The theme for this year's conference is 'Fish Farm to Plate'. *Enquiries: Email: deidre@iafrica.com or Visit: www.conferencesetal.co.za*

Groundwater

September 17-19

The 13th Biennial Groundwater Division Conference & Exhibition will take place in Durban, with the theme 'Groundwater: A New Paradigm'. *Enquiries: Conference Secretariat at Tel: (012) 348-9598; Email: info@gwd.org.za or Visit: www.gwd.org.za.*

Municipal engineering

October 23-25

The 2013 Conference of the Institute of Municipal Engineering in Southern Africa (IMESA) will be held at The Boardwalk Hotel & Conference Centre in Port Elizabeth with the theme 'Municipal Engineering: Meeting Peoples' Needs'. *Enquiries: Debbie Anderson (Conference*

Secretariat); Tel: (031) 266-3263;

Email: conference@imesa.org.za;

Visit: www.imesa.org.za

Large dams

November 5-7

The South African National Committee on Large Dams (SANCOLD) is hosting a conference on 'Advances in Dam Technology for Water and Energy in Southern Africa' at the Black Mountain Hotel in Thaba N'chu, Maria Moroka Nature Reserve. *Enquiries: Merentia Meyer; Tel: (021) 808-4352; Email: merentia@sun.ac.za; Visit: www.sancold.co.za*

Ecosystem health

November 20-21

North West University is hosting its fourth Annual Eco Health Research Forum at Golden Gate Highlands National Park, Clarens. The theme for this year's conference is 'Multidisciplinary Reflections on Environment, Health and Well-being Research in Southern Africa'. *Enquiries: Yolandi Krone (Conference administrator); Email: yolandi.yevents@gmail.com; Cell: 082 553 6463.*

Water by numbers

- **R827-billion** – The funds government is planning to spend on infrastructure projects over the next three years, according to Minister of Finance, Pravin Gordhan. A total of R430-billion has been allocated from the fiscus to build various water infrastructure, including dams, water and sanitation projects and new homes.
- **793 Mℳ** – The volume of water savings made during the WWF's Earth Hour campaign in March when 629 MW of electricity was saved by people switching off their lights for an hour.
- **144** – The number of complaints the South African Human Rights Commission (SAHRC) has received over the past two years about problems with the quality and supply of water.
- **75%** – The percentage of countries in Asia and the Pacific experiencing 'a serious lack of water security', according to a new report developed for the Asian Development Bank and Asia-Pacific Water Forum. A total of 37 of the 49 countries assessed were found to be either suffering from low levels of water security or have barely begun to engage in the task of improving water security
- **2 300** – The number of open toilets that reportedly remain unenclosed in Rammolutsi at Viljoenskroon, in the Free State. After the Mqohaka Local Municipality's failure to appear before the SAHRC to explain its apparent inaction to enclose the toilets, two years after they were first reported, the Commission appealed to Parliament and the Ministries of Human Settlement and Cooperative Governance & Traditional Affairs, to deal with the matter.

Entries open for First Biennial WRC Photographic Competition 2013



The Water Research Commission (WRC) invites the water community to be part of its first Biennial Photographic Competition 2013. The competition has been launched to celebrate and share the Commission's funded research projects and their impact

on the lives of all South Africans. Photographs will be received and adjudicated by a hand-selected panel of judges. Prizes will be awarded to the top three photographs (winner and two runners up).

The top 12 photographs will be displayed at the WRC Symposium 2013, where the winners will be announced, and will be compiled into a special 2014 WRC Calendar.

The competition is open to the general public to submit photographs. Photographs must portray images related to current or former WRC-funded

projects. Subject matter can relate to water & sanitation service delivery and innovation, industrial/mining water, water for agricultural use, water resource management, water & the environment, water & society, water & health and water & the economy.

Individuals can enter as many photographs as they wish, however, each photograph must be accompanied by a separate entry form.

The closing date of the competition is **1 August, 2013**.

For more information regards rules and entry details as well as to access the entry form, Visit: www.wrc.org.za/News/Pages/TheWRClaunchestheFirstBiennial-PhotographicCompetition2013.aspx

Business organisation joins anti-corruption initiative

Leads 2 Business has added its voice to the outcry against tender irregularities with a R100 000 donation towards Consulting Engineers South Africa's (CESA's) 'war chest'.

The initiative, for which CESA has already set aside R1-million, will be used to take legal action against 'corrupt' municipalities and private companies thought to act irregularly or illegally in the process of awarding or securing contracts. "Our subscribers are feeling the brunt of the gluttony practiced by corrupt

officials and fly-by-night companies," commented Leads 2 Business Founder and CEO, Victor Terblanche. "It is about time that we unite against the scourge that is so blatantly prevalent within the tendering industry."

Ethical professionals, contractors and suppliers alike are adversely affected by anti-competitive behaviour in the form of incompetence, corrupt practices, mismanagement, irregularities and outright fraud, noted Terblanche. "With Leads 2 Business being at the forefront

of tender notifications, we are in a position to identify irregularities in the bidding processes and, to date, have forwarded numerous tenders and tender awards to CESA's offices for investigation. Impractical and unreasonable timeframes contrary to regular bidding practice and sporadic media advertisements are among the criteria we use to identify untoward or suspicious behaviour. We commend CESA for taking up this initiative and have pledged our full support to their endeavour."

Durban explores new solutions for water security and service delivery

Etheke Municipality is exploring approaches to improve the quality and quantity of water in its lifeblood water resource – the uMngeni River – including restoring and maintaining the catchment's natural infrastructure.

Ecological, or natural, infrastructure refers to functioning ecosystems that produce and deliver services that are of value to society, such as freshwater, soil formation and disaster risk reduction.

Situated at the lower end of the catchment, the city currently spends millions

annually on making its water potable. "This has to change. We have tried traditional engineering solutions and it is not working," reports eThekweni Head of Water & Sanitation Services, Neil Macleod, who is spearheading the new initiative.

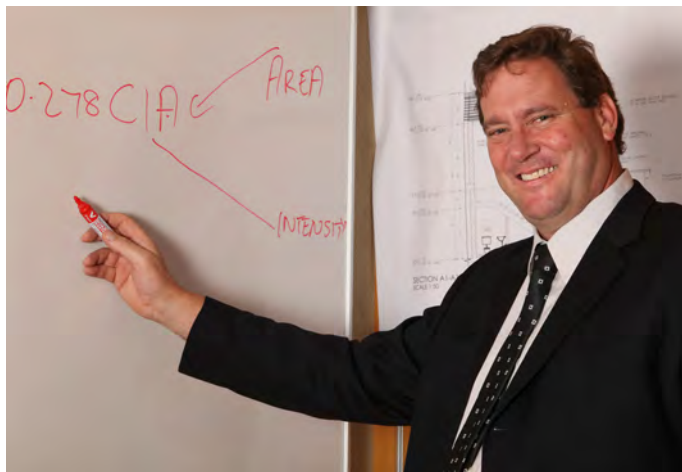
A workshop held earlier this year to explore potential partnerships to unlock the potential of natural ecosystems in the area provided evidence of the critical role that ecological infrastructure can play in improving the overall state of water resources in the catchment, while

simultaneously providing job creation opportunities through the restoration and maintenance of the ecological infrastructure.

Information presented at the workshop highlighted many of the challenges faced in the catchment as a result of inappropriate agricultural practices, industrial and other pollutants, poorly maintained sewage treatment works, among others, that are threatening the quality and quantity of water available for municipal use.

Source: eThekweni Metro

Hydrologist warns consumers about 'water guzzling' ways



As citizens in a semi-arid country, South Africans are wasteful water users, using as much as five times more water per person than we should.

According to Peter Shepherd, partner and principal hydrologist in the Johannesburg office of SRK Consulting (SA), the problem is further exacerbated by the uneven distribution and seasonability of rainfall, with 43% of rain falling on just 13% of the land. Also, the major urban and industrial developments are remote from the country's larger water courses.

He said that per capita water consumption in urban areas, where about 25% of our water is used, is about 200 ℓ a day - an unsustainable quantity for our available resources. "We are not a country with unlimited water resources and our water usage will exceed our available fresh water within the next 20 years."

"We urgently need to review our water usage habits," said Shepherd. "The more water we use, the more we have to find and we are running out of cheap and easy places to source water."

South Africa already transports water great distances – about 10% of our water originates from Lesotho – and it becomes more expensive as these distances grow. "Our gardens are where a lot of our water goes, so we need a more 'water-wise' approach to how we design our gardens and choose our plants," said Shepherd. "Being vigilant about water leaks is also vital; we could be losing

in excess of 20% of our water supply through unattended leakages and ageing infrastructure, despite good progress being made to renew and improve municipal infrastructure."

According to Shepherd, we could learn from neighbouring countries like Botswana, where most low-cost houses are built with rainwater tanks, and innovative methods are used to catch run-off in permeable areas that can infiltrate water into underground water systems.

An important factor that strengthens the country's ability to manage scarce water resources is the solid statistical platform that underpins national strategies and the application of technologies. "However, our hydrology skills base is ageing steadily and there are not enough qualified youngsters coming through to fill the gaps that are forming," said Shepherd. "The good news is that this is a broad and exciting field for young South Africans to consider as a career, and the demand for skills is high."

The hydrology profession, according to Shepherd, is not doing enough to foster awareness among school leavers, and promoting the potential areas of work in the field of water management. "School children know what a lawyer or accountant does, but few school leavers know what a hydrologist is," he said. "We're not doing ourselves any favours by our reticence to better publicise the vast opportunities in this exciting field of work."

Billions of Rand, dedication, needed to curb water wastage, Minister says



gross average water consumption is 286 ℓ/person/day – much higher than the international average of 173 litres.

According to Molewa, non-revenue water remains a challenge for many municipalities due to factors such as poor planning, limited financial resources to implement the necessary water demand management programmes, poor infrastructure asset maintenance, and lack of necessary skills and capacity. "Non-revenue water can potentially have a significant impact on water supply, and in some areas high levels of lost water has already forced the commissioning of new transfer schemes," she said.

The minister called on the entire water use sector to evaluate its water use and adjust consumption patterns. "Some organisations have already developed strong programmes around environmental protection and water conservation as part of their own programmes and their corporate social investment. I believe that if we all identify where large savings can be achieved within our individual sectors and go over to action, a lot can be achieved to reduce stress on our water resources," Molewa noted.

According to WRC CEO, Dhesigen Naidoo, water demand management while challenging for many municipalities, presented an opportunity to persuade customers to use water more efficiently. "Water sales are the prime source of income for local government structures. It is high time that people realise that if water is not used conservatively, demand will outstrip supply, resulting in the construction of expensive augmentation schemes, which cost billions of Rand."

An amount of R2-billion will be required every year for the next ten years in order to reduce South Africa's municipal water losses to a 'realistic target' of 25%.

This is according to the Minister of Water & Environmental Affairs, Edna Molewa. She was speaking at a Water Research Commission (WRC) Dialogue on the state of non-revenue water in South Africa, in Cape Town, during National Water Week earlier this year.

The dialogue brought together stakeholders to discuss the findings of the latest *State of Non-Revenue Water in South Africa (WRC Report No. TT 522/12)*, published by the WRC in collaboration with the Department of Water Affairs. The study, South Africa's most comprehensive yet, found that the country's present level of non-revenue water is in the order of 37%, of which a quarter is considered to be losses through physical leakage. (For more results, see 'Counting the lost drops – Study into non-revenue water shows we can do more' in *the Water Wheel* January/February 2013)

This percentage translates into a volume of around 1 580 million m³ of water that is 'lost' each year. This is roughly equal to the annual supply of Africa's largest water utility, Rand Water.

A worrying factor pointed out by the study is the fact that South African

WRC-NWU initiative to protect SA's historical records

The Water Research Commission (WRC) together with North West University (NWU) Vaal Campus is answering the call for the establishment of information storage facilities to preserve South Africa's water history.

This follows after the need for a water archival repository system has been expressed by various stakeholders in the South African water sector. It is envisaged that a number of entities, from government departments to water boards, will gain from the project. A number of retired

water engineers have already volunteered their records, including hydrology guru, Prof Will Alexander.

The challenges around archiving in a modern age were also at the centre of discussions hosted by the WRC and NWU in Vanderbijlpark earlier this year. The event, attended by around 100 delegates, shared the vision of the South African Water History Archival Repository.

International insight into archiving in a digital age was provided by special international guest speaker, Dr Adam

Jansen (pictured) of the School of Library, Archival and Information Studies at the University of British Columbia, Canada.

"Archiving in the electronic age involves a series of managed activities necessary for the protection of digital records of enduring legal, historical or fiscal value from loss, alteration, deterioration and technological obsolescence, while maintaining them in a trustworthy state in order to ensure an accurate rendering of those records in perpetuity in an environment independent from that which produced the record."



SA, neighbours sign environmental treaty

South Africa has signed an environmental treaty with the governments of Angola and Namibia.

Water and Environmental Affairs Minister, Edna Molewa signed the environmental treaty called the Benguela Current Convention, in Benguela, Angola, in March. The Benguela Current Convention is a formal agreement between the three governments and seeks to promote a coordinated regional approach to the long-term conservation, protection, rehabilitation, enhancement and sustainable use of the Benguela Current Large

Marine Ecosystem, to provide economic, environmental and social benefits.

Molewa is the current chairperson of the Benguela Current Convention and, as such, South Africa had played an important role in drafting and negotiating the Convention text. The Benguela current constitutes the boundaries of the Benguela Current Large Marine Ecosystem (BCLME), an area of ocean space stretching from Benguela, in the province of Cabinda in the North of Angola to Port Elizabeth.

According to the Department of Environmental Affairs, by signing the Benguela

Current Convention, Angola, Namibia and South Africa agreed to manage the BCLME in a cooperative and sustainable way for the benefit of coastal people who depend on the ecosystem for food, work and well-being.

The Convention will also establish the Benguela Current Commission – in existence since 2007 – as a permanent inter-governmental organisation with a mandate to promote the long-term conservation, protection, rehabilitation, enhancement and sustainable use of the BCLME.

Source: SA News

University staff and students vote for safe water with their feet

Stellenbosch University (SU) joined thousands of people from Africa and across the world in a local 'World Walks

for Water and Sanitation' event to raise awareness of people's right to safe water.

Organised by the university's Water

Institute and the NEPAD Southern Africa Network of Water Centres of Excellence (SANWATCE), more than 100 members of staff and students, including the Executive Mayor of Stellenbosch, Conrad Sidego, walked the 2,4 km on 19 March.

Also joining the march, SU Vice-rector

(research and innovation), Prof Eugene Cloete, said that such a day is important to make people aware of the scarcity and importance of water. "Such a day is very important if you take into account the fact that 1,2 million people in the world do not yet have access to safe drinking water. In South Africa, one out of every five children die because of a water-related illness."

According to Prof Cloete, there are many ways in which water wastage can be curbed. "The average person here uses 55 000 litres of water per year just by flushing the toilet. That is equivalent to an average-sized swimming pool."



Water on the web

www.ngopolis.com

This new website has been created to harness the power of social media for the conservation and sustainable development sector. The site will allow disparate groups to share data and will act as a resource enabling nature conservation and development professionals, educators, scientists, academics, and students to find relevant peers and information, to communicate in real time, to pool data and manage collective data tables, upload and download files, bookmark important websites, hold discussions, create groups for organisations or issue areas, and access the latest news and updates.

www.wisa.org.za

The Water Institute of Southern Africa (WISA) has launched its new-look website. Visit the site for information on membership, branches, divisions, and events.

<https://twitter.com/gwdivision>

The Groundwater Division of the Geological Society of South Africa has an active Twitter account. Follow to keep up-to-date with all things related to groundwater in South Africa.

Classic WRC publication underscores importance of wastewater management

Media headlines regularly woe the state of municipal wastewater treatment plants in South Africa. Dipping into the Water Research Commission's (WRC's) rich archive of reports and publications reveals that the country has a long history of grappling with wastewater management issues – with an abundant record of innovation to show for it.

Wastewater doyen, Kenneth Angus Murray's publication, *Wastewater Treatment and Pollution Control*, first published by the WRC in 1987, remains as relevant as it did 30 years ago. While the legislative milieu has changed, many of the technologies used to treat wastewater remain relevant today.

The publication follows the history of wastewater treatment in South Africa up to the 1980s, including the origins of sanitation and wastewater management and the international sanitation revolutions of the nineteenth century.

Murray explains how, as towns and cities developed following the arrival of European settlers in the seventeenth century, urban areas first made

use of sanitary buckets, with sanitary pail contents being removed by special mule-drawn carts (or trains in the case of Cape Town). Originally the bucket contents were disposed of at depositing sites in deep trenches with continuous coverage of earth.

In the Cape of Good Hope, established as a halfway house for East-bound ships by the Dutch in 1652, sanitation buckets were first disposed of by household slaves, who were meant to empty the buckets in the sea. However, it was not unusual for bucket contents to find its way into the town's water canals. From 1850 the canals were covered to prevent abuse, but progress in this direction was slow.

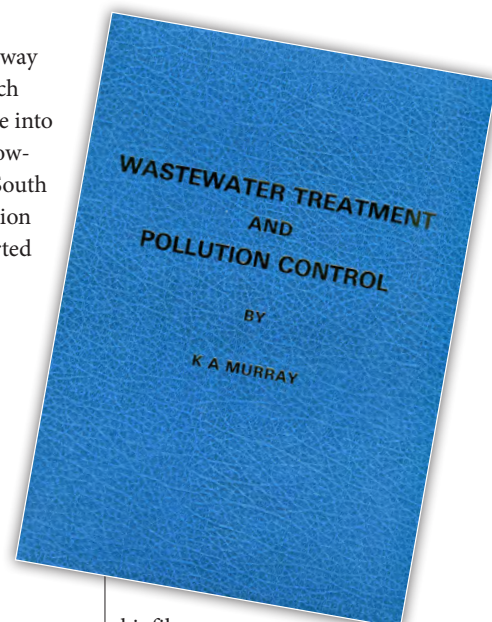
At the start of the South African War (1899-1902), British military authorities introduced the septic tank method of sewage treatment. The first municipal sewerage scheme planned in South was designed by consulting engineer Thomas Stewart for Wynberg (Cape Town) in 1898. This consisted of septic tanks, percolating filters and land treatment. The

final effluent found its way into Princess Vlei, which overflowed to discharge into the sea in False Bay. However, as a result of the South African War, construction of the scheme only started in 1902.

The first municipal scheme to be put into operation in South Africa was that designed by the City Engineer of Bloemfontein. Designed in 1901, construction work started in 1904 and sewage arrived at the works in November 1904. This scheme consisted of septic tanks, primary and secondary filters, followed by irrigation of cultivated land. Subsequently, other inland towns, notably Pietermaritzburg, Johannesburg and Pretoria became interested in more sophisticated sanitation removal and actions were taken by these authorities to deal with the disposal of their respective sewages.

The first sewer system in Johannesburg, which brought sewage to the Klipspruit 'sewage farm' was completed in 1907. Around the same time Pietermaritzburg constructed a wastewater treatment works consisting of screens, hopper-bottomed sedimentation tanks, percolating filters and separate sludge digesters. These works were significant in that it was one of the earliest works incorporating separate sludge digestion.

Walton Jameson, who designed the Pietermaritzburg works, then moved to Pretoria designing similar works for the capital city. The original



biofilters established at the Daspoort wastewater treatment plant are still in use more than 100 years later. Towns located next to the ocean opted for sea outfalls.

It was only after the Second World War that municipal sewage treatment really took off in South Africa. The methods have essentially remained the same to this day.

These methods are included in the book along with chapters on South Africa's contribution to the field of wastewater treatment, practical aspects of wastewater treatment and pollution control in South Africa, adverse effects of sewage spills, control of pollution from industrial effluents, marine pipelines and more.

The publication is still available from the WRC and is a must for the water history collector. To order the publication, *Wastewater Treatment and Pollution Control*, contact WRC Publications at Tel: (012) 330-0340; Fax: (012) 331-2565 or Email: orders@wrc.org.za



NLSA

A view of the parade and heerenracht (now Adderley Street), Cape Town, in 1763. Before the construction of the sewerage system in Cape Town waste content was often dumped in the city's drinking water canals.

Environmental & health issues deserve priority in development agenda – UN

Unless Africa's leaders prioritise environmental and health issues, and prevent the degradation of health-promoting food and medicinal plants, people's health and productivity will continue to suffer, warns a new report by the United Nations Environment Programme (UNEP).

"Africa's population is growing at the fastest rate in the world and its economy is expanding at a commensurate rate, yet not enough focus has been placed on the role environmental concerns play in ensuring the well-being of this expanding, dynamic continent's citizens," said UNEP Executive Director, Achim Steiner.

Environmental risks contribute to 28% of Africa's diseases, according to the African Environment Outlook-3 (AEO-3). Diarrhoea, respiratory infections and malaria account for 60% of known environmental health impacts in Africa.

The report also highlights a lack of capacity to deal with the growing effects of climate change; and inadequate water, sanitation and hygiene – in 2010, only 60% of the sub-Saharan population had access to safe water.

Other issues highlighted include the negative impact of degradation of health-promoting goods and services such as food and medicinal plants made possible by land and marine biodiversity. For example, 80% of

Africa's rural population depends on traditional medicines harvested from nature.

Climate change and variability impact human health because of Africa's under-developed capacity to cope with the potentially negative impacts. The report provides policy changes that include incorporating climate-related scientific findings into decision-making; building adaptive capacity; and strengthening early warning systems, preparedness and response.

The report gives policymakers a clear pathway to a sustainable and healthy future, Steiner said.

Source: UN News

Silver nanoparticles may adversely affect environment

In experiments reproducing the natural environment, Duke University researchers have demonstrated that silver nanoparticles, which are used in many consumer products, can have an adverse effect on plants and microorganisms.

These preliminary findings are important, the researchers said, because little is known about the environmental effects of these nanoparticles, and the only studies conducted to date involve high concentrations of the nanoparticles in a laboratory setting which, they point out, does not represent 'real-world' conditions.

Silver nanoparticles are used in a host of products, most commonly in textiles and clothing. These nanoparticles are used because of their characteristics is the ability to kill bacteria, inhibiting unwanted odours. They work through different mechanisms, including generating oxygen free radicals which can cause DNA damage to microbial membranes without harming human cells. Other products with silver nanoparticles are children's toys and pacifiers, disinfectants and toothpaste.

The main route by which these particles enter the environment is as a

byproduct of water and sewage treatment plants as the nanoparticles are too small to be filtered out, so they end up back in the environment.

This latest research was conducted by the Centre for the Environmental Implications of Nanotechnology (CEINT), and published in the February 27 edition of the journal, *PLOS ONE*. "Our field studies show adverse responses of plants and microorganisms in a replicated long-term terrestrial environment following a single low dose of silver nanoparticles, applied by the likely route of exposure, sewage biosolid applications," explained Benjamin Colman, a post-doctoral fellow in the CEINT.

For their studies, the CEINT researchers created mesocosms, which are small, man-made structures containing different plants and microorganisms meant to represent the environment. They applied biosolids with low doses of silver nanoparticles in the mesocosms, then compared the effects of the nanoparticle-treated plants and microorganisms to the mesocosms receiving no nanoparticles.

"Our results show that silver nanoparticles in the biosolids added at concentrations that would be expected to a diverse terrestrial ecosystem caused ecosystem-level impacts," Colman said. "Specifically, the nanoparticles led to an increase in nitrous oxide fluxes, changes in microbial community composition, biomass, and extracellular enzyme activity, as well as species-specific effects on the above ground vegetation."

The researchers plan to continue their studies with another ubiquitous nanoparticle – titanium oxide.

Cooperation key to drought prevention – UN

Countries need to work together to use their experiences, science and technologies to create formal national preventative policies against droughts.

This is according to United Nations (UN) officials speaking at the High Level Meeting on National Drought Policy in Geneva, Switzerland, in March.

"Prevention must be our priority," said UN Secretary-General Ban Ki-moon. "No single nation can insulate itself from global shocks. The only way to respond is through cooperation – between countries and among civil society, government and business."

Organised jointly by the UN World Meteorological Organisation, the UN Food and Agriculture Organisation (FAO), the UN Convention to Combat Desertification (UNCCD) and partners, the five-day meeting brought together policymakers, development agencies and leading scientists and researchers.

Droughts have affected the Greater Horn of Africa and the Sahel region, the US, Mexico, Brazil, parts of China and India, Russia and South-east Europe. In addition, 168 countries claim to be affected by desertification, a process of land degradation in the drylands that affects food production and is exacerbated by drought.

"Drought ranks as the single most common cause of severe food shortages, particularly in developing countries," said the Special Representatives of the FAO DG, Ann Tutwiler. More than 11 million people died, and 2 billion have been affected by droughts since 1900, according to the UN Office for Disaster Risk Reduction.

A main objective of the Geneva meeting was to familiarise countries with drought preparedness measures, including technical knowledge and conditions for the successful development of drought policies. Organisers said that they hoped the meeting would lead to the development of national drought management policies focusing on cooperation and coordination at all levels of government, and which increase governments' capacity to cope with extended periods of water scarcity.

Nature organisation lashes out at dam-building 'sins'

Worldwide nature organisation, WWF has criticised dam projects





be modified or halted," added Dr Meng.

No sustainable outcomes can be expected when dam proponents rely on superior financial strength and political connections rather than on dialogue, transparency, and reason, says WWF. Additionally, some governments lack the capacity or independence to protect public interests.

Successful and overall long-term beneficial dam projects need more than just the legal regulator's approval, according to the report. "For large-scale projects, operators

worldwide that it says continue to violate fundamental sustainability criteria.

In the WWF report, *Seven Sins of Dam Building*, numerous dam projects under construction or planned are given a failing review by the conservation organization. Aside from the internationally controversial Belo Monte (Brazil) and Xayaburi (Laos) dams, European projects, such as in Austria and Turkey, are also on the list. The 'seven sins' outlined in the report include issues with dam location, neglecting biodiversity, environmental flows, social and economic factors, and risk analysis. WWF also notes that dam decisions often blindly follow 'a bias to build' without considering better, cheaper, and less damaging alternatives.

"Properly planned, built, and operated dams can contribute to food and energy security. Unfortunately, short-term interests are too often the focus of decision-making," says Dr Jianhua Meng, Water Security Specialist for WWF. "In order to guarantee acceptable levels of social and environmental sustainability, dam installations and operations should be stringently checked against sustainability criteria as formulated under the World Commission on Dams or the Hydropower Sustainability Assessment Protocol. If necessary, insufficiently performing projects must

must also obtain the 'social license to operate'. Acceptance of the project by the population is fundamental to sustainable management," said Dr Meng. "Negative effects, such as relocation, destruction of cultural sites, or the collapse of local fisheries are still too often dismissed as somebody else's problem."

Scientific evidence and risk assessments too frequently lose out to one-sided political or economic agendas, according to the report. Subsequently, dams are still planned and built in ecologically high value areas and biodiversity loss is still too often not accounted for. Serious impacts, caused by a change in the natural water flow dynamics or the disappearance of wetlands, are still not given consideration.

Moreover, the size of a dam is not necessarily a deciding factor. Though numerous mega-projects can be found in the report's case studies, the cumulative impact of many small hydro projects, like for instance in Romania, cannot be underestimated. The problems are not limited to developing and emerging countries. G7 companies and engineers continue to not only push projects forward in emerging markets that are unacceptable by global standards, but also in the heart of the EU and North America, reproaches WWF.

For example, heavy ecological deterioration looms for three alpine valleys in

the Ötztal Alps in Austria, if the extension of the Kaunertal hydroelectric power plants is implemented with the current plans, the report cites. "WWF reviewed nine dams and we found that many projects commit not just one, but many grave sins of dam building. However, these errors are avoidable. Lack of capacity, economic pressure, or specific regional circumstances can no longer be presented as excuses," Dr Meng stated.

To access the report Visit: http://awsassets.panda.org/downloads/wwf_seven_sins_of_dam_building.pdf

Millions of children still dying daily because of poor water, sanitation

Despite technological advances in water and sanitation supply an estimated 2 000 children under the age of five die every day globally from diarrhoeal diseases.

"Sometimes we focus so much on the big numbers that we fail to see the human tragedies that underlie each statistic," said Sanjay Wijesekera, global head of UNICEF's water, sanitation and hygiene programme, speaking on World Water Day (22 March). "If 90 school buses filled with kindergartners were to crash every day, with no survivors, the world would take notice. But this is precisely

what happens every single day because of poor water, sanitation and hygiene."

Almost 90% of child deaths from diarrhoeal diseases are directly linked to contaminated water, lack of sanitation or inadequate hygiene. Despite a burgeoning global population, these deaths have come down significantly over the last decade, from 1,2 million a year in 2000 to 760 000 a year in 2011. UNICEF says that is still too many.

UNICEF child mortality data show that about half of under-five deaths occur in only five countries: India, Nigeria, Democratic Republic of Congo, Pakistan and China. Two countries – India (24%) and Nigeria (11%) – together account for more than a third of all under-five deaths. These same countries also have significant populations without improved water and sanitation.

"The numbers can be numbing, but they represent real lives, of real children," noted Wijesekera. "Every child is important. Every child has the right to health, the right to survive, the right to a future that is as good as we can make it."

According to Wijesekera the progress made since 1990 shows that, with the political will, with investment, with a focus on equity and on reaching the hardest to reach, every child should be able to get access to improved drinking water and sanitation, perhaps within a generation.

To watch UNICEF's World Water Day message Visit: <http://www.youtube.com/watch?v=QGpyD1maXqc&feature=youtu.be>



New from the WRC



Report No. TT 532/12
The identification of a suitable culture organism to establish a bio-assay for evaluating sedi-

ment toxicity (Y Cloete & B Shaddock)
 Sediments act as a source and sink for a variety of organic and inorganic contaminants. These contaminants accumulate, resulting in extremely high concentrations even once the overlying water concentrations are at or below acceptable water quality guidelines. Any changes in the physical parameters of the overlying water can cause these pollutants to be released back into solution. These accumulated contaminants can be released at high higher concentrations than previously detected. In recent years sediment contamination has highlighted the need to monitor these previously overlooked pollutant sources in aquatic ecosystems. When the contaminants bound to sediments become toxic they pose a risk both to the aquatic organisms as well as human health. South Africa does not currently have standardised methods to assess sediment toxicity. Although international methods exist, they are largely untested in South Africa and the organisms needed to conduct these tests are not readily available. The three main aims of this project were to identify ecologically relevant benthic/epibenthic organisms that can be successfully cultured under laboratory conditions in South Africa; to develop a stable culture of applicable organisms that can be used for sediment toxicity testing; and to assist in the training of Department of Water Affairs Resource Quality Services staff with culture maintenance, good laboratory practices and application of sediment tests.

Report No. 1870/1/12 (Volume 1) and 1870/2/12 (Volume 2)
Deployment, maintenance and further development of Spatsim-HDSF (DJ Clark; DA Hughes; JC Smithers; SLC Thornton-Dibb, A Lutchminarain; DA Forsyth; JIM Stassen & E van Niekerk)
 The Spatial and Time Series Information Modelling (SPATSIM) software is an integrated hydrology and water resource information management and modelling system. SPATSIM integrates spatial and time series information in a flexible modelling framework that includes a variety of data storage, retrieval, analysis and display options suitable for the application of a range of different framework compatible models. Through the WRC, the software was further developed and is now known as SPATSIM-HDSF. It was recognised that there was a need to further test and debug the new restructured modelling framework, further develop the framework, further develop the modelling tools associated with the framework, and provide user training and support for the framework and associated models. These requirements were met through the latest project. Volume 1 deals with the SPATSIM-HDSF Modelling Framework while Volume 2 provides a National Database of Ecological Reserve and EWR Management.

Report No. KV 304/12
Monitoring the impact and recovery of the biota of the Rondegat River after the removal of alien fishes (DJ Woodford; OLF Weyl; M Cunningham; T Bellingan; FC de Moor; H Barber-James; JA Day; BR Ellender & NK Richardson)
 Alien invasive fishes pose the greatest threat to the survival of native fishes in the Cape Floristic Region of South Africa. While the majority of invasive fish are now too widely spread to be eradicated, targeted removal of these fishes from key reaches where re-invasion can be prevented offers a near-term way to improve the survival of some threatened

fish populations. The CAPE project, a joint venture between Western Cape government and civil society organisations, began a process in 2003 to identify priority streams where alien invasive fish could be targeted for removal. The Rondegat River in the Cederberg was identified as an ideal candidate for a pilot project whereby invasive smallmouth bass would be removed from the stream using a comprehensive Environmental Impact Assessment (EIA) to assess the feasibility and justifiability of using the piscicide Rotenone on a 4 km-stretch of the Rondegat River. The EIA found the project to be justified, and recommended a comprehensive environmental monitoring programme be set up to assess the impacts of fish eradication operations on the ecosystems of the Rondegat River. This report summarises the findings of that monitoring programme.

Report No. 1906/1/12
A short-term heavy rainfall forecasting system for South Africa with first implementation over the Gauteng Province (LL Dyson; CJ Engelbrecht; K Turner; S Landman)
 The project set out to develop an ingredients-based rainfall forecasting system for the summer rainfall areas of South Africa and specifically the Gauteng Province. Daily rainfall climatology was developed for Gauteng in order to better understand heavy rainfall over the province. Several parameters were calculated for Irene and this was consequently used to investigate the thermodynamic conditions associated with heavy rainfall over Gauteng. A lightning climatology was constructed over Gauteng and the lightning characteristics associated with heavy rainfall were identified.

Report No. TT 533/12
A guide to SANIVEY – Assessing user acceptance and functioning of mobile communal sanitation facilities in informal settlements (A Lagardien, C Muanda & A Benjamin)

In order to meet its sanitation targets, the South African government makes use of several sanitation technologies (including mobile communal sanitation). Despite the speedy delivery of these basic services, it is estimated that 16 million people living in South Africa do not have access to basic sanitation facilities. Several sanitation technologies that are planned or being provided are found to be inadequate and not serving their intended purposes. The user acceptance of some of these technologies is as low in such a way that the provided sanitation systems are being torched, vandalised or sabotaged. In addition, the functioning of these sanitation systems is not evident from user perspectives. This situation creates a huge barrier between the municipalities and communities which, in most cases, result in violent protests, vandalism and destruction of other infrastructure. With municipalities struggling to come up with mechanisms to eradicate the sanitation backlog through a speedy service delivery, research was conducted in partnership with three municipalities covering peri-urban and semi-rural informal settlements and covering a range of mobile communal sanitation facilities expressly to inform user acceptance and functioning of this new type of sanitation system. To ensure a high level of user acceptance and adequate functioning of the mobile communal sanitation facilities in informal settlements, a framework for assessing user acceptance and functioning of these facilities was developed from which an easy-to-use software called SANIVEY was developed to analyse results of the application of the framework. This report outlines the stepwise application of the software.



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Report No. KV 303/12

Microbial pathogens in the Umgeni River, South Africa (J Lin; A Ganesh; M Singh)

As water demands increase, there are some concerns that need to be addressed to ensure protection of public health and the health of the environment. South Africa's water resources have been under increasing threat of pollution due to rapid demographic changes, which have coincided with the establishment of informal human settlements. Public water systems rely on bacterial indicators (i.e. coliforms) for monitoring water quality. However, it has been shown that bacterial indicators are often poorly correlated with the presence of other microorganisms. Viruses are a group of particular concern because they include stable pathogens that can be resistant to standard wastewater treatment processes. The spread of viral pathogens through water is a real possibility as several studies have detected enteric viruses in treated wastewater. The objective of this study was to evaluate the seasonal variation of viral abundance, especially human pathogenic enteroviruses, in the Umgeni River, in KwaZulu-Natal.

Report No. 1648/1/12

An assessment of the social and economic acceptability of rainwater harvesting and conservation practices in selected peri-urban and rural communities (MF Viljoen; G Kundhlande; MN Baipethi; P Esterhuysen; JJ Botha; JJ Anderson; GA Minkley)

Over the years many new rainwater harvesting techniques have been developed and some traditional and indigenous techniques modified and improved. Rainwater harvesting is the purposeful collection of rainwater from various catchments such as roads, hillsides, pastures and within fields; and rooftops and the storage of such water in physical structures or within the soil profile. For many years many organisations and individuals have advocated the use of rainwater harvesting, but the uptake and incorporation into water policies has been slow. The WRC has funded research on rainwater harvesting for a decade and a half. The aim of this project was to determine the factors influencing decisions by households in varying locations to adopt

or reject various rainwater harvesting techniques. The study was carried out in the Thaba Nchu and Amathole District, in the Free State and Eastern Cape provinces, respectively.

Report No. 1857/1/12

The capability of the Mfabeni peatland to respond to climatic and land-use stresses, and its role in sustaining discharge to downstream and adjacent ecosystems (P Grundling; JS Price; AP Grootjans; WN Ellery)

The effects of changes in climate or landscape on wetland ecosystems need to be considered within the context of natural processes. Hydrological processes are a key component in the development and maintenance of wetlands and the source of water determine a wetland's vulnerability to a changing landscape and environment. The overall objective of this research was to investigate the ecosystem processes that regulate water supply in the St Lucia wetland complex, with specific reference to the Mfabeni peatland.

Report No. KV 281/11

Edibility of selected freshwater fish from the Rietvlei Dam (IEJ Barnhoorn; MS Bormman; JC va Dyk; B Genthe; GM Pieterse)

The manipulation of the food chain in freshwater impoundments has been used as an alternative to restore good quality of water – especially in dams plagued by eutrophication – by having more native and advantageous fish species. The restructuring of fish communities, therefore, improve the ecology of the dam. Some experts regard *C. gariepinus* as an undesirable species due to its predatory and bottom-feeding habits. In order to maintain the good ecological functioning of a dam, this species need to be removed and therefore, the fish community will naturally shift towards *Oreochromis mossambicus* (Mozambique tilapia) as the most important species. As part of a WRC food web management/manipulation project, the harvested fish was to be sold, which meant that the fish would become available for human consumption. Therefore, the risk these fish pose to human health needed to be explored.

Report No. 1928/1/12

An assessment of the current distribution, biodiversity and health of the frogs of the Kruger National Park in relation to physical and chemical factors (W Vlok; PSO Fouché; CL Cook; V Wepener; GM Wagenaar)

In South Africa only one of the three orders of the class Amphibia, namely Anura, is present. The Anura, which includes frogs and toads, display a spectacular diversity of body form while their calls are a unique trait used for identification. Of the 117 species known in South Africa more than 20% are regarded as threatened, while about 7% are regarded as 'data deficient', which implies that limited data is available and it is therefore difficult to determine their conservation status. As a conservation organisation, the Kruger National Park realised that the decline in amphibian populations would extend into the park and requested that the current distribution of frogs in the park be investigated. In addition, it was requested that the potential impact of acid rain on frog health and the impact of mega herbivore grazing on the habitat be determined.

Report No. 1805/1/12

The development and testing of an integrated hydro-economic model to evaluate the financial impact of curtailment decisions on a farm case study in the Crocodile catchment (B Grové; M Frezghi; A Pott & N Lecler)

The Second Edition of the National Water Resource Strategy emphasises the need for 'smart water management' to complement traditional engineering and technology-based approaches to water management. Smart water management entails, among others, the inclusion of business principles and sustainability into water management – with strong stakeholder involvement in the planning and managing of water resources. An important stakeholder group in the water sector is irrigated agriculture, which accounts for around 62% of all surface- and groundwater use in the country. In many instances, irrigated agriculture is seen as a potential source of water for reallocation to other water-use sectors due to the perceived inefficiencies and potential to achieve water savings. Currently, the Mhlathuze catchment is undergoing compulsory licensing to

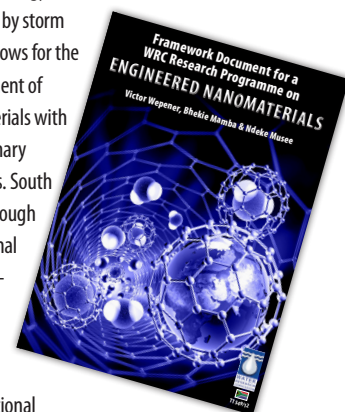
reconcile imbalances in that catchment.

The research reported in this document contributes towards improved decision-making and operational management at both catchment and water user association level, through the development of an integrated hydro-economic modelling framework. This framework allows water managers to test various catchment-scale water management scenarios on irrigators' security of water supply and the resulting impact on irrigation farming profitability and livelihoods.

Report No. TT 549/12

Framework document for a WRC research programme on engineered nanomaterials (V Wepener; B Mamba & N Musee)

Nanotechnology has taken the world of science by storm since it allows for the development of new materials with extraordinary properties. South Africa, through the National Nanotechnology Strategy, has initiated a national coordinated effort to guide the country's nanoscience and nanotechnology to ensure that we remain competitive within the international research community in this fast-developing field. With the rapid progression of nanotechnology from laboratory to industrial applications and commercialisation of products, it is imperative that risk that may be associated with engineered nanomaterials requires attention at its infancy phase to ensure safe and responsible long-term development of this novel technology. In this document an outline on the development of a research framework and a motivation as to why the different components were selected to address the research needs into risk assessment of engineered nanomaterials are presented. To stay in line with current national initiatives, a research programme is required to increase our collective understanding on the potential risks and mechanisms of addressing such risks adequately.



Destruction of nature's chemist – RESEARCHERS URGE FOR ACTION



Courtesy: Johan Wentzel

Persistent overharvesting of South Africa's plants for medicinal purposes as well the destruction of the habitats in which they are found could lead to millions of people losing access to their premier healthcare service. This is according to researchers who have completed a report for the Water Research Commission (WRC) on the distribution, use and ecological roles of medicinal plants in freshwater ecosystems. Article by Lani van Vuuren.

The use of plants for medicinal purposes is an inextricable part of South Africa's culture. An estimated 30 million people make regular use of the services of the country's 200 000 traditional healthcare practitioners, all of which apply indigenous and exotic plants in their remedies. This does not include the people who purchase medicinal plants from mostly informal markets. It has been estimated that the annual local trade in medicinal plants amounts to

20 000 t, representing 574 species.

While the properties and uses of medicinal plants have been well researched in South Africa, their natural habitats and the roles these plants play within these habitats are less well studied. The WRC study, undertaken by independent researchers Dr Johan Wentzel and Carin van Ginkel, focused on building knowledge around the country's freshwater medicinal plants, i.e. those plants found in freshwater areas, such as wetlands and alongside

ivers. The project specifically investigated the distribution, propagation, ecological role and use of these plants. The researchers also sought to assess to what extent current national legislation can be utilised for the protection of freshwater medicinal plants.

“While the freshwater ecosystems in which these plants occur are not defined by plants with medicinal properties, these medicinal plants still occupy a very specialised habitat, and it is important that this habitat be understood so that protection measures can be put in place so as to ensure their survival,” write Dr Wentzel and Van Ginkel in their final report. “These ecosystems show great temporal and spatial variations and this ensures the variety and survival of these plants. Many of these plants are very habitat specific, such as certain ground orchids, pineapple lilies and red-hot pokers.”

It is also suspected that many of these plants have a symbiotic relationship with certain fungi in the soil that ensures their survival as well as their propagation in nature. An example of the latter is ground orchids. This has the implication that these plants will only be propagated outside of their natural habitats with great difficulty. Their sustainable use and protection is therefore of particular importance.

Freshwater ecosystems differ greatly from one another depending on type, location, and climate, but they nevertheless share important features. In addition, because freshwater ecosystems are dynamic, they all require a range of natural variation or disturbance to maintain viability or resilience. Water flows that vary both season-to-season and year-to-year, for example, are needed to support plant and animal communities and maintain natural habitat dynamics that support

Picture left: Wild spearmint (*Mentha longifolia*) is traditionally used to treat many ailments, from headaches and stomach pains to epilepsy and insomnia.



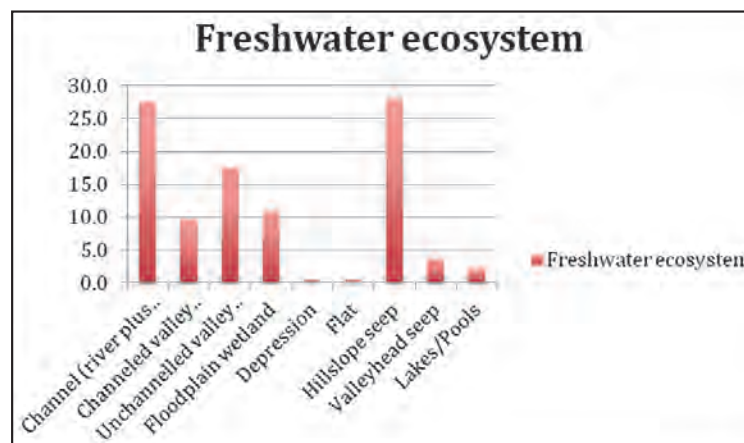
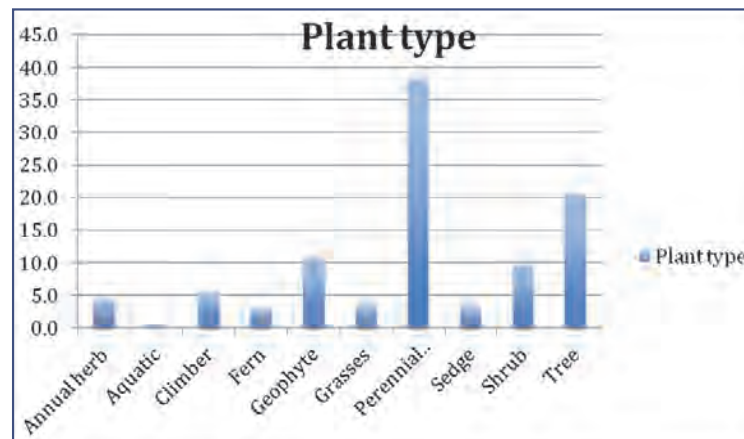
Courtesy: Johan Wentzel

production and survival of species.

Variability in the timing and rate of water flow strongly influence the sizes of plant and animal populations and their age structures, the presence of rare or highly

specialised species, the interactions of species with each other and their environments, and many more ecosystem processes. This spatial and temporal variability ensures the species richness of these habitats.

The river pumpkin, or wild rhubarb (Gunnera perperna), is generally found in marshy areas and along stream banks.



Top left: Distribution of plant types across the spectrum of freshwater ecosystems. The most widely used plants are perennial herbs and trees.

Bottom left: Plant distribution as per freshwater ecosystem.



Courtesy: Johan Wentzel

Brunsvigia natalensis (Natal candelabra flower) flowering in a wetland near Badplaas, Mpumalanga.

Unfortunately, most of the country's freshwater systems have to endure circumstances far beyond their resilience capabilities. Far-reaching destruction of the country's wetlands has occurred as a result of mining, agriculture and urban developments, while in-stream developments, pollution and riparian damage threaten the country's rivers.

The team discovered and consequently listed 230 medicinal plants occurring in South Africa's freshwater ecosystems. This list includes many of the most important medicinal plants for local communities. The plants were grouped into the following plant types: annual herbs, aquatic (submerged and free floating) plants, ferns, geophytes, grasses, perennial herbs, sedges, shrubs and trees. The perennial herbs were found to be the most utilised plant type followed by trees, geophytes and shrubs.

Apart from their medicinal properties, these plants were found to play an important role in their respective habitats, from acting as bank and soil stabilisers, to helping to improve water quality and retain floods and, to playing a role in species diversity support (for example, as a food source or as nesting material used by animals and birds).

Dr Wentzel and Van Ginkel point out that it is important to link the occurrence of medicinal plants to habitat and role. "If this is understood better, propagation requirements as well as resilience to change in the habitat can be assessed." They also recommend that the ecological role that medicinal plants play within a particular habitat need to be quantified. Since most medicinal plants only occur in small numbers and low concentrations, it is important to understand the ecological

niche that these plants occupy.

Because of the inter-connectedness of the different components of freshwater ecosystems, interference with one component, i.e. the harvesting of medicinal plants, can affect the functioning of the other components, the researchers say. "Proper management is therefore needed to ensure the sustainability of the freshwater system as well as the sustainable use of the medicinal plants."

While some medicinal plants, like perennial herbs, can be propagated within a year or two, growing trees can be difficult, taking up to 15 years. The researchers suggest that in cases where medicinal plants are difficult to propagate, or raw material becomes scarce, alternatives should be investigated.

Unfortunately, the team found that medicinal plants are currently harvested at unsustainable rates in the wild. In fact, some important plant species are already considered extinct outside protected areas. In KwaZulu-Natal, for example, the wild ginger (*Siphonochilus aethiopicus*), the pepper bark tree (*Warburgia salutaris*) and the black stinkwood (*Ocotea bullata*) are no longer found outside reserves and parks.

"The true traditional healer understands ecology and will never overharvest," Dr Wentzel points out. "Unfortunately, many people now harvest plants indiscriminately as a source of income. While, legally many of these plants are protected and may not be removed from the wild, the spatial extent on which this activity is taking place makes it impossible to enforce legislation in this regard."

Since it is understood that the use of medicinal plants make up an important part of African culture, authorities often turn a blind eye to overharvesting. "What is not realised is the extensive damage already caused to wild populations," notes Dr Wentzel.

To ensure long-term sustainable utilisation, wild populations of medicinal plants will have to be

Hillslope seep in the Verlorenvallei Nature Reserve outside Dullstroom, Mpumalanga. This habitat is one of the most diverse concerning the occurrence of medicinal plants.



Courtesy: Johan Wentzel

To order the report, *Distribution, use and ecological roles of the medicinal plants confined to freshwater ecosystems in South Africa (Report No. KV 300/12)*, contact Publications at Tel: (012) 330-0340; Fax: (012) 331-2565; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download a free copy.



Chironia palustris is a perennial herb traditionally used to treat diarrhoea and colic in children.

Courtesy: Johan Wentzel

protected. One way to achieve this is to establish holding nurseries on a regional scale where local traditional health practitioners and plant gatherers can obtain stock that they can propagate themselves. Emphasis should be placed on the training of traditional health practitioners and plant gatherers to enable them to

propagate their own medicinal plants.

The researchers conclude: "It must be accepted that the use of plants for medicinal purposes is ingrained in the fabric of our society. What is needed is the assurance that future generations will still be able to reap the benefits that nature provides." □

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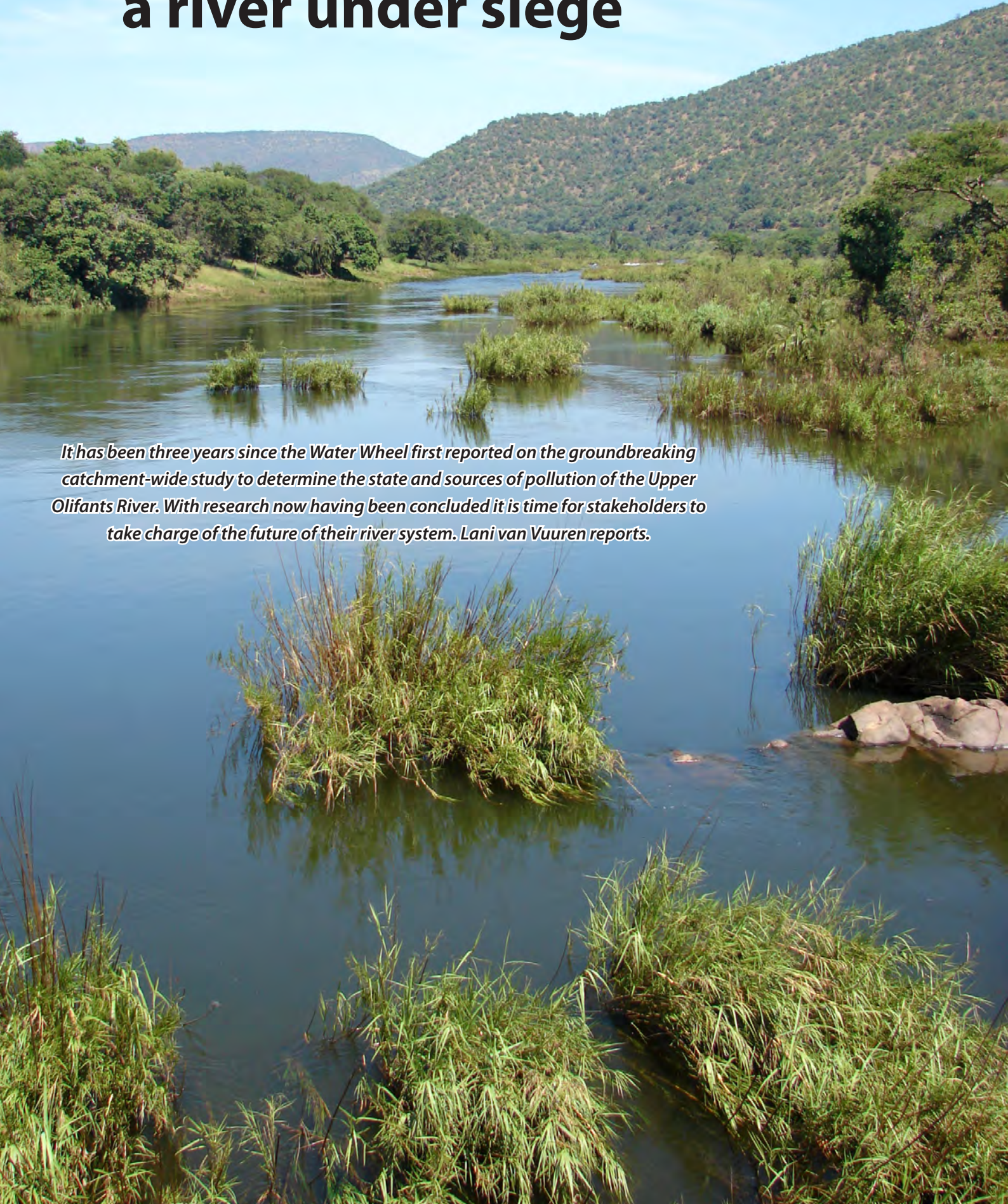
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OLIFANTS

– Time to stand up for a river under siege

It has been three years since the Water Wheel first reported on the groundbreaking catchment-wide study to determine the state and sources of pollution of the Upper Olifants River. With research now having been concluded it is time for stakeholders to take charge of the future of their river system. Lani van Vuuren reports.



Few water research projects have captured the imagination of the South African public as much in the last few years as the Upper Olifants River study. The nation followed the multidisciplinary project closely as it unfolded to provide an accurate status of the health of the Upper Olifants River system, in Mpumalanga.

What followed was a detailed and accurate view of the influence of human activities on a catchment at a level of detail previously unheard of. Using various sampling techniques and research methodologies, researchers pinpointed the exact location of pollution hotspots and their repercussions on river health. Led by CSIR Natural Resources & the Environment (NRE) more than 30 researchers from various disciplines and organisations cooperated on the project.

The status of the Olifants River as one of the hardest-working rivers in South Africa was confirmed through the study, although even the researchers were surprised at the levels of pollution the river system has had to endure. It is now hoped that stakeholders will use the information generated from the research to develop and refine appropriate water quality management responses for the catchment, and institute the necessary remedial measures to reduce pollution loads in the river system.

MAIN OUTCOMES

The study focused on a variety of impacts on the Upper Olifants River system (including nutrients, metals and microbiological). While studies of this nature are expensive, it enabled the formation of a holistic view of processes occurring in the catchment and how they possibly interact with one another. This provided for an improved overview of source and effects of pollutants in the system as well as the prioritisation of mitigation and management options to improve water quality throughout the catchment.

The study underlined an acute need to improve the development and management of human activities in the Upper Olifants River catchment to halt an increasingly serious situation of poor water quality, eutrophication and contamination. Researchers identified three main sources of impacts on the quality of the Upper Olifants River and its tributaries. These are acidic water, metals and sulphates from mining and industrial activity; excessively high nutrient input from poorly operating municipal wastewater treatment works as well as some agricultural activities; and extremely high microbial input from untreated or poorly treated sewage. Some of the adverse effects of these pollutants include widespread eutrophication of the river, toxic water quality in places, and an increase in the potential for bioaccumulation of pollutants, such as metals, in organisms through the food chain.

Researchers have expressed concern about the high level of eutrophication in the river, specifically the main stem of the Upper Olifants. Here dense algal mats (resulting from high phosphate levels) are extensive – highlighting the severity of the nutrient pollution problem. Once-off sampling showed high concentrations of orthophosphate (i.e. inorganic phosphate) downstream of wastewater treatment plants.

Poorly functioning wastewater treatment works, along with informal settlements in the catchment, also contribute to high volumes of microbial pollution and pathogens (including *Vibrio cholera* and *Shigella*) in the Upper Olifants River system. This places people, specifically those in rural, poor areas, who use untreated water from the catchment, at high risk of contracting disease. The risk of faecal pollution also extends to other water users in the catchment, especially producers of export fruit and vegetables that rely on Olifants River water for irrigation.

KEY CONSIDERATIONS IN IMPROVING THE HEALTH STATUS OF THE UPPER OLIFANTS RIVER

- There is no 'quick fix' or 'one-size-fits-all' solution. The problem requires a well planned and effectively implemented long-term approach.
- The issues require a truly collaborative approach between government, water resource managers, business and communities.
- The issue cannot be solved by a single, short-term technical intervention. Solving the problems will require the implementation of a suite of social, economic and technical interventions.

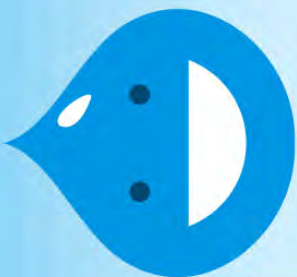
Acid mine drainage (AMD), particularly from abandoned coal-mines, are having a significant impact on the current system and is the most important source of metals to the upper catchment. The Klipspruit, for example, was found to be particularly badly affected, and significantly impacts on the Olifants River downstream of the confluence, resulting in elevated metal concentrations and a decline in the aquatic ecosystem health. The potential for the Olifants and Wilge rivers to dilute this AMD input can

Acid mine drainage, particularly from abandoned coal-mines, is the most important source of metals to the upper catchment.



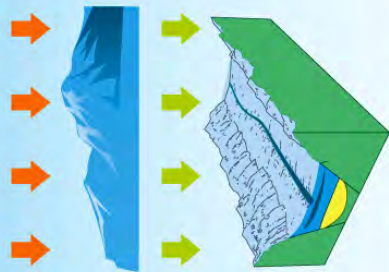
Lani van Vuuren

FRESH WATER FOR ALL



FRESH WATER IS THE COMMON DENOMINATOR OF TODAY'S MOST PRESSING CHALLENGES, LIKE HEALTH, FOOD & ENERGY. BUT IT'S OFTEN POORLY MANAGED & FACES SEVERE PRESSURE. HOW CAN THE WORLD BETTER COOPERATE AROUND THIS VITAL CAUSE?

WHAT IS FRESH WATER?



FRESH WATER ISN'T IN OCEANS OR SEAS. IT'S A GLOBAL COMMON GOOD THAT OCCURS NATURALLY IN ICE SHEETS, ICE CAPS, GLACIERS, BOGS, PONDS, LAKES, RIVERS, UNDERGROUND STREAMS, AQUIFERS.

WHAT IS WATER COOPERATION?

WATER COOPERATION MEANS GETTING EVERYONE TOGETHER - SCIENTISTS, POLICY MAKERS, GOVERNMENTS, WATER MGMT SPECIALISTS, CIVIL SOCIETY - TO ENSURE THAT FRESH WATER BEST SERVES EVERYONE'S NEEDS



WAYS TO COOPERATE



BUILD A WATER PUMP IN A RURAL VILLAGE



MANAGE AQUIFERS ACROSS COUNTRIES



EXCHANGE SCIENTIFIC DATA



WHY COOPERATE FOR FRESH WATER?

THERE'S ONLY A FIXED AMOUNT OF FRESH WATER



WATER IS NOT CONFINED TO POLITICAL BORDERS

276

OF THE WORLD'S RIVER BASINS CROSS AN INT'L BORDER

FRESH WATER IS A HUMAN RIGHT

2 BILLION

PEOPLE DEPEND ON GROUNDWATER TABLES, INCLUDING 273 TRANSBOUNDARY AQUIFER SYSTEMS

60%

OF FRESHWATER AVAILABLE IN THE ARAB REGION ORIGINATES FROM



EGYPT & ALMOST ALL COUNTRIES IN SUB-SAHARAN



~80%

OF RENEWABLE WATER RESOURCES IN THE ASIA-PACIFIC, HOME TO 2/3 OF THE WORLD'S HUMANS, IS CONSUMED BY

and partners in celebration of World
ational/awareness purposes only.

ORIGINATES FROM ANOTHER REGION

AFRICA SHARE A TRANSBOUNDARY BASIN



ORIGINATES FROM ANOTHER REGION

TODAY



~3.5 MIL

DEATHS RELATED TO INADEQUATE WATER SUPPLY, SANITATION & HYGIENE



3-5 MIL

CHOLERA CASES

UNEQUAL ACCESS TO IMPROVED DRINKING WATER SOURCES GLOBALLY



94% VS

FOR URBAN AREAS



76%

FOR RURAL AREAS



71%

OF WATER COLLECTION BURDEN FALLS ON WOMEN & GIRLS, IN SUB-SAHARAN AFRICA



6%

MINISTERIAL POSITIONS IN THE FIELD OF ENVIRONMENT & NATURAL RESOURCES ARE HELD BY WOMEN

2050

7 BIL > 9 BIL



WORLD POPULATION WILL INCREASE

+20%

GLOBAL AGRICULTURAL WATER CONSUMPTION



+ 60%

HYDROELECTRICITY & OTHER RENEWABLE ENERGY NEEDS

MORE COOPERATION IS NEEDED



450

AGREEMENTS TO SUPPORT COOPERATION AROUND INT'L WATERS SIGNED BETWEEN 1820 & 2007



90+

INT'L AGREEMENTS DRAFTED CONCERNING WATER TO IMPROVE MANAGEMENT OF DOWNSTREAM BASINS IN AFRICA

BUT

60%

OF THE PLANET'S 276 INT'L RIVER BASINS HAVE NO COOPERATIVE MANAGEMENT SCHEME

SUCCESS STORIES

THE GUARANI AQUIFER

ARGENTINA, BRAZIL, PARAGUAY & URUGUAY ALL SHARE THIS AQUIFER. IN AUGUST 2010, THEY FORMALLY AGREED TO ENSURE ITS EQUITABLE USE & CONSERVATION.



THE NILE BASIN

EXPERTS, PUBLIC-PRIVATE SECTORS & SOCIOLOGISTS JOINED TOGETHER TO EXPLORE ALTERNATIVE DEVELOPMENT SCENARIOS & BENEFIT-SHARING SCHEMES.



LET'S MAKE FRESH WATER AN INSTRUMENT FOR PEACE



Poorly functioning wastewater treatment works are one of the main contributors of pollution in the Upper Olifants River.



Lant van Vuuren

be significantly reduced during prolonged dry periods or winter seasons, when the flow originating from the Klipspruit can exceed that originating from the Olifants and Wilge rivers.

Other affected tributaries include the Blesbok Spruit, Kromdraai Spruit and Saalklap Spruit. Water treatment options designed to neutralise AMD and remove metals are essential to improving water quality in these catchments, the CSIR project team found.

While operational mines do not appear to contribute as much to metal concentrations in the river at present

when compared to abandoned operations, it will become important to establish proper closure plans to avoid increased levels of AMD pollution once end-of-life is reached.

All of this pollution eventually lands up in the Loskop Dam, which acts as a sink for upstream pollutants. The dam is showing strong signs of becoming hypertrophic (the highest level of eutrophication) and has been experiencing occasional blooms of toxic blue-green algae.

The change in water quality and trophic status has had a marked effect on wildlife in the dam. A study

of the Mozambique tilapia in Loskop Dam found that the fish survived on a diet dominated by species of blue-green algae (*Microcystis*) and a dinoflagellate (*Ceratium*), which showed elevated levels of certain metals (aluminium, iron and manganese).

The few studies that have investigated dietary exposure to elevated levels of these metals have reported an increase in lipid peroxidation, a symptom of pancreatitis. The link between these two factors has not been confirmed, but warrants further research. Pancreatitis is a disease usually associated with high dietary intake of polyunsaturated or rancid fat, and the hardening of fat reserves as a result of anti-oxidant depletion. The disease is thought to be responsible for the drastic reduction in the crocodile population at Loskop Dam to just five individuals at last count.

INVOLVING ALL PARTIES

One of the greatest challenges in translating any research into action is overcoming the traditional gap that exists between science and practice. Engagement between scientists and stakeholders

The Upper Olifants River catchment supports various industries, whose effluent have a marked impact on water quality in the river.



Lant van Vuuren

becomes extremely important in this case. Since the Upper Olifants River research project was commissioned by water users themselves, acting through the Olifants River Forum, stakeholder participation has been an important element of the project from the start, reports research project leader Dr Paul Oberholster of CSIR NRE.

“Interaction with stakeholders has been a major part of the research project, and our findings have been shared on a number of fora and through various media. Our goal has always been to translate the scientific knowledge gained from the project into practice, which is why we opted for a transdisciplinary approach to the research question from the beginning.” In addition to a number of technical reports, a summary report is planned that will present key findings and recommendations from the research project in an easy-to-digest format.

CSIR NRE Senior Researcher, Dr James Dabrowski, adds that reaction to the research project has been extremely positive overall. “The majority of stakeholders are aware of the fact that the Upper Olifants River catchment is in a poor condition – the study has provided a greater understanding of the variety of pollutants affecting the catchment.”

Information sharing has never been about ‘naming and shaming’ polluters, but rather about encouraging cooperation and collaboration towards improving the status quo. For this reason stakeholders have generally been very cooperative in terms of sharing information and allowing access to property in order to perform sampling, Dr Dabrowski reports. It is expected that this interaction will continue even now that the project has been completed.

The research has shown that in some cases simple innovations can be enough to make a real difference – one of the innovations to come out of the project is a user-friendly Fish Kill website where members of the public can report fish kill events in

the Upper Olifants River catchment.

Another important innovation from the study relates to the use of the SWAT model to determine phosphorus loads at catchment level. “The study has demonstrated that the successful restoration and management of eutrophication in South African rivers requires knowledge of the phosphorus sensitivity of the system and how it will respond to increases or decreases in phosphorus loads,” explains Dr Oberholster. “Phosphorus sensitivity of rivers is determined by employing physical, chemical and biological processes which influence the transport, transformation and retention of nutrients during downstream transport.”

The project team has therefore developed phosphorus indices to act as decision support for assessing river phosphorus sensitivity classification to aid conservation planners and water managers in achieving the ultimate goal to manage and restore phosphorus impacted catchments by reducing high levels of phosphorus loads. It is believed that these indices can be used in other catchments to prioritise point- and non-point sources of nutrient pollution.

Other innovations to emanate from the project include the Safe

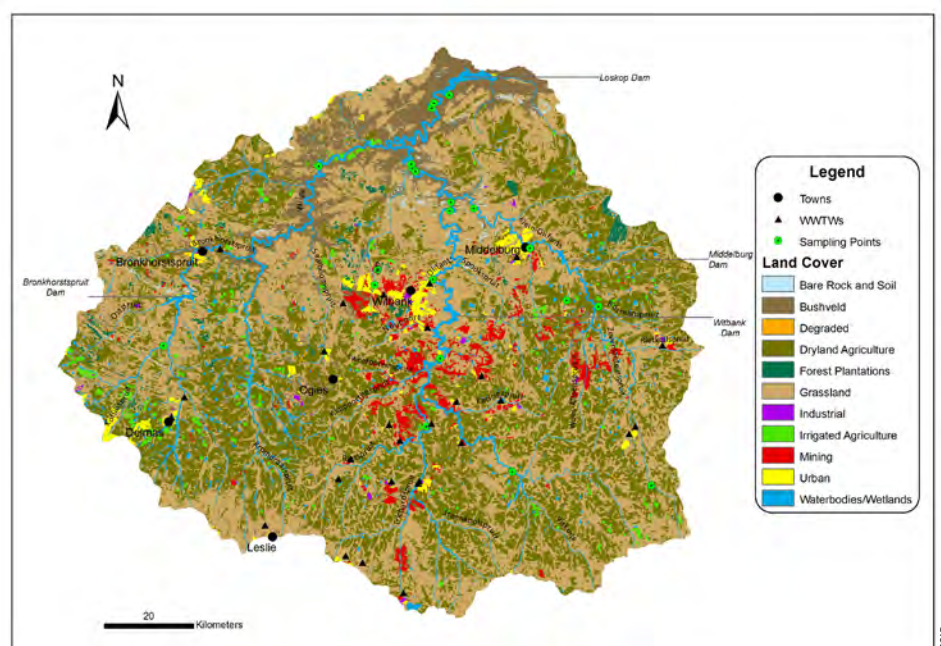


Lani van Vuuren

Waters Earth Observation System which uses remote sensing to track toxic cyanobacterial blooms in the main dams to assist water withdrawal; the development of a DNA toolbox to determine anthropogenic impacts on sub-cellular level and to investigate mitigations in aquatic specimens over time; and a Wetlands Risk

Above: Industrial pollution has wiped out aquatic biodiversity in some stretches of the Upper Olifants River system.

Below: The study area showing main sampling points.



CSIR

AFRICA'S FIRST FISH KILL WEBSITE LAUNCHED

“While there is no quick fix for pollution it is hoped that the momentum built through the Upper Olifants River study will drive its water users forward in bettering caring for their catchment together.”

Africa's first website where members of the public can report fish kills is now up and running for the Upper Olifants River catchment.

The website is the initiative of University of Pretoria Veterinary Science PhD Candidate, Jackie Dabrowski, and was established in an effort to improve regional responses to fish kills as a way of addressing water quality issues within the Upper Olifants River catchment. “While conducting research into fish health at Loskop Dam I struggled to put together details of the events surrounding historic fish kills at Loskop Dam,” Dabrowski tells *the Water Wheel*. “Data and contacts were difficult to obtain and were scattered between institutions. I was also approached by several people with anecdotal evidence of fish kills, however, frequently too late after the event to mount any effective investigation. The fish kill website seemed to be a logical solution to these issues.”

A ‘fish kill’ is defined as the death of a number of fish (usually greater

than 25) along a 1 km stretch of river or a square kilometre in a dam over a 48-hour period due to unnatural conditions. Fish act as excellent indicators of water pollution as they are easily seen and are sensitive to changes in water quality. Fish kills can highlight problem areas where management is required to improve water quality. However, if not reported timely to authorities this can result in delayed scientific investigation and thus a loss of valuable information for efficient research, governance and management.

The fish kill website allows users to report both new and historic fish kills while providing useful information on the occurrence and causes of this phenomenon. “Both current and historic records are significant,” explains Dabrowski. “Repeated fish kills at a certain location can help authorities prioritise areas that require urgent management interventions.”

The website offers several benefits, especially since all reported fish kills are available for public view. Members of the public are now empowered since they have a platform upon which they can act when

encountering a fish kill. It is expected that repeated reports of fish kills requiring investigation will result in pressure being applied to reduce the impact of land uses causing the problem. Archived records provide the public, non-government organisations, researchers and management bodies with evidence of water quality impacts that may be related back to certain land uses.

“The professional and timeous investigation of fish kills provides evidence that may be used in litigation, if necessary,” adds Dabrowski. “This will hopefully encourage more accountability of various stakeholders in the catchment to act responsibly in terms of their impact on water quality.”

Within the first month of operation the website had already proven that fish kills are a factor in the Upper Olifants River catchment, with reports of fish and ducks dying at Witbank Dam, a fish kill at Loskop Dam and a second fish kill at a pan near Middelburg being reported. All of these events were investigated by the Department of Water Affairs and researchers from the CSIR within 24 hours of receiving the report, a sign of the site's current effectiveness.

The website has spurred numerous requests for similar websites to be set up in other catchments across the country. The Upper Olifants website will provide an interesting test case into the system. To view the website and report fish kills Visit: <http://www.orf.co.za/FKHome.html>



Assessment Index to determine the environmental condition of wetlands. The latter has already been applied by Eskom to monitor wetlands potentially impacted by its operations.

Arguably of greatest value is the fact that the study has generated awareness of water quality in the catchment. “Through this process, people and organisations have

begun talking with one another and relationships are being built. This cooperation is essential with respect to improving land management and other processes that impact on water quality,” Dr Dabrowski points out.

Positive actions have already resulted from these relationships. Coaltech, in collaboration with CSIR and Working for Wetlands, are

restoring some of the wetlands in the catchment that have been impacted by AMD. In another initiative, some farmers have moved away from fertilisers to more environmentally-friendly alternatives to reduce phosphates entering the system. Significant also is the fact that the Brugspruit Water Pollution Control Works, originally established in 1997

to protect Loskop Dam from the effects of AMD, has been refurbished and Rand Water has been appointed by the Department of Water Affairs (DWA) to operate and maintain the AMD neutralisation plant.

DWA's Strategic Technical Task Team for Water Quality Management has also established the Save the Olifants Coordinating Committee – an internal departmental initiative aimed at addressing water quality issues in the Olifants River catchment in a coordinated manner. The committee constitutes various directorates that have line functions in water quality management and planning, including (but not limited to) water quality planning, water services regulation, national water resources planning, resource quality services, resource protection and waste, and compliance monitoring and enforcement, among others.

Committee Chair, Pieter Viljoen, points out that the Save the Olifants Coordinating Committee is not a substitute for water quality management sections in DWA nor is it taking over the mandate or the functions of the relevant sections. "The committee's main purpose is to act as a vehicle to ensure better water quality management by enhancing cooperation between DWA internal stakeholders and improving cooperation and communication with external stakeholders."

The committee has already resulted in a number of water resource management improvements in the Olifants River catchment, despite current human resource challenges. This includes improved cooperative water resource management between various DWA water quality management sections, improved communication to external stakeholders and quicker response times to water quality incidents as well as a greater awareness among water quality managers of incidents in their area of jurisdiction.

Despite the onslaught on the system, the Upper Olifants River – like its namesake – has shown to



CSIR

be remarkably resilient to pollution. With time and dedicated effort researchers are positive that the condition of the river will improve.

VALUE TO OTHER CATCHMENTS

There is no doubt among the researchers that this type of study could – and should – be replicated in South Africa's other catchments. According to Dr Oberholster, it is also important to take the lessons learnt from the Upper Olifants River study, for example, related to AMD, and apply them to catchments where future mining is planned, such as the Waterberg. "A hundred

years ago when mining started in the Olifants River catchment there were no best management practices in place. Lessons from this study can be used to develop such practices in the mining industry to ensure we protect our ecosystem services in the Waterberg where the next 200 to 500 coal deposits lie."

While there is no quick fix for pollution it is hoped that the momentum built through the Upper Olifants River study will drive its water users forward in bettering caring for their catchment together. It is only through strong leadership and collaboration that we will ensure we do not drive one of South Africa's hardest working rivers into retirement. □

Stakeholders of the Upper Olifants River catchment gathered at an information sharing event in February to discuss research outputs and possible solutions to pollution in the Upper Olifants River.



Lani van Vuuren

Lake Loskop, which acts as a sink for pollutants from the Upper Olifants River, is in danger of becoming eutrophic should external nutrient inputs not be drastically reduced.

Report unearths rich history of SA FRESHWATER SCIENCE



Courtesy FRU

A momentous report on the history and status of the freshwater science in South Africa has not only recorded this sector's remarkable journey over the last 100 years, but revealed serious threats to the science's endurance and continued impact towards the sustainable development and management of the country's water resources. Report compiled by Lani van Vuuren.

The effective management of South Africa's water resources requires an informed and reliable scientific foundation to provide appropriate evidence-based information to guide decision-making. Aquatic sciences, together with engineering, provide this foundation and help to ensure that the country's water resources are managed sustainably.

South Africa has a proud history of research in aquatic sciences that can be traced back to the start of the twentieth century. A recently completed study, funded by the Water Research Commission (WRC), set out to record the evolution of aquatic sciences in South Africa since 1900,

identify the external driving forces that helped to direct research, pinpoint the individuals and institutions responsible for shaping the ways in which aquatic sciences developed, and determine the extent to which aquatic sciences have contributed to effective management of South Africa's water resources.

The result is a first-of-its-kind report for South Africa. The report, *The freshwater science landscape in South Africa, 1900-2010*, provides a broad overview of the evolution of South African aquatic science from its early years up to the present day, focusing specifically on inland surface waters. The study was led by Drs Peter Ashton of the CSIR and

Dirk Roux of South African National Parks, with inputs from a host of the country's top aquatic scientists.

The report illustrates how in the early 1900s, the primary focus of aquatic science was directed at taxonomic work as investigators sought to identify and classify the variety of new organisms they encountered. From that time South African aquatic science slowly developed to its present form where the hydrological and biophysical characteristics of inland waters have to be integrated with the social, economic and political issues related to the uses that are made of the country's scarce water resources.

THE EARLY YEARS (1900 – 1945)

Only a handful of aquatic researchers (mostly trained overseas) practiced their trade in South Africa during the early years. These men and women were all pioneers and innovators, finding the ways and means to conduct their research with very little support in terms of instrumentation, facilities and finances. The one resource that these scientists had was time, as well as almost complete freedom to carry out research on topics of their own choice.

MIDDLE YEARS (1946 – 1979)

The middle years brought organisational structure to the science enterprise in South Africa, with the newly established Council for Scientific and Industrial Research (CSIR) playing a pivotal role in this regard. Related developments include the establishment of the Limnological Society of Southern Africa (1963), Institute for Freshwater Studies (1964), JLB Smith Institute of Ichthyology (1968), WRC (1971) and the Department of Water Affairs Hydrological Research Institute (1972).

Important research programmes were started during this era, notably

the National Programme for Environmental Sciences in 1972 and the Cooperative Scientific Programmes (CSPs) in 1975. The Water Act (1956) and the publication of the very influential report by the Commission of Enquiry into Water Matters (1970) provided national direction.

A growing appreciation for the inherent connectedness of biophysical systems and acceptance of the concept of ecosystems spawned a global initiative, the International Biological Programme, to coordinate large-scale ecological and environmental studies. South Africa responded to this international movement by establishing the National Programme for Environmental Sciences (NPES). This was a very significant event in the chronology of aquatic science because it provided, for the first time, a national vision that was to become a rallying point around which researchers could build learning relationships.

This era of the national programmes was characterised by collaboration across the country while individual researchers and groups were encouraged to become internationally competitive. The administrators gave considerable attention and support to profiling the researchers and research conducted under the banner of the NPES. This grew the confidence of scientists.

The period of the Cooperative Scientific Programmes (CSPs), which followed up the NPES, also stands out as a period of relatively high cohesion among aquatic scientists in the country. The depth and breadth of scientific research that resulted from these programmes is unequalled up to this day.

A number of field stations were established around the country, which provided excellent facilities for academic supervisors to take students into the field and expose them to the realities of specific aquatic systems. These practical extensions of the lecture hall made a significant difference in the training and enthusiasm of students and often provided the fuel for passion and getting students 'hooked' on a career in science.

TURBULENT TRANSITIONAL YEARS (1980 – 1994)

External pressures, such as the drive to commercialise research and a certain degree of international isolation, together with the internal demise of the CSPs, had a profound effect on the course of aquatic science in South Africa after 1980. In a sense, the 1980s spelled the end of what many consider to have been the 'golden era' of aquatic research in South Africa, and it would take some



Courtesy FRU

Students at the University of Cape Town's Freshwater Research Unit undertaking a river sampling exercise. Nowadays site work has become a luxury rather than a necessary in aquatic science research.

EXCEPTIONAL INDIVIDUALS OF THE PAST

Mary Agard Pocock (1886-1977)



Mary combined her unusual talents in art and science in the study of botany. Educated in England, she had an adventurous spirit, joining ethnologist, Dorothea Bleek, in 1925 for a six-month journey on foot from Livingstone in northern Rhodesia (now Zambia) through the Barotse floodplains of the upper Zambezi, and then through Angola to Luanda. Pocock is best known for her pioneering research on the Volvocales. Her 'outstanding work on algae' was recognised in 1957 when she received the Crisp Medal and Award from the Linnaean Society of London and later in 1967, when Rhodes University conferred on her an honorary Doctorate in Science.

Keppel Harcourt Barnard (1887-1964)



Keppel was born and schooled in London. He joined the South African Museum in Cape Town as an assistant in 1911, working his way up to become Director in 1946. Keppel was a taxonomic 'polymath', publishing over 200 papers on the taxonomy of various freshwater species. He mounted several collecting expeditions to remote places, including the coast of Portuguese East Africa (now Mozambique) and the Kunene River in northern Zambia, some of them by oxwagon. Keppel is described as one of the last breed of biologists who had both the breadth and depth of knowledge to make him conversant with almost all animal taxa.

George Evelyn Hutchinson (1903-1991)

George was born and educated in England. In 1925 he was hired on a three-year contract as a



temporary lecturer at the University of the Witwatersrand. After a year of teaching he worked on pans in the eastern portion of the Highveld and elsewhere, publishing the first significant paper on South African limnology in 1932. He later left South Africa to join Yale University as a postdoctoral fellow where he taught for 43 years. He is widely regarded as one of the founding fathers of aquatic ecology.

Eduard Meine van Zinderen Bakker (1907-2002)



Born and educated in the Netherlands, Eduard emigrated to South Africa in 1947 where he joined the Department of Botany at the University of the Free State. He initiated limnological research on the Orange River system and, in 1965, on the sub-Antarctic islands of Marion and Prince Edward. Some months before he died, he expressed his philosophy as follows: "The most valuable legacy we can leave to our fellow humans, young and old, is the overwhelming awareness that we are surrounded by countless wonders that do not ask for pseudo-explanations, but can only be answered in a manner that befits the marvels of nature, namely with reverence and with a huge question mark."

John Hemsworth Osborne Day (1909-1989)



John was born in England, but was brought up in Mozambique and later South Africa. Following studies in South Africa he completed his PhD through Liverpool University. In the mid-1930s, John was employed at the University of Cape Town (UCT), first as research assistant

and later as a lecturer. Almost single-handed, John surveyed the invertebrate fauna of the rocky shores of southern Africa from Lüderitz to northern KwaZulu-Natal. When World War II broke out in 1939, John returned to the UK to join the Royal Air Force where he lost his leg. Returning to UCT after the war, he developed the first estuarine research programme in southern Africa. John believed that good fundamental data are essential for understanding the functioning of aquatic ecosystems, and his surveys of the rocky shores, inshore waters and estuaries of South Africa are still models of good practice equalled in very few parts of the world.

Katherine Marjorie Frances Scott (1913-1998)



Marjorie obtained her PhD at the University of Cape Town (UCT) in 1939. After living for some years in Argentina, she returned to South Africa at the start of World War II, to the Department of Zoology at UCT, during which time her research switched to estuaries. She later moved to the National Institute of Water Research (NIWR) of the CSIR where she worked until her retirement in 1978. Here she turned her attention to freshwater biology. Marjorie found herself increasingly drawn to taxonomic studies, firstly of adult chironomids and caddis flies, which gradually became her main interest. Marjorie was a brilliant scientific illustrator, and she left a legacy of drawings that are scientifically accurate and aesthetically pleasing. She continued her work on caddis flies on a voluntary basis after she retired right up to her death at the age of 85.

Arthur Desmond Harrison (1921-2007)

Arthur was born in Kalk Bay near Cape Town. He obtained his PhD from UCT. His work on the



Arthur's aquatic ecology of the Great Berg River, published in the *Transactions of the Royal Society of South Africa*, was the earliest on South African rivers and represented some of the earliest significant publications on the ecology of rivers anywhere. Arthur joined the NIWR, and later took up a Rockefeller Grant for bilharzia research at the University of Rhodesia in Salisbury. Later he returned to South Africa, briefly becoming Professor of Zoology at the University of Natal before accepting a professorship in Biology at the University of Waterloo in Canada. During all these years he had a particular interest in non-biting midges, publishing many papers, especially on the South African fauna.

Arthur was an immensely knowledgeable, insightful and productive scientist and a charming person. He was a limnological pioneer in Africa when the field was in its infancy.

Prof Brian Allanson (1928 –)

Brian, to whom the WRC report is dedicated, was born in Sri Lanka. He moved with his family to Port Elizabeth as a young boy, and attended Grey High School, in Port Elizabeth. After qualifying in Zoology and Chemistry at the University of Natal in 1948, Brian accepted a post at Hilton College as assistant science master. He then went to UCT to obtain his MSc in Marine Biology in 1954. He joined the UCT Zoology Department in 1955. In 1963, Brian was appointed Professor and Head of the Department of Zoology and Entomology at Rhodes University, the youngest Professor ever to have been appointed there. Two years later he became the first Director of the university's Institute for

Freshwater Studies. This group has played a seminal role in the investigation of the physics, chemistry and biology of coastal lakes and estuaries, notably Lake Sibaya and the Kosi lake system in KwaZulu-Natal and the coastal lakes of the Southern Cape. Brian retired from the Chair of Zoology at Rhodes in 1988. He served as Dean of the Faculty of Science for some years, as Chair of the Research Committee, and as the first Dean of Research. Following retirement, Brian with his wife moved to Knysna, where he established a small practice as a consulting aquatic ecologist, which he continues to this day. In 1995, Brian initiated the Knysna Basin Project, a research programme to assess the environmental condition of the Knysna estuary.



time for a new order to emerge.

The transitional period is characterised by a number of post-CSP trends, including reduced fieldwork which is now seen as a 'nice to have'. Due to the high cost of fieldwork this trend has persisted and nowadays studies are commonly designed to require less fieldwork and focus more on desktop work.

During the period when the CSPs operated, there was a national vision for science; now it seemed that every organisation had to have its own vision and the vision for aquatic science as a whole seemed to have dimmed close to the point of extinction. With the commercialisation of science, human resources performance evaluation tools started to encourage research administrators to measure themselves less against the advancement of science and more against financial targets and organisational or short-term political objectives.

Lastly, it appears that support for careful, time-consuming PhD-type research diminished after the CSP

years, with contract research rising as an alternative. Many scientists became consultants to put bread on the table and to remain in the sector.

A positive memory of this period was the strong sense of cohesion among aquatic scientists across organisational boundaries as well as a synergistic relationship between aquatic scientists and a highly competent and motivated group of water resource managers (mostly engineers) from the Department of Water Affairs (DWA).

A second positive note was the important role that the WRC started, and continues, to play in facilitating knowledge production, sharing and management in the water sector. "The Commission was the life raft to aquatic sciences following the demise of the CSPs, and it has continued to be a lifeline to research in the aquatic field, not only by contributing the necessary funds for research but creating cohesion in the sector through its research review and reporting processes," notes Dr Roux.

THE LATTER YEARS AND CURRENT STATUS (1995-2010)

In the years after South Africa's first democratic elections comprehensive revision of the country's water legislation dominated the aquatic science scene, culminating in the National Water Act of 1998. Pervasive restructuring and name changes characterise the institutional landscape during this era.

From the middle-1990s, the River Health Programme enabled the collection of data that show, through State-of-River reports, the relatively poor state and ecological integrity of many South African river systems. This undesirable state of affairs was confirmed when South Africa's first National Spatial Biodiversity Assessment, conducted in 2004, found that the country's river systems are more threatened than terrestrial or marine ecosystems.

Science now found itself operating within a much more rigid set of



SASAgS

QUO VADIS SOUTH AFRICAN AQUATIC SCIENCE?

The report concludes with a synopsis of the current status of aquatic science in South Africa and makes a number of recommendations to strengthen the sector and its impact going forward. These recommendations range from needs in the basic education system and the job market, to the essence of functional monitoring programmes and a national vision to guide the development and deployment of aquatic science in South Africa.

There lies an exciting and challenging time ahead for South Africa's aquatic scientists as the country continues to grapple with a myriad of water challenges. Aquatic scientists will increasingly be called upon to address societal needs related to their fields of expertise and they must be ready to contribute in this regard, the report points out. "Aquatic scientists will be required to move beyond the 'traditional' simple production of a set of results, and instead make sure that their results can be turned into solutions that will help to solve a particular problem experienced by society."

To order the report, *The freshwater science landscape in South Africa, 1900-2010. Overview of research topics, key individuals, institutional change and operating culture (WRC Report*

No. TT 530/12)

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Delegates at the 1980 conference of the Limnological Society of Southern Africa.

hierarchical structures and bureaucratic management approaches. With these changes emerged more administrative responsibilities and a need to account at an ever-shrinking timeframe (e.g. more regular progress reports).

According to Dr Roux, the project team was concerned to see how tied up people have become with existing commitments and responsibilities, especially senior aquatic scientists who now hold managerial positions. "While we found aquatic scientists in general more than keen to share their memories and experiences for this report, many could simply not find the time to do so. In such a crowded work life, the question must be asked around how much space is left for reflection, creativity and originality?"

Also, despite a relatively large

number of trained aquatic scientists, few find employment that offer true research opportunities. Simply put, the South African aquatic science sector is in danger of becoming out of breath.

The importance of institutional stability in order to build that 'bank' of knowledge to deal with water challenges was another important factor revealed by the study. This principle applies to research centres and government departments alike. Several units and directorates that used to be rich breeding grounds for aquatic science no longer exist or seem to have lost the ability to fulfil this function. Eroded institutional memory caused by the loss of experienced staff has weakened the national capacity to use all the information that has been so proudly produced, the WRC report points out.



A working group committee gathering at the Sabie River during the height of the Kruger National Park Rivers Research Programme in the 1990s. The multi-year, multi-disciplinary research programme did much to bring aquatic scientists and stakeholders together.

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Guidelines set to train new generation of extension officers

A newly-published set of training guides on irrigation water management from the Water Research Commission (WRC) aimed at extension officers is set to vastly improve the knowledge base of this imperative link in the agricultural sector.

Article compiled by Lani van Vuuren.



All types of irrigation farmers, whether they operate on a small or large commercial scale, require advice from time to time to remain profitable and improve the sustainability of their operations. For many of these farmers, but especially smallholder farmers, the source of that advice is the agricultural extension officer.

The advancement and expansion of South Africa's agricultural base – particularly small-scale agriculture – remains an important objective of national government. It is an aim that requires improving and extending skills development and training in the agricultural sector, including entrepreneurship training. This should include the training of a new corps of extension officers that will respond effectively to the needs of smallholder farmers and contribute to their successful integration into the food value chain.

LACK OF TRAINING = LACK OF CONFIDENCE

Successful irrigation farming requires much more than just the right irrigation equipment. The science of irrigation management is complex and comprehensive, and therefore the irrigation extension officer requires comprehensive technical knowledge and skills in irrigation management as well as appropriate knowledge and understanding regarding human behaviour in order to serve his farming community effectively.

There are around 390 extension officers currently serving small-scale and commercial irrigation farmers. The extension services offered vary from advisory services for sustainable income generation; providing and facilitating access to agricultural information for improved planning and decision-making; facilitating access to technology and, where possible, providing these technologies; providing and facilitating access to advice on sustainable agricultural production as well as on skills

development; and strengthening institutional arrangements.

Unfortunately, WRC-funded research has found that the extension link has deteriorated in recent years, and that, generally, the current level of training presented by organisations to extension workers for the tasks that they have to perform on irrigation schemes is inappropriate in many cases. "We found that there was no systematic, practical, in-service training provided to extension officers working on irrigation schemes," reports WRC Executive Manager: Water Utilisation in Agriculture, Dr Gerhard Backeberg.

The better the extension service, the better the smallholder irrigation operation. Unfortunately, the opposite is also true. "Smallholder farmers rely first and foremost on extension officers as a source of information, guidance and advice. With extension services lacking or collapsing, this essential support services cannot be provided. In turn, this obviously contributes to less productive smallholder farming, which is in most cases performing below potential."

Information is presently available on various biophysical and socio-economic aspects of irrigation management, and various irrigation courses are offered at universities of technology and agricultural colleges. However, there is a general feeling among extension officers involved in irrigation that this information is not presented in the required format and that the courses do not prepare them adequately for the tasks they have to perform on irrigation schemes.

Essentially, this means that extension officers are generally not equipped with the necessary knowledge base and skills to perform their critical role in the agricultural sector. For many extension officers this results in a lack of confidence, a decline in their credibility and a withdrawal from the communities they are meant to serve. An urgent need was therefore identified to

"Knowledge about these issues will provide the necessary confidence for extension officers to respond to enquiries by farmers and to correctly refer questions for more detailed answers to subject matter specialists."

GUIDELINES IN THIS SERIES

- *Training material for extension advisors in irrigation water management Volume 1 (Main Report) (WRC Report No. TT 539/12)*
- *Training material for extension advisors in irrigation water management Volume 2 (Technical learner guides):*
 - *Part 1: Soil-plant-atmosphere continuum (WRC Report No. TT 540/1/12)*
 - *Part 2: Assessing of soil resources (Report No. TT 540/2/12)*
 - *Part 3: Agro-climatology (Report No. TT 540/3/12)*
 - *Part 4: Irrigation water management (Report No. TT 540/4/12)*
 - *Part 5: Irrigation engineering (Report No. TT 540/5/12)*
 - *Part 6: Irrigation legislative context (Report No. TT 540/6/12)*
 - *Part 7: Irrigation economics (Report No. TT 540/7/12)*
 - *Part 8: Irrigation crop and fodder production (Report No. TT 540/8/12)*
- *Training material for extension advisors in irrigation water management Volume 3 (Extension learner guide) (Report No. TT 541/12)*

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All farmers, whether operating on a large or small scale, require irrigation advice from time to time in order to maintain sustainable and profitable operations.

restore the self-esteem of these individuals and to improve the service delivery of the extension profession.

TURNING THE TIDE

A first step in rectifying the situation was to define a 'knowledge profile' for the training of extension officers, in other words, to identify the essential, basic knowledge they would require to advise effectively on irrigation water management, Dr Backeberg explains. The WRC therefore initiated a research project to design and test the required learning modules for training of extension officers in mainly the provincial departmental service.

In a project led by the University of Pretoria (UP), learning material was consequently developed for the eight learning areas identified to form the 'knowledge profile' of the extension officer. "This training material covers the main elements which directly or indirectly inform irrigation water management.

Knowledge about these issues will provide the necessary confidence for extension officers to respond to enquiries by farmers and to correctly refer questions for more detailed answers to subject matter specialists," explains Dr Backeberg.

The aim of the learning material is to support tertiary training organisations, such as agricultural colleges and universities of technology, offering agricultural programmes on a NQF Level 5, as well as to support training providers offering short courses in irrigation management. The project has been co-funded by the Department of Agriculture, Forestry & Fisheries.

This set of guidelines is the fourth in a series of research reports compiled by the WRC in partnership with UP on extension in irrigation water management in recent years. "It further demonstrates the productive research output by following a thematic and programmatic approach to investment in research by the WRC," Dr Backeberg points out.

The latest educational offering, consisting of nine parts, is set to help build the necessary skills and competencies required of extension officers to assist irrigation farmers in the learning process they need to undergo regarding irrigation water management. A total of 93 learning modules have been included in the material, which have been divided into technical- and extension-related modules.

The learning package covers the entire spectrum of irrigation water management, starting with a brief overview of the soil-plant-atmosphere continuum, then moving on to agri-climatology, irrigation water management, to irrigation engineering, the irrigation legislative context and irrigation economics. The package also covers irrigation crop and fodder production and general skills required for productive agricultural extension.

According to Dr Backeberg, this research output fills a major knowledge gap by making comprehensive training modules available for in-service training of extension officers. "It is a timely contribution to the priority identified in the Vision for 2030 of the National Development Plan, namely to train a new corps of extension officers for practical support to smallholder farmers."

A focused drive is planned between July 2013 and June 2014 for knowledge dissemination, in which agricultural colleges, FET colleges and AgriSETA accredited and registered training providers will be targeted. This will not only raise awareness of the existence of the new guides, but also encourage the application of the training modules for practical training of extension officers on all smallholder irrigation schemes in South Africa.

Armed with the necessary knowledge and skills a new generation of extension officers will be ready to play their critical part in developing sustainable irrigation agriculture in South Africa. ■

TOPICS COVERED BY THE EXTENSION TRAINING GUIDES ON IRRIGATION WATER MANAGEMENT

- **Soil-plant-atmosphere-continuum:** The soil-plant-atmosphere relationship recognises that all components of the irrigation field should be taken collectively into account when decisions are made regarding irrigation water management. This section serves as an introduction to concepts such as dynamic field balance of water and energy that is required for the flow of water and helps the learner understand the whole picture.
- **Assessing of soil resources:** The objective of this technical guide in soil science is to provide learners with a comprehensive understanding of the soil factors required for land suitability evaluation and land use planning for irrigated agriculture. Specific attention is given to soil requirements (ideal conditions) and tolerances of crops grown under irrigation.
- **Agro-climatology:** This learning material consists of ten modules. The aim is to provide learners with a general overview of the agro-climatic factors that need to be taken into consideration for effective irrigation management. This will enable them to communicate effectively with subject matter specialists and farmers in this regard.
- **Irrigation water management:** The aim of this learning material is to acquaint learners with a comprehensive understanding of irrigation water management principles, introduce them to various irrigation systems that can be selected, an understanding of the layout and operation of an irrigation system and how to set benchmarks for efficient irrigation water management on the farm.
- **Irrigation engineering:** In this guide learners are provided with an overview of irrigation engineering aspects required for effective management such as evaluation and maintenance of irrigation systems. The resultant knowledge and skills will enable the extension officer to communicate effectively with specialists such as irrigation engineers and to troubleshoot on the farm.
- **Irrigation legislative context:** This learning material aims to provide the basic knowledge and understanding required to apprehend the legal environment of an irrigation farmer. Four modules relating to the agricultural policy of South Africa, including the National Water Act, National Water Resource Strategy and Irrigation Strategy, are included.
- **Irrigation economics:** This learning material aims to provide a basic understanding of farm management with the various tools that can assist the farmer to achieve his objectives. These tools and methods are divided into six sections, which include production and resource planning, financial management, marketing, human resource management and risk management. All of these sections are then incorporated into the business plan which forms the roadmap for the farm.
- **Irrigated crop and fodder production:** This learning material provides an overview of sustainable cropping systems, basic understanding of the water uptake by plants, vegetative and reproductive growth of plants, followed by a comprehensive overview of production practices with specific emphasis on the crop irrigation requirements of various crop types.
- **Agricultural extension:** This material addresses the identified skills and competencies as identified for agricultural extension. The 11 modules in this section covers various extension-related aspects, such as communication for rural innovation, extension approaches for agricultural development, leadership and facilitation, group mobilising, holistic farm planning and land evaluation skills.





Leading an academic career with pride

With an extensive academic record and having been at the forefront of some of South Africa's leading civil engineering research work with the students he has supervised, former President of the Water Institute of Southern Africa (WISA), Prof Frederick Otieno, chats to Debbie Besseling about the highlights of his fulfilling career, not the least of which is his 75 academic papers and 120 conference presentations.

Tell us about your current position as Deputy Vice Chancellor (DVC): Technology, Innovation and Partnerships, and Professor of Civil Engineering, at the Durban University of Technology (DUT).

I took up my role as Deputy Vice Chancellor in April 2010. In this position my role is to develop strategy, as well as lead and support research and innovation at DUT. My other areas of responsibility as an Executive include the Enterprise Development Unit (EDU), Business Support Unit (BSU), Cooperative Education, Information Technology and Support Services (ITSS), Innovation, and Research Institutes, all of which fall under my control.

The position of Professor of Civil Engineering is a fall-back position which I will slot into at the end of my contract as DVC. However, one cannot carry the title of Professor if you are not professing knowledge. I like to keep abreast with professional developments in my work and so I actively supervise at least three Masters and three Doctoral students at any time, and also undertake research in my own area of specialisation. It is important that I am in touch with what is being

researched and happening in the profession.

Your first academic achievement was in 1979 when you obtained a Bachelor of Science in Civil Engineering, Upper Second Honours at the University of Nairobi, Kenya. In terms of your academic credentials what would you like to highlight?

I have an MSc and a PhD in Civil Engineering and a Master of Business Administration (MBA). The MBA I did to strengthen my management capabilities and strategic thinking. I strongly recommend this to anybody who comes from a non-business background and who intends going into a management position.

I am a Fellow of the South African Institution of Civil Engineering, Senior Fellow of WISA and a Professional Registered Engineer. Recently I was appointed as a Fellow of the African Academy of Sciences, a very prestigious body on the continent. I regularly attend short courses and seminars to sharpen my skills and enable me to keep abreast and remain relevant in an ever changing environment.

Tell us about the topic of your PhD that you completed in 1989 in Civil Engineering (Environmental Engineering) at the University of Newcastle upon Tyne, England.

The title of my thesis was 'The Impact of Leachate Recirculation on Landfill Leachate Quality'. Essentially this involved modelling different scenarios that present themselves at landfill sites to try and address questions of protecting groundwater resources which can be costly to remedy if polluted.

What have been some of the highlights of your career?

My first job was as a design engineer in 1979 with Kenya Consulting Engineers in Nairobi, Kenya. This provided me with my grounding in the profession – it was my internship as an engineer. I have had several highlights in my 34-year career. In fact, I would say all the places that I have worked in have been as such. I can, however, highlight four places that stand out.

The first is working for the World Bank in the development of environmental action plans for arid and semi-arid districts in Kenya from 1991 to 1993. These were turned into

areas that could support life, and thus there could be economic activities that would emanate from these previously neglected areas.

Being Head of Department and successfully mounting and running the MSc in Water and Environmental Management at the University of Durban Westville in 1994 to 1999 is the second highlight. Many young men and women who attended this programme now occupy senior positions in the water and environmental sector in the public and private sector in South Africa and elsewhere internationally.

The third highlight of my career was as Dean of Engineering at Technikon Pretoria (now Tshwane University of Technology or TUT) and then Executive Dean of Engineering and the Built Environment at TUT from 2003 to 2010. This had to do with successfully managing the merger and also positioning the faculty as a leader in Research and Postgraduate training at TUT.

The last highlight is my current post as DVC Technology, Innovation and Partnerships at DUT, where we are faced with managing the challenges of developing and strengthening the culture of research and postgraduate work at the university.

With regard to corporate experience, you serve on a number of committees and boards. Please discuss your current positions.

I have served on several, but I would say the most challenging ones were Pikitup (A City of Johannesburg entity for solid waste management) and the South African National Roads Agency (SANRAL) when we developed and approved the toll roads in Johannesburg. Pikitup being challenging as waste is everywhere and every politician is concerned about it. SANRAL and the Gauteng Road Improvement Programme, which as we know are controversial and are major areas of interest to the general public.

Currently I serve on the boards of Rand Water, the Rand Water

Foundation and Invotech Incubator. I am the Chairperson of the latter organisations. The challenges when serving on these boards are about understanding the Public Finance Management Act (PFMA), developing and executing strategy, good corporate governance as per King III and keeping at arms length from daily management to enable those managers and executives to lead and excel in their roles. They are, after all, the real experts in these areas.

In terms of innovation and research in the water sector, what projects has DUT been involved in?

Three interesting projects that DUT are involved in are firstly working with Umgeni Water and Rand Water to develop strategies to minimise and be able to predict treatment costs of drinking water. A second project is aimed at minimising water usage in the agriculture sector. Currently, 60% of the water available is used for agricultural purposes. There are high inefficiencies in the use of this water and any gains that we make in this area would contribute to availing more water for use by human beings. This project involved the development of a model for efficient water usage while optimising crop yield. The third area that we are involved in is that of water demand management. Instead of always increasing supply, rather look at an integrated approach, which minimises usage, waste and creates less demand.

What is your message to young individuals entering the field of civil engineering on what it takes to have a successful career in civil engineering?

Civil engineering is an interesting and worthwhile profession that addresses the needs of mankind and is responsible for a better quality of life for our people. It is a varied profession, and includes sectors ranging from buildings, drinking water, sanitation and wastewater treatment, roads, transportation and highways,

services and infrastructure, environmental and geotechnical. To succeed, the individual needs to be strong in the subjects of mathematics and science and have good analytical skills. In terms of practicing as an engineer and so that the public is protected, one needs to be professionally registered. This is also a quality assurance mechanism and it also ensures that only qualified and registered people design and take responsibility for work that they do for the good and safety of the public.

In terms of employment, the sector offers a broad range of employment opportunities. Possible areas of employment include: Consulting engineers, local authorities, government departments, non-governmental organisations, research institutes, academic institutions, banking, development banks (World Bank, African Development Bank, DBSA etc), development agencies etc.

What in your opinion are some of the major challenges that we as a country are facing in the water and sanitation sectors?

One of the major challenges is to provide all citizens with good quality drinking water within a reasonable distance and with adequate sanitation services. The vast spread of our rural population makes this difficult and expensive. The cost of treatment has become quite high with most sources being highly polluted. Another area that needs to be addressed is the ageing infrastructure that needs to be replaced. In addition, qualified staff are needed to operate the treatment plants especially in outlying local authorities. As South Africans we are privileged to be provided with certain free quantities of water in terms of our Constitution. However, in terms of what is used above the free basic water allocation, and thus what needs to be paid for, remains a challenge in terms of cost recovery. Like any business if you are spending more to produce than what you are recovering, then there is going to be a deficit. □

“One of the major challenges is to provide all citizens with good quality drinking water within a reasonable distance and with adequate sanitation services.”

New WRC publications strengthen SA climate change armoury

The latest series of water and climate change studies emanating from the Water Research Commission (WRC) was launched amid great fanfare earlier this year.

The launch formed part of a WRC dialogue on climate change and water to explore current knowledge on potential impacts of climate on the South African water scene, potential science and

technology-related solutions and decision-making support mechanisms. The dialogue provided a platform for various stakeholders to express views on what the science and technology response to climate change has been, and should be going forward. Discussions also provided an opportunity for attendees to debate key questions around addressing climate change impacts, adaptation and mitigation measures, South Africa's

contribution to global climate change initiatives and the country's own resilience to potential change. Speaking at the event, WRC CEO, Dhesigen Naidoo, said that adaptation to climate change is a current reality that water resource managers must adhere to. "Our water problems will increase in future under climate change. We all need to decide whether we want to act now or face the crisis at a later stage."

All photographs by Lani van Vuuren



Imraan Patel (Department of Science & Technology); Dr Sylvester Mpendeli (Department of Environmental Affairs); Prof Roland Schulze (University of KwaZulu-Natal); Chris Moseki (Water Research Commission); Dr Sabine Stuart-Hill (UKZN) and Dhesigen Naidoo (WRC).



Imraan Patel (centre), Deputy Director-General at the Department of Science & Technology receives the new WRC climate change publications from WRC CEO, Dhesigen Naidoo (right), while main author, Prof Roland Schulze, of the University of KwaZulu-Natal, looks on.



Deputy Ambassador of Jordan, Omar Ababneh, provided insight into the potential effects of climate change on water resources from an international perspective.



WRC CEO, Dhesigen Naidoo, tackles some issues at the dialogue.



One of the main researchers on the WRC climate change project, Sabine Stuart-Hill of the University of KwaZulu-Natal, also participated in discussions.

SOUTH AFRICAN NATIONAL COMMITTEE ON LARGE DAMS CONFERENCE



SANCOLD

5 – 7 November 2013
Thaba 'Nchu

Advances in Dam Technology for Water and Energy in Southern Africa

About the Conference

The South African National Committee on Large Dams (SANCOLD) Conference will be held at the Black Mountain Hotel in Thaba 'Nchu, Maria Moroka Nature Reserve between Tuesday 5 and Thursday 7 November 2013.

SANCOLD invites all from Africa and the wider family of ICOLD to participate in the conference, which will include technical presentations, a technical visit and an exhibition.

This is an ECSA Continuing Professional Development (CPD) accredited event. This Conference is a Category 1 activity and offers 3.0 credits.

Programme

Overview

The conference will commence on Tuesday morning 5 November. On Tuesday there will be presentations by keynote presenters and of technical papers. There will be a special programme for the young engineers during the first two days of the conference. The conference dinner will be held on the Wednesday evening. A technical visit to the Metolong Dam site, in Lesotho, has been arranged for Thursday 7 November. Valid passports are required to enter Lesotho.

Registration

Conference registration is now open. Registration forms, with payment, have to be received no later than 7 October 2013.

Please note that:

Payment is required by cheque or by bank transfer; confirmation of registration will be given after payment has been received in full. The registration fee does not include accommodation.

If you have any queries regarding registration and for further detailed information, please visit www.sancold.org.za or contact:

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Water Research Commission



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

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

Impact areas address the following key issues:

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

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