THE WATER WHEEL

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MICROPLASTICS – *Freshwater menace*

PROTECTING OUR VULNERABLE WETLANDS

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WATER RESEARCH COMMISSION

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South Africa

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International Conference on Acid Rock Drainage
International Mine Water Association
WISA Mine Water Division

10 – 14 September 2018
CSIR International Convention Centre
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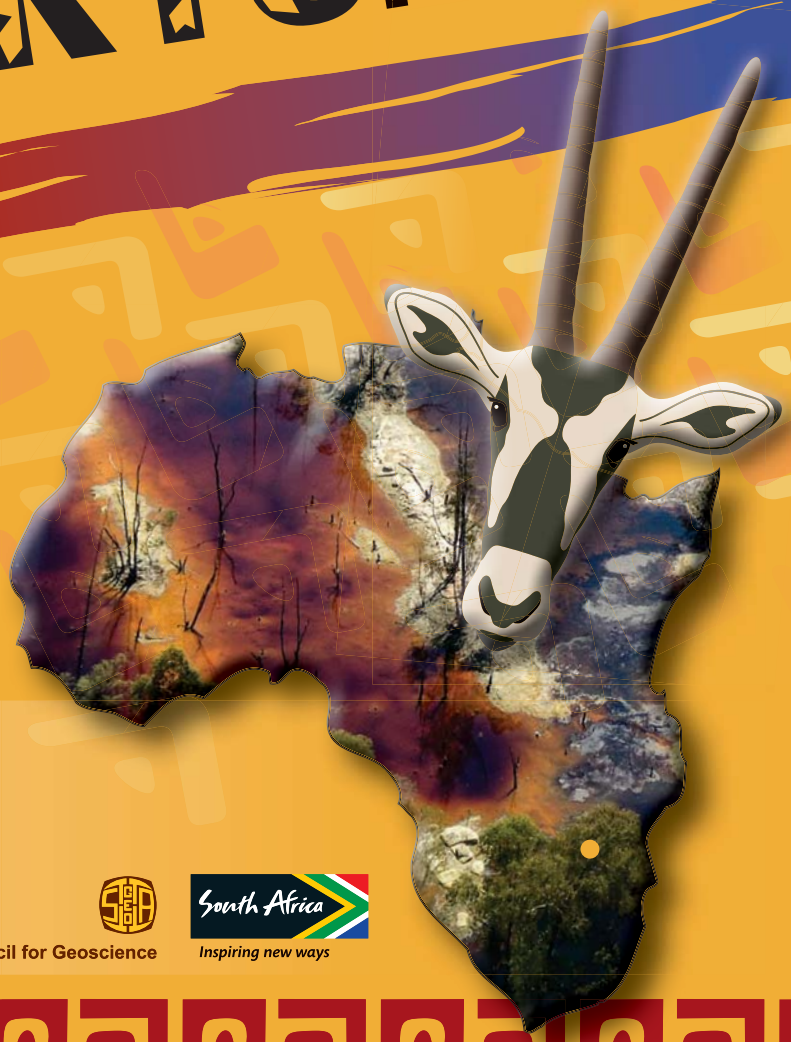

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FLUID THOUGHTS

WRC CEO, Dhesigen Naidoo

Carpe Diem – Time to design a new water future

I write this from the 2017 International Water Association (IWA) Water and Development Congress in Argentina, where 2 000 delegates from 30 countries have gathered. There is consensus that globally, water security is declining. This is backed up by barometers such as the Global Risk Register compiled annually by the World Economic Forum (WEF). Water crisis has consistently been one of the top five risks to the global economy in recent times.

This will come as no surprise to South Africans as we have belly-crawled under the barbed wire that was the worst ***El Niño*** event in more than twenty years. Our recovery has been at best sluggish, on the back of miserly post-drought rainfall patterns, so much so that at least one major metropolitan area – the City of Cape Town – has designated a Day Zero: the dreaded signal for extreme water rationing as the city reaches its highest level of water stress. While the City of Cape Town represents an extreme, many South African cities and towns are one poor rainfall season away from this scenario.

Is this the New Normal? There is a sufficiency of research, including an examination of the past hundred years of rainfall data, to support the theory that Southern Africa's foreseeable future will be characterised by lower than average precipitation with longer drought episodes. Even more worrying is the change in the rainfall modality to shorter more intense episodes prone to flooding events. This not only heralds the continued water availability conundrum, but is also a severe threat to the existing infrastructure platforms, like roads. Our transport infrastructure was designed for a very different rainfall pattern within a season. Potholes are not only a function of poor maintenance, but also of roads designed to manage and tolerate different, more moderate, rainfall episodes.

Two critical questions emerge: Firstly, are we trying to fix a 21st century problem with 20th century technology and 19th century operating rules? We continue to obsess about surface freshwater solutions when we have available to us some of the best technologies to treat wastewater and saline waters (either seawater or brackish and polluted inland sources) as 'new' water sources – or, as the Singaporeans call them – 'new taps'. We have in South Africa remarkable science that enables safe, hygienic sanitation using less than half a litre of water per flush, less than a twentieth of the current standard. This enables up to a 30% water saving for every household in the country.

The second question beckons: when are we going to act decisively? This is the WeiJi moment. We are explicitly clear regarding the Wei, or danger associated with this New Normal. We need to spend more effort on the strategy to realise the Ji or opportunity associated with crisis. We have the possibility of a turning point in our water fortunes. We have a chance to completely redefine the water management paradigm, and in a manner that fundamentally and simultaneously improves energy and food security as well, as we engage the water–energy–food nexus.

We have the chance to radically improve our trade balance stimulated by a switch in our technology balance of payments. This can be achieved by the industrialisation of water and sanitation in South Africa as envisioned in the 2017 Industrial Policy Action Plan (IPAP). We are well positioned to develop a significant water private sector that has the potential to set up a manufacturing base and supply chain producing goods and services to empower water and sanitation services in the New Normal for the global market – solutions that can enable a 100% assurance of supply of quality water and universal dignified sanitation in a manner that creates wealth and sustainable livelihoods, and enhances inclusive economic growth.

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WATER DIARY

Water business
April 15-17
Business meetings are at the heart of the Global Water Summit, happening in Paris, France. Every year, over 600 top executives come together to determine water's key role in sustainable economic growth and to meet with potential partners, suppliers and clients.
Visit: www.watermeetsmoney.com

Water loss
May 7-9
The IWA Water Loss Specialist Group, together with the City of Cape Town, will host the biennial Water Loss Conference and Exhibit at the Century City Conference Centre in Cape Town. The conference will be one of the world's largest water loss conferences and is expected to attract over 500 participants from more than 50 countries.
Visit: https://www.eiseverywhere.com/ehome/251759&internal=1

Aquatic science
June 24-28
The Southern African Society of Aquatic Scientists will be holding its 2018 congress in Cape St Francis Bay resort, in the Eastern Cape. The theme for the congress is 'Aquatic ecology in the Anthropocene'. Enquiries: Petrie Vogel (conference organiser); Tel: (12) 346-0687; Email: admin@savetcon.co.za;
Visit: www.savetcon.co.za

Water resource management
June 24-27 2018
The Water Institute of Southern Africa (WISA) is hosting its biennial conference at the Cape Town International Convention Centre.
Visit: www.wisa2018.org.za

World water week
August 26-31
World Water Week is the annual focal point for the globe's water issues. It is organised by the Stockholm International Water Institute. The theme is 'Water, ecosystems and human development'.
Visit: http://www.worldwaterweek.org/

Beverage firm wins supplier environmental awards

Coca-Cola Beverages South Africa was awarded top honours at the Massmart Supplier Environmental Awards.

Now in its fourth year, the awards honour Massmart's local suppliers for their commitment and exceptional performance in the implementation of environmentally-sustainable business practices. "As retailers our aim is for customers to be able to walk into our stores and trust that due consideration has gone into ensuring that the products on our shelves are produced sustainably and responsibly-sourced," noted Group Sustainability Manager, Alex Haw.

At the awards ceremony the retailer's top performing suppliers were recognised for their commitment to sustainable supply-chain management.

Coca-Cola Beverages South Africa impressed by working with Mpact to construct Africa's first company approved food grade rPET (recycled polyethylene terephthalate) recycling plant. The plant has the capacity to recycle 21 000 t of PET per annum. The company also implemented a schools plastics recycling programme, which has grown from 68 t per year in 2011 to more than 1 150 t in 2017.

For the first time, Woodlands Dairy and Samsung also received special recognition at the ceremony. Woodlands Dairy was honoured for being the first company in the dairy industry to implement an integrated wastewater treatment plant and biogas boiler. This has enabled them to reduce reliance on municipal water by 45%, and has contributed to a 78% drop in greenhouse gas emissions.

Samsung was recognised for their industry-leading contribution to e-waste recycling through their support of South Africa's largest and longest running post-consumer e-waste takeback programme.

Concluded Haw: "The suppliers recognised have been outstanding in their efforts to incorporate sustainable practices in the way that they run their businesses."

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NEWS

Policy to guide provision of sanitary products

The question of how sanitary products will be funded will be guided by a recently-developed policy framework document. This is according to National Treasury.

Speaking in Parliament late last year, Yanga Mputa, Chief Director at the National Treasury's Tax Policy Unit, said this when briefing the Multi-party Women's Caucus. The National Treasury appeared before the caucus amid mounting calls to exempt sanitary towels from value-added tax (VAT). This is due to concerns that a tax on sanitary products is unfair, it impacts negatively on the cost, which makes them unaffordable to women, especially those from poor backgrounds. The policy framework, aimed at informing government's response to the calls, was opened to public comment in October.

The National Treasury is part of an inter-departmental task team, led by the Department of Women, which is tasked with developing a policy response to the issue.

Contrary to public demand, National Treasury has indicated that it would rather support the provision of sanitary products through budge reprioritisation. Dr Kay Brow, Chief Director from the National Treasury's Budget Planning unit, said her department supported initiatives aimed at providing free sanitary products to school girls.

"There are already allocations specifically from provincial budgets that are going towards the provision of sanitary products."

It was reported at the same meeting that Gauteng has allocated R58 million towards sanitary and other hygiene products, while KwaZulu-Natal has allocated R20 million. The Free State, North West and Eastern Cape have contributed R6 million, R2.2 million and R1.2 million, respectively.

Source: SAnews

Programme invests in consulting engineering skills

A lack of investment in the development of skills for consulting engineering human resources over the years has resulted in a skewed and unbalanced scenario over the years. This is according to Consulting Engineers South Africa (CESA).

"The immediate challenge in the industry is the constraint faced by under-resourced middle management engineers in providing adequate experiential training of upcoming young engineers," the organisation said in a statement. In answer to this challenge, the CESA Business Consulting Engineering (BCE) programme, an annual development programme, has been established. Presented by the organisation's School of Consulting Engineering, the programme equips engineering staff in the consulting environment with the non-technical skills which form an integral part of the work of a consulting engineer, but which are not part of a normal tertiary engineering education programme.

Among others, students learn about the consulting engineering environment, business management, project finance, legal and contractual matters while getting exposure to aspects of inter-personal skills development, which enhance their ability to work in teams and become future leaders in the industry.

The 2018 course will run from February to December, and a maximum of 25 students are accommodated.
Visit: www.cesa.co.za/node/142 to find out more.

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Experts meet over SA's strategic surface and groundwater source areas

Protection of South Africa's most importance water source areas is critical for a water-safe future, and the reason why the CSIR and partners have embarked on a research project supported by the Water Research Commission (WRC).

Towards the end of last year, CSIR experts met with their private sector counterparts, as well as senior planners and policy-makers to finalise the delineation of South Africa's national strategic surface and groundwater source areas.

Strategic water source areas supply a disproportionately high amount of the country's water in relation to their size. In the first phase of the research, scientists used rainfall data to map the areas that produced most of the country's surface water – the water in streams, rivers and wetlands.

"The surface-water strategic water source areas occupy just 8% of South Africa's land area, yet provide 50% of our water. This water supports at least 50% of the population, 64% of the economy and about 70% of the irrigated agriculture," noted Dr David le Maitre, an ecologist and hydrologist at the CSIR.

"In the second phase of the project, we looked at mapping groundwater sources such as aquifers and boreholes. These data sets will now be included in an integrated and updated report that is being finalised."

Threats to these catchments include contamination and damage through mining, agriculture and urban development. Researchers discussed the importance of including all South Africans in their management and protection. Therefore the project will produce recommendations for water and land management for government officials, industries and land owners located in these areas.

The final technical report, guidelines and information will be published in 2018.

Finance industry joins mission to close SA's water infrastructure gap

Leading water, infrastructure and financial sector stakeholders met in Johannesburg towards the end of last year for in-depth talks on funding models to improve South Africa's water security.

The third Annual Water Stewardship summit kicked off with calls for the financial sector to look introspectively at ways to support efforts to close the water services infrastructure funding gap amounting to around R30-billion per annum; in support of the coming National Water and Sanitation Master Plan.

The Department of Water and Sanitation (DWS) is currently in the process of drafting the country's new National Water and Sanitation Master Plan, which is expected to be completed later this year. Outlining the goals of the plan, Trevor Balzer, DWS Deputy Director-General: Strategic and Emergency Projects, echoed sentiments which called on big businesses to assist in funding sustainable development projects. "This… is a critical time in South Africa's water and sanitation planning. We expect to incorporate the feedback from the financial community and other stakeholders to create a plan that effectively addresses the country's needs."

The summit, organised by the Strategic Water Partners Network, the National Business Initiative and the Royal Danish Embassy, provided an often-neglected opportunity for public and private financiers to become involved in the initial planning and project conceptualisation stage of the new masterplan. By involving such financiers early in the process, it is hoped that the masterplan can be designed in such a way that it is attractive to investors.

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GLOBAL

Not-so-sweet artificial sweeteners a sign of contamination

The presence of artificial sweeteners in rural groundwater shows evidence of contamination by local septic system wastewater, according to researchers from the University of Waterloo, Canada.

The study, which appeared in the ***Journal of Environmental Quality***, describes how the researchers tested private, rural groundwater wells in the Nottawasaga River Watershed, in central Ontario, for four artificial sweeteners as a way to detect groundwater impacted by human wastewater being released by septic systems in the area.

Artificial sweeteners are ideal human wastewater tracers as they exit the human body essentially unchanged, and are not completely removed by most wastewater treatment processes. Human wastewater contains relatively high concentrations of artificial sweeteners.

"Although the four artificial sweeteners we measured are all approved for human consumption, it is the other septic contaminants that might also be present in the water that could pose a health risk," said John Spoelstra, first author on the study and an adjunct professor in earth and environmental sciences at Waterloo. "As for groundwater entering rivers and lakes, the effect of artificial sweeteners on most aquatic organisms is unknown."

Among other contaminants, septic effluent can contain bacteria such as ***E.coli***, viruses, pharmaceuticals, personal care products, and elevated levels of nitrate and ammonium.

In conducting the study the researchers found that more than 30% of samples analysed from 59 private wells show detectable levels of at least one of four artificial sweeteners, indicating the presence of human wastewater. Estimates reveal between 3% and 13% of wells could contain at least 1% septic effluent.

The team also tested groundwater seeping out of the banks of the Nottawasaga River and found 32% of their samples tested positive for sweeteners. Again, this indicates that some of the groundwater entering the Nottawasaga River has been affected by septic system effluent.

"We were not really surprised by the most recent results given what we've found in past studies," noted Spoelstra. "Septic systems are designed to discharge effluent to groundwater as part of the wastewater treatment process.

Therefore, contamination of the shallow groundwater is a common problem when it comes to septic systems."

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Online course focuses attention on environmental impact of conflict

UN Environment and partners have launched a massive open online course on environmental security and sustaining peace.

Conflicts over natural resources are among the greatest challenges in 21st century geopolitics, and present serious threats to human security. At least 40% of all internal armed conflicts over the past 65 years have had an important natural resource dimension.

Since 1989, more than 35 major armed conflicts have been financed by revenues from conflict resources. In the coming years, extreme climate stresses are expected to double the risk of violent conflict.

Despite the risks that war and armed conflict pose for the environment and the role that natural resources may play in fuelling or amplifying armed conflicts, there are also significant opportunities linking the environment and peacebuilding.

UN Environment Executive Director Erik Solheim said: "Let's not forget the power of environmental cooperation to drive peace and prosperity."

Indeed, knowledge and experience regarding the important role of natural resources and the environment in post-conflict peacebuilding has grown immensely over the past two decades.

Building on these experiences, UN Environment has teamed up with the Environmental Law Institute, the Earth Institute at Columbia University, Duke University, and the University of California at Irvine to develop a new online course on Environmental Security and Sustaining Peace.

The course synthesises 100 000 pages of material and 225 case studies from over 60 post-conflict countries into seven hours of dynamic video lectures. The course is based on the experiences and lessons learned of over 1 000 experts and 10 UN agencies.

"The goal is to build a new community of 10 000 practitioners that can make natural resources a reason for cooperation rather than conflict," said Solheim.

The course covers a range of natural resources, from extractives to land and water, as well as a range of tools and approaches from conflict and gender sensitivity to assessments, mediation and spatial planning.

Visit http://bit.ly/2znYH7o for more information.

Report sheds spotlight on corruption impact on women

Identifying ways to recognise and address corruption in the water sector isn't new. However, little research has been done into how corruption impacts women and men differently.

The latest report by UNDP-SIWI Water Governance Facility (WGF) draws on experiences from Colombia and South Africa to identify these differences and understand their underlying causes.

Corruption within the water sector is widespread, ranging from petty bribes to the manipulation of large-scale infrastructure and public water services. It compromises access to safe drinking water and sanitation, posing a significant threat to billions of lives. Globally, women bear the main responsibility for household water access, and are therefore at greater risk of exposure to corruption.

The report brings to light topics such as sextortion, where services are only offered in exchange for sexual favours. It also confirms existing research, specifically, that women tend to be less corrupt than men, or are less likely to engage in corruption because they stand to lose more if caught.

"Corruption impacts women differently than men," says Pilar Avello, Programme Officer at WGF. "The fact that water is a vital resource for survival makes women in need of it likely to engage, even offer, sex in exchange for water. We need to talk about this at a higher-level, bring the discussion to the table and collectively find ways to fight it."

The report is a key output from the WGF's research project ***Water, integrity and gender*** and draws on interviews carried out in Bogotá, Colombia and Johannesburg, South Africa. It aims to identify the types of corruption that exist and better understand the motivations behind them, to work towards instituting 'good' governance through more transparent, accountable and effective institutions and procedures.

"Raising the issue of gender in water sector corruption is only the first step," says Dr Jenny Grönwall, Programme Manager at WGF. "Developing gender equalising strategies needs to be next one."

To read the report visit: http://bit.ly/2mwFU4Q

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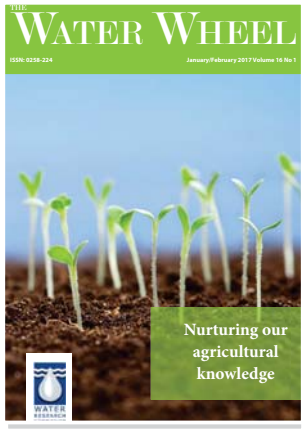

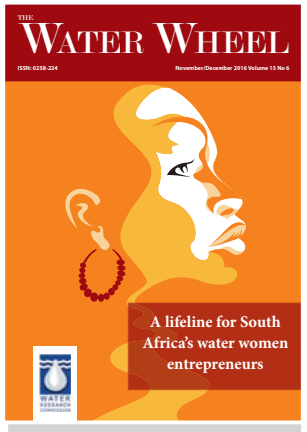

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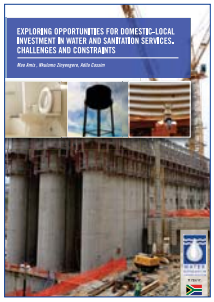

Exploring opportunities for domestic-local investment in water and sanitation services

The Department of Water and Sanitation is the custodian of water resources and responsible for coordinating investments in water infrastructure. There are about 250 government-owned water schemes in South Africa. It's estimated that South Africa requires at least R1.4 billion in investments per annum to maintain the current water infrastructure. This funding challenge has exacerbated the water management situation in the country. This study sought to develop understanding on the perceived challenges and constraints faced by the private sector, which prevents them from harnessing the opportunities of investing in the water and sanitation sector in South Africa. This was based on the premise that by unpacking these perceived challenges, a clear picture of the investment opportunities in the sector might be unveiled to make a business case for investments in the sector.

Report No. TT 725/17

Developing innovative approaches to national allocations and transfers to local government and its use

The design of a system of transfers is of critical importance to the efficiency and equity of local service provision and fiscal health of sub-national government. South Africa's fiscal framework has evolved progressively over the years with an example of recent work being a review by National Treasury, the South African Local Government Association (SALGA), the Department of Cooperative Governance and Traditional Affairs (CoGTA) and the Finance and Fiscal Commission (FFC) of the system of local government infrastructure grants. Innovations also continue to emerge internationally, particularly relating to performance based grants. In this context, the WRC commissioned this research study aiming to build on work previously undertaken; review current processes related to transfers and allocations; and undertake an international scan of innovative approaches and relevant experience with a view towards identifying challenges and constraints and presenting future requirements and solutions for further evolution in the system of transfers and allocations for water services in South Africa.

Report No. 2487/1/17

The validation of the variables (evaporation and soil water) in hydrometeorological models: Phase II

For many field and modelling applications, accurate estimates of soil water (SW) are required, but are often lacking. Modelled estimates of SW are often used without proper validation and the verification of the results is questionable. In addition, remotely sensed (RS) products are becoming more widely used in hydrological modelling. However, RS SW measurement is faced with the difficulty of "seeing" below the soil surface and penetrating the aerial plant canopy layer. This project was initiated to provide a spatially explicit validation procedure for the 1 km grid of SW and total evaporation produced.

Report No. 2323/1/17

Towards wastewater biorefineries: Integrated bioreactor and process design for combined water treatment and resource productivity

This project investigated the wastewater biorefinery (WWBR) concept: the integrated processing of a wastewater stream or streams to generate products of value, including "clean" water, and remediate the effluent simultaneously. In this approach, products of variable value are produced concomitantly with clean water as a product, typically through multiple unit operations. The preference is to generate products of sufficient value to make the biorefinery economically viable. The focus of this research project was on developing and testing this concept, as well as evaluating its applicability to and potential in the South African context.

Report No. 2380/1/17

Risk Based, Site-Specific, Irrigation Water Quality Guidelines: Volume 1 Description of Decision Support System

The 1996 South African Water Quality Guidelines comprise one of the most widely-used tools in water quality management. However, they are now viewed as significantly out of date. A Phase 1 Department of Water Affairs and Forestry (now Department of Water and Sanitation) project was completed by a panel of experts in 2008. They performed a needs assessment, developed a general philosophy and described the general specifications of a decision support system (DSS) for revised water quality guidelines for South Africa. The general aim of this project was to develop a software-based decision support system (DSS) able to provide both generic and site-specific risk-based irrigation water quality guidelines for South Africa. The DSS assesses fitness-for-use and establishes water quality requirements for the effect irrigation water constituents have on soil quality, crop yield and quality, as well as irrigation equipment.

Report No. TT 727/17

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EMERGING POLLUTANTS

Study explores microplastic pollution

Microplastics are causing marine pollution problems of global concern. Researchers are now also looking at the hidden impacts of these tiny plastic particles on our local freshwater environment. Article by Jorisna Bonthuys.

Plastic is considered an essential part of our everyday (modern) life. It is durable, inexpensive and has thousands of uses. The invention of plastic has changed the way we dress and package things, among others.

This has, however, come at an environmental cost. A staggering amount of waste, including millions of tons of plastic, enters the oceans each year. Recent studies have suggested that the ocean receives an estimated 8 million metric tonnes of plastic waste per year.

Plastic debris in our oceans is a complex contaminant of increasing concern. It is now considered one of the significant global challenges facing the marine environment, alongside climate change, biodiversity loss, sea-level rise and ocean acidification.

The plastic waste we produce on land that does not get reused or recycled or are poorly managed at waste facilities and may eventually reach the oceans. This happens either through dumping or from runoff through drains and rivers. This plastic can travel a long distance – even some of the most isolated islands are now affected by it. Some plastics may have a half-life of 400 years, meaning it will be around for centuries in the marine environment.

Many plastic objects, including plastic bags, packaging material, earbuds or straws, are consumed by marine animals. This is because plastic garbage is often mistaken for food by marine animals. High concentrations of plastic material have, for instance, been found in the stomachs of albatrosses, whales, and turtles.

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This plastic waste comes in many shapes and sizes. This includes large visible items you can collect during beach clean-ups as well as small particles that are often invisible to the naked eye. Over time some of these objects degrade, breaking down into even smaller particles.

Scientists warn: Microplastics are playing an increasing role in the uptake of industrial pollution in marine life. It has now been introduced to the food web. These tiny fragments or particles are ingested by some species. This could be contributing to high levels of chemical contamination of marine organisms.

The big problem with microplastics

Microplastics (< 5 mm size) come from a variety of sources. Some are from places you would expect, such as broken down plastic bags. The origins of others are more surprising. Turns out, every time you wash your synthetic clothing or carpets, tiny plastic fibres are also released into the environment.

Many common household items, including toothpaste and cleaning supplies, also have microbeads in them. These tiny manufactured plastic particles can pass through water filtration systems. Other sources include the abrasion of large plastic objects during manufacturing processes, or from the erosion of tyres.

Scientists have grouped these and other sources into two broad categories: primary and secondary sources. Manufactured microplastics (primary sources) include industrial pellets, scrubbers (used in personal care products like shower gels) and abrasives (used in synthetic sand-blasting). Secondary microplastics are derived from the degradation of larger objects (like plastic milk bottles).

Researchers have found microscopic tiny plastic particles (called microplastics) are now almost everywhere – even in deep ocean sediments. It is estimated that approximately 1,5 million tons of microplastics end up in the oceans annually. This is according to a recent study published by the International Union for Conservation of Nature (IUCN).

This figure corresponds to a world equivalent per capita release of 212 grams. This is the comparable with 43 plastic grocery bags thrown into the ocean per person per week (roughly one bag per week per person worldwide).

According to the IUCN, 98% of microplastics are generated from land-based activities. Only 2% is generated from activities at sea. The main pathways of these tiny pollutants into the oceans are through road runoff (66%), wastewater treatment systems (25%) and wind transfer (7%), according to this study.

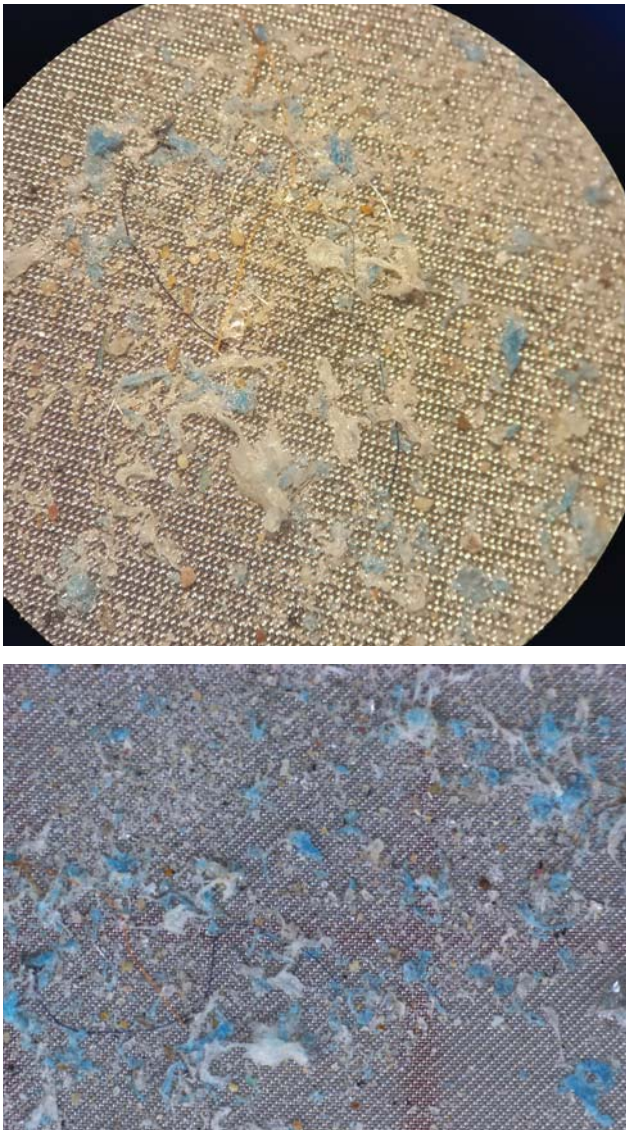
Assessing microplastic risks

Microplastic pollution is nothing new. Studies on the presence of small plastic fragments in the oceans were, for instance, first published in the 1970s. Scientists say they are only starting to understand the risks and the chemical pollutants associated with it.

In recent years, there has been a renewed interest in microplastics. Most of the work done on microplastics in South Africa relate to persistent organic pollutants and in the marine environment. Very little is known about microplastics in freshwater resources.

Now a scoping study funded by the Water Research Commission (WRC) is underway to look at microplastic pollution in local waterways, wetlands and urban freshwater resources. Prof Henk Bouwman, a specialist in ecotoxicology from North-West University is leading this work. The study is part of the WRC's research focus on (emerging) water quality challenges related to complex chemical and microbial pollutants.

The researchers want to determine just how many microplastics are present in our freshwater resources. They are also interested in what impact this has on biodiversity and ecosystems. Based on their findings, they will come up with recommendations for further research.



Carina Verster

Small plastic particles and fibres from surface water samples.

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The problem with microplastic pollution of freshwater resources might be more significant than we think. "Research indicates the real and potential risk of microplastic at many levels," Prof Bouwman points out. This issue, along with climate change, water scarcity and urbanisation, could exacerbate our freshwater problems even further.

South Africa is already facing a dual crisis of water availability and deteriorating water quality. The deteriorating state of the environment, poor past land-use planning, and patchy success in the delivery of services such as sanitation, are increasing the exposure of people to contaminated water sources.

"Microplastics can affect the metabolism, fertility, and mortality of aquatic organisms."

Increasingly, more emerging contaminants of concern (including microplastics) are detected in the environment. "Often these contaminants are largely unregulated," Prof Bouwman points out. "The potential health impacts of individual compounds or mixtures are also mostly unknown."

The ingestion of plastic particles by filter feeders at the base of the food web raises toxicity concerns from pollutants. "Microplastics can affect the metabolism, fertility, and mortality of aquatic organisms," Prof Bouwman explains. "This can affect the ecosystem and potentially human health and is cause for concern."

Microorganisms can also attach to these tiny plastic particles. "This means that microplastics can carry persistent organic pollutants and toxins over long distances. The full impact and risks of microplastics pollution in water is yet to be discovered.

"Seeing that accumulated pollutants have been found in plastic debris on some of the most remote places on earth, the transport of pollutants from polluted areas to less polluted areas in freshwater systems is therefore entirely feasible."

The risks posed by microplastics may be enhanced when local communities remain dependent on freshwater. The small size of these particles makes it also nearly impossible to get rid of with current wastewater treatment processes. This was pointed out by Carina Verster recently in an article published in the ***Integrated Environmental Assessment and Management Journal***. Verster, one of Bouwman's students, is also doing research on this subject.

As part of the WRC-funded scoping study, municipal water was tested in metropolitan municipalities in three provinces (North West, Gauteng and the Free State). At each site, 90 litres of water was collected for analysis. The scientists also collected samples from river systems such as the Vaal River, Mooi River and Wasgoedspruit. They are currently investigating the presence of microplastics in the drinking water of four different municipalities (Ekurhuleni, Mbombela, Tshwane, and Tlokwe Municipality).

"The preliminary results confirmed the presence of microplastics in the municipal water of all four cities," says Prof Bouwman. One municipality had the highest number of 15 particles per litre tap water, and another the lowest average of only four particles per litre. Water tested at the two other municipalities contained eight particles per litre.

In freshwater sources, some samples had more than 40 particles (including fibres) per litre, greater than 20 µm.

The concentrations found in this study are far greater than the 0,9 particles per litre found in a study done in Austria in 2014 on the Danube River. Unfortunately, due to the lack of standardised units to report the concentration of microplastics in the environment, it is at this stage difficult to compare the results.

Given the low dilution potential of local freshwater resources, coupled with ongoing waste management problems, the impacts of microplastics on local freshwaters resources and the biological processes dependent on it remains unclear.

With South Africa being a water-scarce country, the quality of its freshwater resources is at an even greater risk. When microplastics-contaminated water and soil are used for drinking and crop production, water and food security as well as the well-being of the population, may be affected. "This direct link between the human population and the environment, now (most likely) also with an increasing microplastics burden, is of concern," Verster pointed out in her article.

South Africa and many African countries also still use persistent organic pollutants, such as DDT for malaria control, especially in remote rural areas. "The links between pollutants in microplastics and potentially more vulnerable rural populations need to be examined. Although the full impact of microplastics on the environment and biota is not yet understood, the potential threats should not be taken lightly," according to Verster.

Greening the (plastic) future

South Africa has a vibrant plastics manufacturing industry, but recycling is limited and insufficient. Lots of unmanaged waste enters the environment. Plastics are used in every sector of the economy and contributes significantly to the local manufacturing sector.

The South African government has also identified the industry as a priority sector to help promote economic growth through the Department of Trade and Industry's Industrial Policy Action Plan. This document (based on 2014 data) states that "an overwhelming" 72% of plastic packaging is not recovered at all: 40% of this is landfilled, and 32% leaks out of the collection system. This means it is not collected at all or collected but then gets illegally dumped.

However, the situation seems to have improved since then with Plastics SA indicating that 45.7% of all plastics have been collected in 2015, with 20.8% being recycled or exported. The South African plastics industry has set itself the ambitious and laudable target of no plastics to go to landfills by the year 2030, Bouwman points out.

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Microbeads can be found in personal care items such as toothpaste, soap and shower gels.

In the meantime, the risks posed by microplastics must be tackled on various levels. Currently, most plans and interventions focus on end-of-pipe solutions.

At the heart of the matter are unsustainable production practices and consumption patterns, inadequate waste management and inappropriate disposal of plastics. This was highlighted in a recent study on marine debris by the Global Environment Facility's Scientific and Technical Advisory Panel.

Prof Bouwman, a member of this panel, says we should reduce, reuse, recycle, redesign and recover plastics as far as possible. "But the consumer alone cannot be held responsible for dealing with this, although their waste management, product choices, and recycling efforts can and will make a difference," he emphasises.

"We need a collective effort between global institutions, governments, manufacturers, retailers, and consumers alike. We also need to promote best practices in water, waste, and wastewater management, amongst other things. Plastics can be designed to be inherently recyclable, and there is lots of potential to turn waste items into new products. Single-use plastics is also something that should be reduced significantly."

Lots of work is underway to rethink the future of plastics. The British Ellen MacArthur Foundation, for instance, promotes a transition to a so-called circular economy. This aims to keep products, components, and materials at their highest value and utility at all times. The idea is that this provides an alternative to the current consumption and discard model that includes plastics, and thereby reduce the leakage of waste into the environment.

An international treaty, like the Stockholm Convention that banned the use of certain persistent organic pollutants, may be required to bring about the sea change needed." The aim would be not to ban plastics, but that countries need to adhere to an international negotiated set of standards and practices to protect human health and the environment," says Prof Bouwman.

While the impacts of microplastics on local freshwater resources are still poorly understood, better water purification, as well as strategies to reuse and recycle plastics as a resource stream, should receive more attention. This can help to minimise future negative costs and impacts.

"This is a global issue, which needs a global solution. All countries need to take up their responsibilities in this regard," Prof Bouwman concludes.

Did you know?

- Most of the marine plastic pollution comes from land-based sources.
- Plastic is very slow to break down in the ocean. Eventually, some of it breaks down into smaller and smaller pieces. Sometimes these pieces are so tiny they can only be seen under a microscope.
- Once in the ocean, these microplastics can either float or sink. Microplastics have been found 1000 m deep on the ocean floor in the Atlantic Ocean.
- Plastic debris can travel long distances via the ocean currents and can also be consumed by many marine life forms. A plastic bag has even been found inside the stomach of a coelacanth in Indonesian waters.
- Approximately 1,53 million tons of primary microplastics are released annually.
- In 2012, Unilever decided to phase out microplastics from their personal care products globally by 2015, based on environmental concerns.
- South Africa, Egypt, Nigeria Algeria and Morocco are among the top 20 countries contributing to marine debris each year.
- Synthetic textiles are the main source of primary microplastics in Africa, Asia and the Middle East.
- About 64 000 people are employed (formally and informally) across the local plastic supply chain in South Africa.In 2015, 315 600 metric tons of plastics were recycled in South Africa, mainly by small businesses.

Source: Plastics SA; UNEP, Global Environmental Facility; Marine Policy.

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WETLANDS

Precious heritage – Project quantifies the value of SA's Ramsar wetlands

A recently completed Water Research Commission (WRC)-funded project has contributed important baseline information for aquatic ecosystem monitoring at Ramsar wetlands. Article by Sue Matthews.

In February 1971, when the Convention on Wetlands was signed in Iran's resort town of Ramsar on the Caspian Sea shore, South Africa was one of 18 countries represented, along with a handful of intergovernmental agencies and international conservation non-governmental organisations (NGOs). It was agreed that the 'Ramsar Convention' would enter into force after accession by seven countries, and South Africa was one of those first seven, depositing its instrument of accession with UNESCO and designating two 'wetlands of international importance' – Barberspan and De Hoop Vlei – in March 1975.

The Convention entered into force on 1 December 1975, but a year earlier the first criteria for identifying wetlands of international importance had been adopted. Given that the original name of the Convention was the 'Convention on Wetlands of International Importance especially as Waterfowl Habitat', it's not surprising that the criteria initially focused heavily on waterfowl, but they have been revised a number of times over the years and now include plants and other animals, hydrological and other ecosystem services, ecological and life-history processes, biogeographical and biodiversity aspects, as well as rarity and threat status.

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"The conclusion from this project is that management of the systems should be site-specific and no single monitoring programme would appropriately suit the uniqueness of each Ramsar site."

A perusal of the Ramsar website reveals that – as of 1 December 2017 – there are 169 parties to the Convention, and 2 289 Ramsar wetlands around the world. South Africa now has 23 sites, the most recent designation being the Bot-Kleinmond Estuarine System in January 2017, but for the earlier sites the 'Ramsar Information Sheet' (RIS) has not been updated since the 1990s.

At the Convention's sixth conference of the parties (COP) in 1996, contracting parties were urged to submit a revised RIS for each Ramsar site every six years, but South Africa is not alone in having neglected to do so. The most recent COP in 2015 passed a resolution noting that 57% of sites worldwide either had no RIS at all, or inadequate maps, or the RIS and maps had not been updated for more than six years.

Contracting parties were requested to comply as a matter of urgency, and the Department of Environmental Affairs subsequently contacted all the relevant management authorities of the South African sites about the need for RIS updates. Since this involves re-evaluating the sites in terms of the latest criteria and submitting information in a format quite different to the original documents, it has been a slow process, but it is anticipated that the updated RIS for each will be uploaded to the Convention's new online system by the end of the first quarter of 2018.

Part of the problem with updating and fleshing out the RIS is that little, if any, biological monitoring has been done at most of the sites, and where it has been done it may not have been published. In an effort to fill in some information gaps, the WRC awarded funding to North-West University: Potchefstroom for a three-year research project, the final report of which has recently been completed. Entitled ***The aquatic biodiversity and tourism value of selected South African Ramsar wetlands*** (**WRC Report No. TT 732/17**), the report collates existing information for nine wetlands around the country, provides baseline data for a number of parameters measured by the research team, and includes a literature review on tourism aspects, such as the potential loss of tourism due to environmental degradation, the environmental impact of tourism activities, and the likely effect of climate change.

The nine wetlands selected were Barberspan in the North-West Province, De Hoop Vlei and Heuningnes Estuary near Cape Agulhas in the Western Cape, Kosi Bay and Lake Sibaya on the Zululand coast and Ntsikeni wetlands in the Drakensberg foothills of KwaZulu-Natal, Makuleke wetlands at the north-east boundary of the Kruger National Park (KNP) in Limpopo, Blesbokspruit in Gauteng and Seekoeivlei in the Free State.

"The selection was based on a combination of sites that didn't have any information that we could find, or completely outdated information, and then also trying to spread it around the country and tackle the different types of systems, from estuaries and coastal lakes to highland wetlands," explains project leader Dr Wynand Malherbe. "For the Makuleke wetlands, for example, there was really no information available before our project, while Barberspan has a lot of information on birds, but very little published on any other aquatic life."

Barberspan is a bird sanctuary with provincial nature reserve status, and summer and winter Coordinated Waterbird Counts – generally known as 'CWAC counts' – have been conducted most years since 1993. Data contributed by citizen scientists for the South African Bird Atlas Project 2 (SABAP2) is also available, so updating the sections of the RIS relating to avian importance should be relatively straightforward. The project team therefore conducted field surveys for diatoms, zooplankton, macroinvertebrates and fish during April and July 2014, and returned in October 2015 for an additional zooplankton survey. They also trained the reserve's nature conservation staff and provided equipment allowing them to continue monitoring macroinvertebrates at a number of sites from February 2016 to January 2017.

North-West University

The Makuleke Wetlands in the Pafuri Triangle, consist of a number of floodplain pans, including Kulukulu, Mapimbi and Makwadzi.

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North-West University

Barberspan (top) and De Hoop vlei (above) were among the wetlands surveyed by the project team.

Information was sourced from various reports and theses as well – four MSc projects on fish, benthic organisms and plankton were found to have been conducted by Potchefstroom students in the 1960s, reflecting the city's relative proximity (± 200 km) to the pan. The different wetland types within the Ramsar site were also classified according to the National Wetland Classification System, developed by Ollis et al. (2013) with WRC co-funding, and the ecosystem services assessed. This kind of information will be vital in completing sections of the RIS that did not exist when the document was last updated in the early 1990s.

Although Barberspan is protected within a nature reserve, it is not immune to threats posed by humankind. In fact, it had already been fundamentally altered by the time the reserve was proclaimed in 1954, because it was originally an ephemeral wetland that dried up most winters. In 1918 a canal was constructed to connect the pan to the nearby Harts River, with the result that it became a perennial system, completely changing the hydrology and ecology. As a permanent waterbody it provided ideal habitat for fish, and it soon became a popular recreational angling destination. While indigenous fish such as sharptooth catfish, smallmouth yellowfish, moggel, Orange River mudfish and southern mouthbrooder occur, there are also invasive aliens like common carp, mosquitofish and probably largemouth bass, although none of the latter were recorded in the project team's surveys.

The connection to the Harts River also brings in nutrients from agricultural runoff and municipal wastewater treatment works upstream. The Earth Observation National Eutrophication Monitoring Programme, developed by Cyanolakes with WRC funding, reveals that the resulting eutrophication often manifests in extensive blooms of cyanobacteria, which may be toxic. The project team likewise found that most of the 22 different

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diatom taxa collected during their own surveys are indicative of eutrophic conditions.

Dr Malherbe notes that this highlights the value of increasing knowledge about diatoms, zooplankton and macroinvertebrates in the Ramsar wetlands, even if there are no particularly 'important' species present. (Criterion 2 for designating a Ramsar wetland relates to its supporting vulnerable, endangered or critically endangered species or threatened communities, according to the IUCN Red List of Threatened Species, but only a few groups of freshwater macroinvertebrates in South Africa, and certainly no diatoms or zooplankton, have been assessed in terms of IUCN criteria.)

"Many of the birds depend on diatoms, zooplankton or macroinvertebrates through the food web," says Dr Malherbe. "The theory is that if you can monitor the food, and pick up that something is going wrong there, you still have enough time to take corrective measures before your bird diversity takes a knock because the food web they rely on has collapsed due to pollution, habitat loss or other anthropogenic impacts."

Some 700 km to the north-east of Barberspan – as the crow flies – are the Makuleke wetlands, designated a Ramsar site in May 2007. The site is within the 'Pafuri triangle' formed by the Luvuvhu and Limpopo Rivers at South Africa's border with Zimbabwe and Mozambique, and is part of the concession area owned by the Makuleke community and managed as part of the KNP. The wetlands mostly consist of floodplain pans, which support a high diversity of species and provide an important refuge for water-dependent frogs, fish and birds, although most of the pans dry up either seasonally or during drought years.

The Makuleke RIS from 2007 is very detailed and comprehensive – having been compiled by SANparks' Dr Andrew Deacon, who played an instrumental role in the KNP Rivers Research Programme – but the focus is naturally on the more obvious wildlife found in the KNP. However, the field surveys conducted by the project team revealed an extraordinary diversity of diatoms and macroinvertebrates. Ten pans were sampled, with a total of 70 diatom and 108 macroinvertebrate taxa identified. The project report highlights the importance of this finding.

"The assessment indicated that each pan was unique and contributes to the overall diversity of the system. If one pan is degraded, it could impact on the overall diversity within the Ramsar wetland," it states. "The conclusion from this is that management of the systems should be site-specific and no single monitoring programme would appropriately suit the uniqueness of each Ramsar site."

This sentiment is expanded upon in the recommendations section of the report. "It is essential that the correct components for each Ramsar wetland be monitored. These should be selected based on the information available, protocols that align with the proposed National Wetland Monitoring Programme and communication with local stakeholders that rely on resources from the system. At a minimum, monitoring should be completed on components of the Ramsar sites that align with or are directly attributed to the Ramsar criteria used for designating the specific site a Ramsar site," it states, adding: "This project has shown that monitoring for water quality, diatoms and aquatic macroinvertebrates should be priority at many of the freshwater Ramsar sites."

As for the tourism component of the study, the project team found that ecotourism could be invaluable in generating income for the Ramsar sites, but this potential is not being fully realised. "Detailed studies should be carried out at each Ramsar wetland to assess the viability of ecotourism, as well as the extent to which it will benefit the site and not be detrimental to the environment."

A water lily in bloom at Kosi Bay.

Apart from generating useful baseline information on the Ramsar sites, the project has provided a hands-on, feet-wet training opportunity for young scientists. Six MSc students – four from North-West University: Potchefstroom and two from University of Johannesburg – have submitted their research theses on different wetlands, and a number of BSc Honours students were involved too.

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Urban wetlands: prize

Control flooding

Filter waste from water

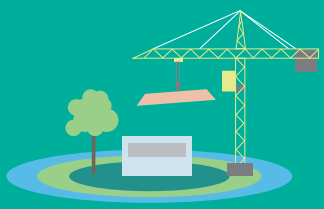
Improve air quality

Source of drinking water

Promote human wellbeing

Source of livelihoods

As demand for land increases, the t



Filling in wetlands disrupts natural water provision

Dumping rubbish degrades natural green spaces

To make cities sustainable into the future: r

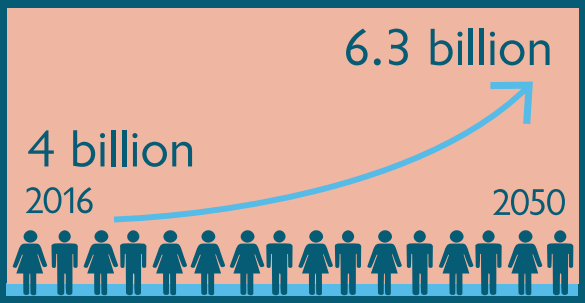
- Include wetlands in urban land use planning
- Preserve and restore urban wetlands

#KeepUrbanWetlands
#WorldWetlandsDay
www.worldwetlandsday.org

ed land, not wasteland

While cities are GROWING

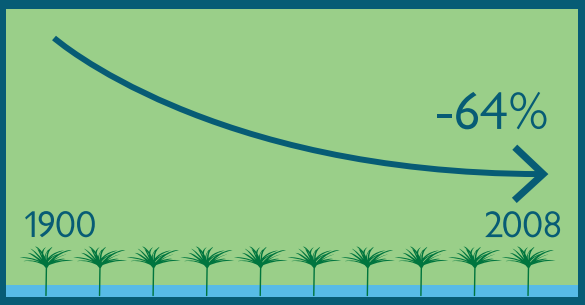
50% of the population live in urban areas today. By 2050 that number will increase to 66%



WORLD URBAN POPULATION, 2016-2050

Wetlands are DECLINING

More than **64%** of the world's wetlands have been lost since 1900



ESTIMATED WETLAND LOSS

endency is to encroach on wetlands

Burning or draining peatlands releases CO_2

Clearing mangroves and mining coral reefs can expose city coastlines to storms

retain, restore and preserve urban wetlands

- Involve local residents in wetland management
- Reduce water consumption and harmful runoff

UN-HABITAT FOR A BETTER URBAN FUTURE

ICLEI Local Governments for Sustainability

WWF

WWT

World Wetlands Day 2 February 2018
Wetlands for a sustainable urban future

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World Wetlands Day is made possible by the Danone Fund for Water.

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Ramsar Convention on Wetlands

PERSONALITY

Proudly-South African Felix Reinders to head up global irrigation and drainage commission

Felix Reinders of the Agricultural Research Council (ARC) is the first South African to be elected President of the International Commission on Irrigation and Drainage (ICID). This honour was bestowed upon Reinders at the 23rd ICID Congress in Mexico in October 2017. **Water Wheel** *spoke to him about his appointment and the vision of this prestigious global body for a water secure world. Article by Kim Trollip.*


Felix Reinders

A research manager at the ARC and a professional engineer with 36 years' experience in the field of agriculture and civil engineering, Reinders specialises in water resources management and irrigation engineering, including research, design, training and mentoring.

Reinders has authored many scientific and semi-scientific papers and articles in the field of irrigation and served on various Water Research Commission (WRC) projects. He is also a visiting lecturer at the largest international graduate water education facility in the world, IHE Delft Institute for Water Education (formerly UNESCO-IHE Institute for Water Education,) where he imparts knowledge on design and operation of drip and sprinkle irrigation systems.

Responding to his election as 24th President of ICID, Reinders said, "I am humbled, as it is a huge honour… and responsibility. This a first for the ARC, for the South African National Committee on Irrigation and Drainage (SANCID), for South Africa and for the Southern African Development Community in the 67-year history of ICID."

Reinders was actively involved in the establishment of SANCID as a member of ICID in 1993. He served as SANCID Vice Chairman and as Chairman on more than one occasion over a period of 20 years. International recognition followed when Reinders was elected Vice President of ICID for the period 2005-2008. He successfully chaired and organised the 51st IEC Meeting and 6th International Micro Irrigation in South Africa conference in October 2000. Under his chairmanship for the period 2008-2011, SANCID was adjudicated as the best performing National Committee of ICID.

"It is actually remarkable that South Africa only became a member of ICID in 1993, and is therefore celebrating its 24th anniversary as a member of ICID. The ARC, Department of Agriculture Forestry and Fisheries, Department of Water and Sanitation, together with the WRC, founded SANCID with the South African Irrigation Institute as an honorary founder member," adds Reinders.

The task at hand: A water secure world

ICID is currently launching its ***Vision 2030 Road Map***. The sub-title of the document is: ***A water secure world free of poverty and hunger***. This is a tall order and as President of the Commission it will be Reinders' responsibility to start rolling out this vision during his term in office. Best practice advises that leaders can't, and shouldn't work in isolation. Hence, in true leadership style, Reinders' approach is one of teamwork.

"For me realising this vision must start with working together with the national committees and working groups of ICID in realising ***Vision 2030*** towards sustainable agriculture water management through inter-disciplinary approaches to economically viable, socially acceptable and environmentally sound irrigation, drainage and flood management. In order to realise the vision, ICID has set clear organisational goals for the network that will enable national committees to re-confirm or re-orient their national goals or will help establish specific goals at the national level, addressing the specific national needs. Fortunately, in the build up towards the ***Vision 2030 Road Map***, interaction with the national committees has already ensured extensive involvement and together we will build on that to realise the vision."

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The goals in the Action Plan of ICID Vision 2030.

The six goals in the Action Plan can briefly be discussed as follows:

GOAL A: Enable Higher Crop Productivity with Less Water and Energy
ICID network would advocate with the national governments and funding agencies to make strategic choices that favour higher crop production using less energy and water thereby contributing to sustainable agricultural water management (AWM) and net increase in farmers' income and profits.

GOAL B: Be a Catalyst for Change in Policies and Practices
ICID, through its working groups will provide guidance to water policy analysts at the national level to facilitate analysis of tradeoffs to maintain the economic efficiency of agricultural production and minimize adverse environmental impacts by developing and sharing experiences, using latest tools and modelling principles for simulating development scenarios, and generating knowledge, which can serve as catalyst for policy changes.

GOAL C: Facilitate Exchange of Information, Knowledge and Technology
Current irrigation systems and services are generally characterised by low water use efficiencies and irrigated agriculture is under considerable pressure to adopt practices and methods to increase efficiency of water use. New irrigation technologies have the potential to increase productivity and in some cases may result in increased water availability for alternative uses (e.g. environmental flows to maintain ecosystem services) or both. ICID will work towards exchange of information, knowledge, management practices and use of new technologies for sustainable AWM.

GOAL D: Enable Cross-Disciplinary and Inter-Sectoral Engagement
ICID network would make available the required information about irrigation, drainage, drought and flood management to all the relevant stakeholders in the language suitable for their use. Where required, platform for inter-disciplinary networking would be facilitated for dialogues among various groups. NCs at the national level and the central office, by facilitating active participation of experts and stakeholders from the relevant sectors and fields of expertise, will play key roles in achieving this goal.

GOAL E: Encourage Research and Support Development of Tools to Extend Innovation into Field Practices
ICID network would provide technical support on the latest innovations available in the agriculture water domain to non-governmental entities that are engaged in providing various kinds of services in the rural areas and are increasingly occupying the vacant space to provide

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excellent opportunities for covering the last mile and help in the outreach into rural communities.

GOAL F: Facilitate Capacity Development
ICID would work towards continuous capacity development of professionals including young professionals through training programmes, promoting irrigation and drainage as relevant academic topics in education and training within the context of integrated water resources management, and will try to foster closer connections with various stakeholders including farmers through NCs.

Strengthening the ICID network will be key
Strengthening of the ICID network, partnerships and enhanced visibility for ICID will be crucial in tackling the complex challenge presented by the water, poverty, inequality and climate change nexus. In order realise the vision of a water secure world that is free of poverty and hunger, one of the first steps Reinders is taking as the new ICID President is to mobilise the Commission's numerous partners and inform them of the critical link between agricultural water management and enhanced food production.

"ICID's partners around the globe include a number of stakeholders. The national committees represent various stakeholders engaged in different facets of agricultural water management in their respective countries. Farmers are the end- and most important user of the knowledge that the network provides through its national committees, and as such, they constitute the key stakeholders. We will also target irrigation and drainage professionals, as they operate in the large public and private sectors and play a crucial role in various aspects of agricultural water management."

Reinders believes that policy-makers have the responsibility to ensure provision of the basic necessities to citizens within the framework of given natural, financial, and human resources in an institutional setting (legislation, organisations, and regulations). The irrigation and drainage industry — that includes public sector agencies, private consultancy companies, individual consultants, contractors, manufacturers, and service providers — plays an important role in the transfer of technology in today's global marketplace.

Academia, research and the extension workers coalesce into a multi-disciplinary research team that plays a critical role in understanding the complexity of issues in agricultural water management.

Finally, society at large, being the ultimate consumer of agricultural produce and as a competing water consumer in various forms, is impacted by the way the network serves farmers to produce more food and fibre with limited water resources and without adversely impacting the environment.

South-South cooperation for capacity development in irrigation management
ICID emphasises South-South cooperation for capacity development in the field of irrigation management. It also has a *Position Paper on the Green Revolution in Africa* and an emphasis on drought management. These are issues we in Africa work on every day. By driving these agendas in ICID, developing countries can benefit.

Reinders agrees. "As 24th President of ICID, I believe we as South Africa are bringing a vast amount of knowledge to the table. The Green Revolution was the result of a sequence of scientific breakthroughs and development activities that successfully fought hunger by increasing food production. The beginnings of the Green Revolution are often attributed to Norman Borlaug, an American scientist interested in agriculture. In the 1940s, he began conducting research in Mexico and developed new disease resistance high-yield varieties of wheat. By combining Borlaug's wheat varieties with new mechanised agricultural and irrigation technologies, Mexico was able to produce more wheat than was needed by its own citizens, leading to its becoming an exporter of wheat by the 1960s. Prior to the use of these varieties, the country was importing almost half of its wheat supply. Due to the success of the Green Revolution in Mexico, its technologies spread worldwide in the 1950s and 1960s.

"In a world that faces new challenges and is more sensitive to the sustainability concerns, it is important that a framework for the 'Second Green Revolution' which aligns itself with sustainable development principles is clearly articulated and fully comprehended to enable all stakeholders to contribute towards the desired objectives in a synergetic collaboration. It has to cover the regions that got a miss in the first edition, for example the African continent was unable to reap the benefits of the first Green Revolution. Similarly within countries in Asia, for example India, the east and north east states were not privileged enough to benefit from the first Green Revolution.

Continues Reinders: "We believe that through the efforts of our national committees in Africa and support from other national committees of ICID network, we will be able to facilitate the second Green Revolution as envisaged by leaders in Africa, including former UN Secretary General Kofi Annan."

Who is Felix Reinders the professional and the person?
Professionally, Reinders completed his engineering studies in 1979 at the University of Pretoria and started his work at the then Department of Agriculture's Directorate of Irrigation Engineering. Working now for the ARC's Institute for Agricultural Engineering, he has a passion for agricultural engineering. "As a professional engineer, I play a pivotal role in the co-ordination of irrigation research, development, testing, design and training." He serves on several International committees and is also previous

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Felix was elected as the President of the International Committee of Irrigation and Drainage at the organisation's 23rd congress held in Mexico in October.

President of the South African Institute of Agricultural Engineers and the South African Irrigation Institute.

Reinders' primary achievements include research on an infiltrometer to size centre pivots, which received international recognition. He is the main author of the ***Water Conservation and Demand Strategy for Agriculture*** as an outflow of the 1998 National Water Act of South Africa. He developed and implemented a mobile irrigation laboratory to determine the performance of irrigation systems in the field.

Like any good researcher, Reinders has authored many scientific papers, chapters in books and articles on irrigated agriculture. He has been involved in organising various international and national symposiums and congresses. He is passionate about education and has trained students on an international (IHE Delft Institute for Water Education) and national basis (universities), successfully mentoring young engineers and technicians to enter the engineering market. He serves on local international committees and has presented various scientific irrigation engineering papers at congresses and symposiums.

Reinders developed a new water use efficiency framework for South Africa, he developed two manuals on drip irrigation (designers- and farmers' manual), and he formulated and compiled the national drainage design manual for South Africa.

Every professional needs to find balance in their busy schedule and Felix Reinders and his wife, Rika, are passionate gardeners. "We love to grow our own vegetables. We also have a selection of orchids and we built ourselves a net house with automated micro and drip irrigation. Further, we love to visit the Kruger National Park on an annual basis because for us, it is South Africa's most exciting destination. Steeped in legend and history, the iconic Kruger National Park in South Africa is there for us to explore its vast landscapes and spectacular African wildlife. Over years, we have created timeless memories with our five children where we spent quality time and during the evening enjoyed the time together around the campfire. When our children, with our grandchildren (the ninth is to be born in the New Year) visit us, we also make time to just enjoy our beautiful country."

"Strengthening of the ICID network, partnerships and enhanced visibility for ICID will be crucial in tackling the complex challenge presented by the water, poverty, inequality and climate change nexus."

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WATER AND HEALTH

What 115 years of data tells us about Africa's battle with malaria past and present

A completed project to synthesise African-wide data on malaria has contributed significant insight into the multifaceted interactions affecting transmission rates on the continent. This article by Bob Snow of the Centre for Tropical Medicine and Global Health at the University of Oxford.

It is difficult to accurately measure the number of people who get malaria each year. This is because the malaria symptoms are shared with many other diseases that lead to death or illness, especially among young children.

However, there is a measure of malaria that is precise. Testing for the malaria parasite among large numbers of people provides a Parasite Rate, a useful measure of the quantity of malaria in any given area.

Surveys are done on a known number of people by malaria control programmes, non-governmental organisations and researchers. Although they don't tell us how many people are sick, the number of infected people in an area is indicated.

The Centre for Tropical Medicine and Global Health at the University of Oxford spent the last 21 years tracking down malaria survey reports done across Africa. The greatest challenge was that they were mostly hidden in old government archives or curated by the World Health Organisation.

Most of the records were either poorly stored, burnt or were missing. In some countries like Kenya, Senegal, Tanzania, South Africa, Botswana, Namibia and Burkina Faso the surveys dated

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back to the 1950s. Conversely, recent surveys have been easier to locate through more modern web-based searches.

To obtain village or school level data published in most journals or reports, scientists and government officials provided the raw data. This is a testament to a new era of data sharing where over 800 people have contributed finer resolution data.

The final report covers over 50 000 surveys dating back 115 years. This is the largest repository containing information on over 7.8 million blood tests for malaria. We analysed malaria infection prevalence for each of 520 administration units across countries south of the Sahara and Madagascar for 16 time periods.

The study suggests that the prevalence of malaria infection in sub-Saharan Africa today is at the lowest point since 1900.

Declining malaria rates

Overall, there was a decline in the number of children infected with malaria at 24% between 2010 and 2015 compared to 40% between 1900 and 1929. The biggest historical reduction in malaria coincided with the introduction of new tools to fight malaria. After the Second World War, the discovery of DDT for indoor spraying and chloroquine drugs made a difference in treating malaria.

Investment in malaria control in Africa has been sporadic in the past. The world has seen a reduction in malaria over the last 15 years, based largely on the use of treated bed nets and antimalarial drugs. If we take our eyes off the ball then rising drug resistance and falling control will lead to the sorts of increases we saw in the 1990s.

Again, in 2005 the rolling out of insecticide treated bed nets and new anti-malarial drugs led to a further drop of malaria cases. The lowest periods of malaria prevalence were evident when the international community abandoned specific malaria control investment in Africa, during the late 1960s, through the 1970s and early 1980s. As a result, every fever was treated with chloroquine, an amazingly effective drug. There was a prolonged drought across the Sahel. This was the perfect lull.

However, from the late 1980s chloroquine resistance expanded across Africa. It was made worse in the 1990s when unprecedented rainfall led to flooding causing major malaria epidemics. Governments in Africa were unprepared because they did not have significant mosquito prevention and management strategies in place. Malaria cases increased and the prevalence was similar to those described before the Second World War. The perfect storm.

It took over five years for the international community to appropriately respond by providing free, and effective malaria treatments to vulnerable persons in the affected countries. They ensured access to effective malaria prevention tools which a decade earlier had reduced the malaria risk by half.

The Global Fund's financial boost and the revisions of the 2005 World Malaria Report led to one of the largest drops in malaria infection prevalence witnessed.

More effective strategies needed

The gains made after 2005 have stalled since 2010. Declining malaria funding, insecticide and drug resistance are the obvious threats to the elimination of malaria in Africa.

Despite an impressive overall decline in malaria prevalence since 1900, Africa has the highest infection risks globally. Large parts of the West through to Central Africa and down to Mozambique continue to have intense malaria transmission.

Unfortunately DDT, new insecticides, chloroquine and new combination treatments and insecticide treated bed nets have not been effective enough to shrink this high malaria burden. New tools are required.

Drug resistance poses a significant threat to efforts to curb malaria.

What next?

There is an urgent need to focus on the high burden countries in Arica, they should not be left behind in a new global agenda for malaria elimination. It is complex, and predicting a future malaria landscape based on climate or economic development alone would be foolhardy. It needs a more integrated approach.

What we can say, however, is that the malaria gap in Africa might shrink a bit at the margins, but that middle belt isn't going anywhere in our lifetimes with what we have at our disposal now – bed nets and drugs.

When insecticide and drug resistance becomes established, unless we have new classes of both drugs and insecticides or a natural period of drought, malaria will revert in large parts of Africa to what it was in the 1990s, another perfect storm.

The article first appeared in www.theconversation.com

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WATER SUPPLY

Reclaimed water – A valuable supply if you can trust it

In the national conversation about water scarcity and the concerns around the drought in the Western Cape in particular, one often hears discussions about groundwater abstraction and seawater desalination to augment drinking water supplies. But there is another attainable, viable and affordable solution often missing from these discussions — direct reclamation of municipal wastewater for drinking purposes. A transdisciplinary research team advises, in a recent Water Research Commission (WRC) report, that we have to engage and educate the public to ensure informed acceptance before reclaimed water is rolled-out. Article by Kim Trollip.

South Africa is a water-scarce country. Any additional source of water should be used, and when it comes to alternative water sources, there are many, of which reclaimed water is one. But the water sector needs to ensure public support before this source is rolled-out across the country.

"The reclamation of water for drinking purposes has a vital role in augmenting supply in order to meet the ever growing demands for drinking water," says WRC drinking water treatment and quality specialist, Dr Nonhlanhla Kalebaila. "Treated wastewater effluent should be regarded as an alternative raw water resource for drinking water production, and it can free considerable amounts of source water for the environment and increase flows to vital ecosystems."

Several reports have emanated from a project entitled ***An investigation into the social, institutional and economic implications of reusing reclaimed wastewater for domestic application in South Africa*** (WRC Project No. K5/2208). Initially the research focused on establishing guidelines on the monitoring, management and communication of water quality (Volume 1). In a follow-up investigation, the work shifted focus to institutional and social factors influencing public acceptance of reclaimed water for potable uses in South Africa (Volume 2).

During this second phase of the project, the researchers found that public perceptions of risks associated with using reclaimed water are initially dominated by the "yuck" factor, because the idea is at first repugnant. But an additional, unexpected dimension to public resistance to reclaimed water for potable use emerged… and it had nothing to do with the so-called yuck factor. It had to do with public trust in municipalities and water service institutions.

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The overall aim of phase two was to investigate and test the major factors that govern people's decisions towards the use of reclaimed water for drinking purposes; and to develop strategies and tools to inform better information-sharing and public engagement within the institutional decision-making process for introducing reclaimed water. The intention was to find ways to influence public perceptions through public knowledge acquisition and information flows, and to engage with the public in order to overcome resistance and build trust, so as to assist water institutions effectively to introduce and manage water reclamation schemes. The researchers found a significant lack of trust in the ability of municipalities and water service institutions to deliver safe water.

Public acceptance of reclaimed water in South Africa remains contentious because of social and institutional factors. Within each municipal context and at stages of the institutional process for introducing water reclamation, opportunities for public queries and institutional responses can serve simultaneously to enhance social learning and build trust in public institutions.

Christophe Muanda of the Cape Peninsula University of Technology (CPUT), lead author of Volume 2 of the research, says the potential of reclaimed water will only be realised if there is a strong associated public education campaign. "Decision-makers, mayors, premiers, community leaders and even teachers need to be briefed and can then participate in the campaign. Journalists too must play a role. We need to look at the language that is used when discussing the issue. Let's call it 'water reclamation'. I heard a journalist on the radio talk about 'municipal sewerage'. It is important to use the correct terminology i.e. recycled or reclaimed water, and ensure that there is mutual understanding on water reclamation technologies and as well the quality and fitness for use of the final water."

The report recommends that water institutions engage with identified target groups to shift public resistance toward acceptance and promotion. The report proposes an approach that will address public resistance to improve acceptance of water reclamation. It is hoped that its findings will aid municipalities in their quest to improve service delivery through productive engagement with the public.

Water reclamation measures up well to other water supply options

There is a comprehensive scenario planning and options analysis process that is normally conducted during water resources planning. This entails identifying multiple "what if" conditions that consider a range of possible factors, including social, environmental (physical), technical, economic, and/or institutional, in order to identify the best water supply option over time, i.e. short, medium and long term. Compared to reclaimed water, groundwater and desalinated water are fairly established drinking water sources, not just in the Western Cape, but in South Africa, and can be implemented fairly quickly. Water reclamation from treated domestic wastewater effluent represents a shift from the largely accepted drinking water supply strategies and requires significant investments in time for feasibility studies, including public engagement and participation.

Groundup/Ashraf Hendricks

Dwindling surface sources have shifted the focus to alternative supplies.

Co-author of Volume 2, Prof Alvin Lagardien of CPUT, adds that as a water scarce country, vulnerable to climate change impacts and increasing urban water demand, it is inevitable that water reclamation for potable applications will became an essential component of supply-side arrangements. He says, "It is in this context that public understanding of water scarcity risks and reclamation as an option paves the way for getting over the 'yuck' factor. In situations where available water supply becomes constrained and water restrictions are implemented, the 'yuck' factor becomes increasingly less significant to South Africans."

The Beaufort West success story

Cities and larger towns produce treated effluent that holds huge potential for further use. **Beaufort West** bears the distinction of having launched South Africa's first direct potable reuse (DPR) plant, where treated wastewater effluent is conveyed directly to a **water** treatment facility for further treatment to drinking **water** standard.

Muanda, who calls himself a social civil engineer has over the past decade moved from hard core engineering to incorporate aspects of social science in his work. He worked closely with experienced social scientist, Dr Jacky Goldin, of the University of the Western Cape on the social aspects of this particular project.

The Beaufort West project had its challenges initially when residents expressed concern. It was ultimately ongoing two-way communication with the local residents that resulted in a successful roll-out. The WRC's Dr Kalebaila adds that, "Water reclamation projects, just like any other project, require active stakeholder and community participation, and not just as part of fulfilling regulatory requirements. It is something that should be done from the beginning. Public participation and engagement is necessary during water resources planning, and ensures mutual understanding of the choice of water sources available.

"In addition to the above, there is a need to streamline the institutional process for the implementation of water reclamation projects in order to improve their adoption and lessen both real and perceived risks to public health."

A framework for examining the readiness of water institutions to implement water reclamation

Based on the findings, public acceptance of reclaimed water in South Africa remains contentious because of social and institutional factors. Within each municipal context and at stages

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of the institutional process for introducing water reclamation, opportunities for public queries and institutional responses can serve simultaneously to enhance social learning and build trust in public institutions. Volume 2 concludes that water institutions should engage with identified target groups to shift public resistance toward acceptance and promotion. The research proposes an approach that will address public resistance to improve acceptance of water reclamation. It is hoped that the findings will aid municipalities in their quest to improve service delivery through productive engagement with the public.

International and local studies essentially agree that negative public perceptions of reclaimed water relate to factors hinging on public knowledge and trust in the institutions responsible for producing the water. This qualitative study of the social and institutional implications of reclaimed water for potable applications has also developed guidelines to enable institutions to address public perceptions so as to ensure the successful implementation of reused water schemes.

The guidelines, Volume 3, provide a framework to address negative public perceptions in this regard.

There is a knowledge deficit in the public domain about water scarcity and the specific strategies to reconcile supply and demand at a local level. From a supply-side perspective, as part of local reconciliation strategies, there are is a hierarchy of options to augment supplies based on local conditions and technical and economic considerations. It is this context that the value proposition of reclamation should be highlighted and proposed as viable and desirable.

The guideline evolved around the several stages in the institutional process for the implementation of reclaimed water schemes and emphasised two elements, knowledge and public engagement.

Guidelines for public engagement on water reuse

Planning: the public is informed about water scarcity with tangible evidence and predictor signs through public awareness campaigns and meetings. Then the purpose, outcomes and impacts of the reconciliation and feasibility studies must be explained through public meetings, discussion forums, information centres and media, both before and after the studies have been conducted.

Reuse decision: the municipality's selection of reclaimed water technology should be conveyed, with endorsement of its benefits, the efficacy of the treatment and its cost-effectiveness. Reference should be made to examples of successful implementation, with leaders/celebrities assisting at public gatherings. Information should also be disseminated through discussion forums, school visits, the media and water bills.

Implementation: public knowledge of safety measures, the capabilities of the plant operating staff and management in respect of operating and maintaining the plant, should be shared through public meetings, site visits, information centres, school and general awareness programmes.

Post-implementation: information about the safety of treated water, monitoring programmes, water quality (water quality parameters, frequency of tests and results), safety measures and risk management plan should make use of guided plant visits, information campaigns and road shows.

The broader research team and the WRC agree that more work needs to be done beyond the guidelines. For example, there remains an absence of documentation providing guidance or a framework for examining the capabilities and readiness of water institutions to implement water reclamation. It is therefore recommended that further research be undertaken to understand and evaluate water services institutions' readiness and capability to introduce water reclamation and implement a strategic approach to overcome public concerns. The objective is to develop a set of criteria that could be used to predict the capacity and readiness of water institutions to undertake the implementation of water reuse.

The article is based on findings from a project entitled: ***An investigation into the social, institutional and economic implications of reusing reclaimed wastewater for domestic application in South Africa*** (**WRC Project No. K5/2208**). The project has produced a series of three reports thus far:

- Volume 1: ***Guidance on Monitoring, Management and Communication of Water Quality*** (**WRC Report No. TT 641/15**)
- Volume 2: I***nvestigation into institutional and social factors influencing public acceptance of reclaimed water for potable uses in South Africa*** (**WRC Report No. TT 734/17**)
- Volume 3: ***Framework guidelines for public engagement on water reuse*** (**WRC Report No. TT735/17**)

To order any of these reports, contact Publications at Tel: (012) 761-9300; Email: orders@wrc.org.za or Visit: www.wrc.org.za to download an electronic copy.

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WASTEWATER TREATMENT

From waste to worth – converting wastewater sludge into high-value products

Sludge management forms a huge part of wastewater operations in South Africa. Whereas in the past, sludge was viewed as nuisance waste to be disposed of at significant cost, there is now a general consensus in the wastewater industry that sludge is a potential source of valuable resources and alternative green energy. This has been further reiterated by the 2017 World Water Development Report, which highlights improved wastewater management based on reducing pollution at source, removing contaminants from wastewater flows, reusing reclaimed water and recovering useful by-products. Article by John Zvimba and Eustina Musvoto.

Lani van Vuuren

Energy recovery is achieved through two primary pathways; biochemical conversion and thermo-chemical conversion, and these produce different end products. Some proven and well established technologies such as anaerobic digestion, gasification and pyrolysis fall into these two pathways, and are currently utilised for wastewater management.

The choice of technology is influenced by factors such as the quality of the feed sludge, the quality of and markets for the by-products, regulatory requirements and public perceptions. Apart from the proven and established technologies, emerging technologies based on hydrothermal carbonisation, such as Polymeric Carbon Solid (PCS) can also play an increasing role in energy recovery from sludge within the South African context and, more importantly, in supporting the circular economy.

The PCS technology is a catalytic thermo-chemical process that takes place in an aqueous solution to produce a biofuel at elevated temperature and pressure (optimal 240 °C and 3.3 MPa). While other technologies have used sub- and supercritical water to produce a biofuel, the reagents used by the PCS technology significantly reduces the temperature and pressures required.

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As a result, the reduced temperature and pressure decreases both capital requirements and operating expenses. The technology is tolerant to impurities, and accepts a wide range of feedstock, including municipal solid waste, sewage sludge, animal manure, agriculture waste, wood products (including sawdust, lumber, bark, branches, forestry) and construction waste.

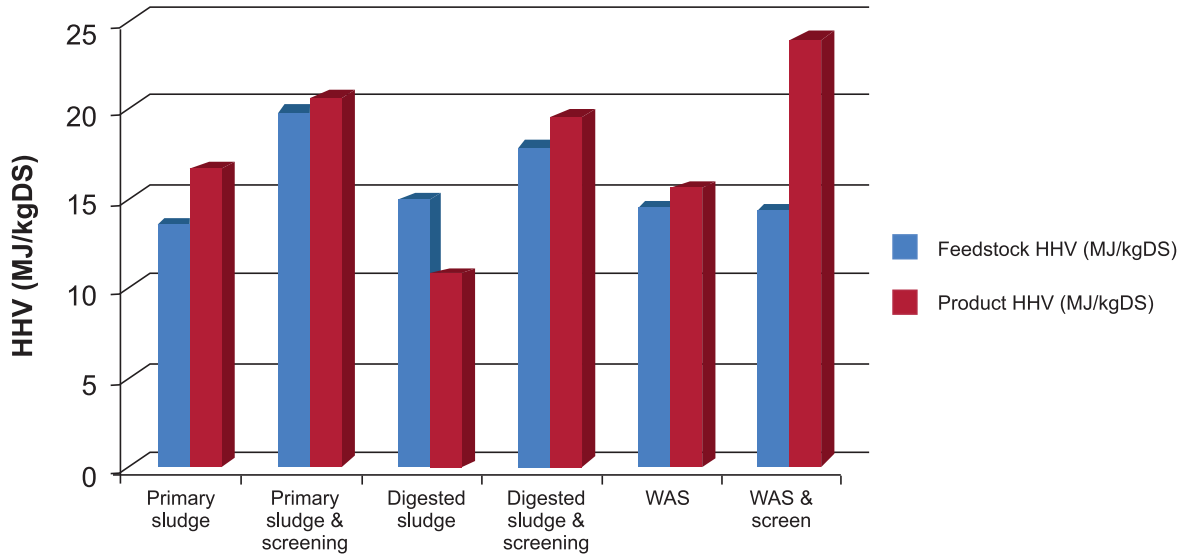
The technology is a carbon neutral process that recycles carbon dioxide and does not contribute to global warming while by-products produced have low toxicity. The simplicity of operation in PCS technology plants makes them suitable for installation in any setting where a significant amount of biomass is accumulated. PCS plants use specialised infeed systems for wet or dry biomass.

A typical plant consists of a mixing tank, pressure vessels where the chemical reaction occurs, and buffer tanks for storage of the end product and the excess energy. The pressure vessels are designed as a self-contained process to transfer maximum energy into the next tank with minimal start up energy and minimal odor or noise emissions. The exothermic energy is recycled so that PCS plants have a positive energy balance.

The PCS technology has numerous advantages over the current most employed mature and proven waste to energy technologies. The advantages of the PCS technology include:

- Carbon dioxide – neutral process with no methane production.
- Wet process – biomass can be used without expensive pre-drying as required in gasification.
- Accepts a very wide range of biomass types, and can safely process problematic wastes that currently require expensive disposal e.g. hospital and biological waste.
- Not in competition with food production as only agricultural and forestry waste is used.
- Exhibits the highest carbon efficiency value of all technology options (PCS = 100% / Biogas = 50%) and can be easily scaled up in continuous batch process.
- Intensive exothermic process converting biomass at molecular level with net energy gain in a self-contained process with little odor or noise emissions.
- Low investment and maintenance costs, operating at moderate pressure and temperature.
- No specialist skills needed in production process based on its straight forward technical operation.
- Environmentally friendly; residual water is sterile and harmless to the environment.
- Resulting biofuel is hydrophobic, easily dewatered and processed into high value products (bio-coal for combustion purposes and biochar for soil conditioning and improvement).

In South Africa, laboratory and pilot-scale studies on processing mostly municipal wastewater sludge carried out to date using sludge from wastewater treatment plants have demonstrated a net energy gain of 3 – 5 GJ/kg using the PCS technology.



Calorific Values (HHV) for feedstock and PCS technology processed product.

The data from these studies play a significant role as feeder into the design of full-scale plants for the recovery of high value products from wastewater sludge, as the main feedstock or in combination with other biomass within the South African context. In this regard, the benefits of adopting and applying the PCS technology for the treatment of sewage sludge within the South African wastewater sector are quite numerous.

The PCS process treats both sludge as well as sludge with screenings at short processing times of 1 hour and temperatures from 180 °C to 240 °C. Pilot-scale studies have shown that an optimal temperature of 210 °C need to be applied to give a high-quality product.

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The process increases the calorific value of primary sludge and waste activated sludge to the level of low grade coal (lignite/ sub-bituminous), which makes the product a clean useful biofuel with very low emissions compared to coal. However, the calorific value of digested sludge is generally low due to anaerobic digestion. The process reduces volatile and total solids by 40 - 62% and 22 – 37% respectively when processing sludge only.

The high solids reduction for digested sludge has shown that despite the product having a lower calorific value, the PCS technology can be applied to process digested sludge and further reduce the quantity of biosolids for final disposal thus saving on disposal costs.

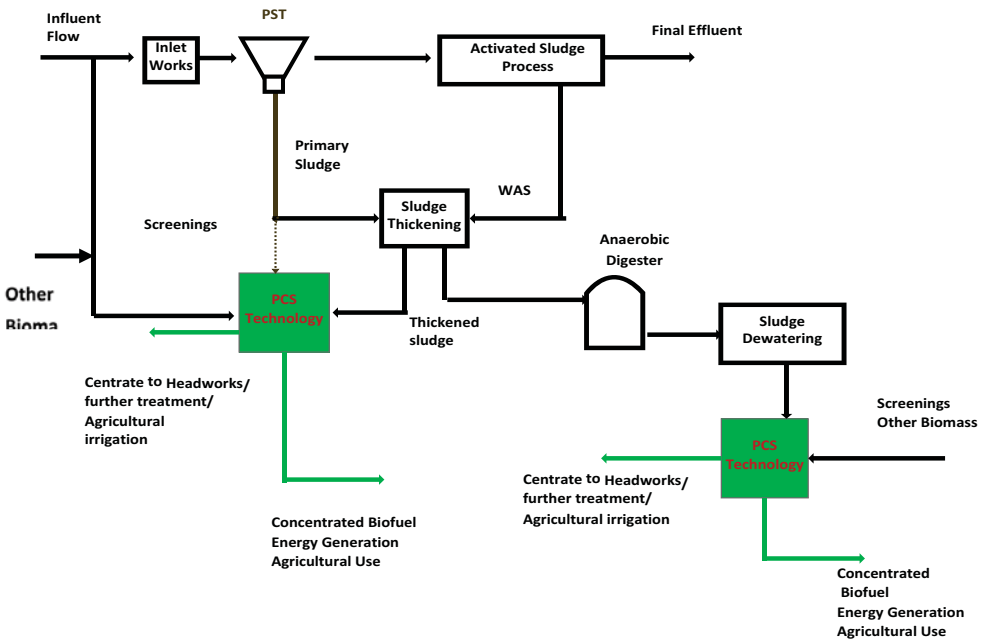
The processing of combined sludge and screenings increases the calorific value of the product by up to 35%. In this regard, the process not only provides a single solution for sludge and screenings handling at wastewater treatment plants but also presents an opportunity for co-processing wastewater sludge with other biomass (e.g. municipal solid waste, food waste, agricultural waste etc.) from the community.

More importantly, the process produces a sterile, inert product without any microbial activity, of a biosolids quality that is above the Department of Water and Sanitation requirements for microbiological Class A and stability Class 1. This therefore gives a wide range of options for beneficial use, for instance, agricultural (depending on metal content and pollutant class), commercial products (e.g. adsorption media, solid biofuel with metal recovery, brick making, cement making).

Generally, the pilot-scale studies to date have demonstrated that the PCS technology treats wastewater sludge to a higher quality than that achieved with the commonly applied biochemical conversion aerobic and anaerobic digestion processes widely applied in South Africa. Moreover, the PCS process also converts the sludge to a useful biofuel and commercial product.

In addition, the studies have also demonstrated that the technology can be applied to post treat digested sludge further reducing sludge quantity for disposal. This, therefore, provides an opportunity for technology coupling at treatment plants that already have sludge digestion processes thus avoiding making the existing infrastructure redundant. The ability to co-process sludge with other biomass offers a unique opportunity to produce a high value biofuel (and other useful commercial products) and the vison of converting wastewater treatment facilities into resource recovery centres a reality.

In this regard, a conceptualised schematic for incorporation of PCS technology into an existing typical South African wastewater treatment plant has been proposed.



Schematic layout of incorporation of PCS technology at a typical wastewater treatment plant.

The feasible incorporation of PSC technology into the existing South African wastewater treatment infrastructure presents further opportunities for supporting implementation of circular economy principles at wastewater treatment facilities as part of sustainable wastewater management. This can have significant benefits as it has potential of catalysing wastewater treatment facilities into integrated economic hubs, not only treating wastewater for effluent compliance, but key resource recovery centres, thereby fostering innovation and mutual beneficial partnerships with communities.

Moreover, this approach has potential of creating new business models and jobs, including developing new skills and investments in communities as well as reducing the carbon foot print, thereby mitigating the impacts of climate change.

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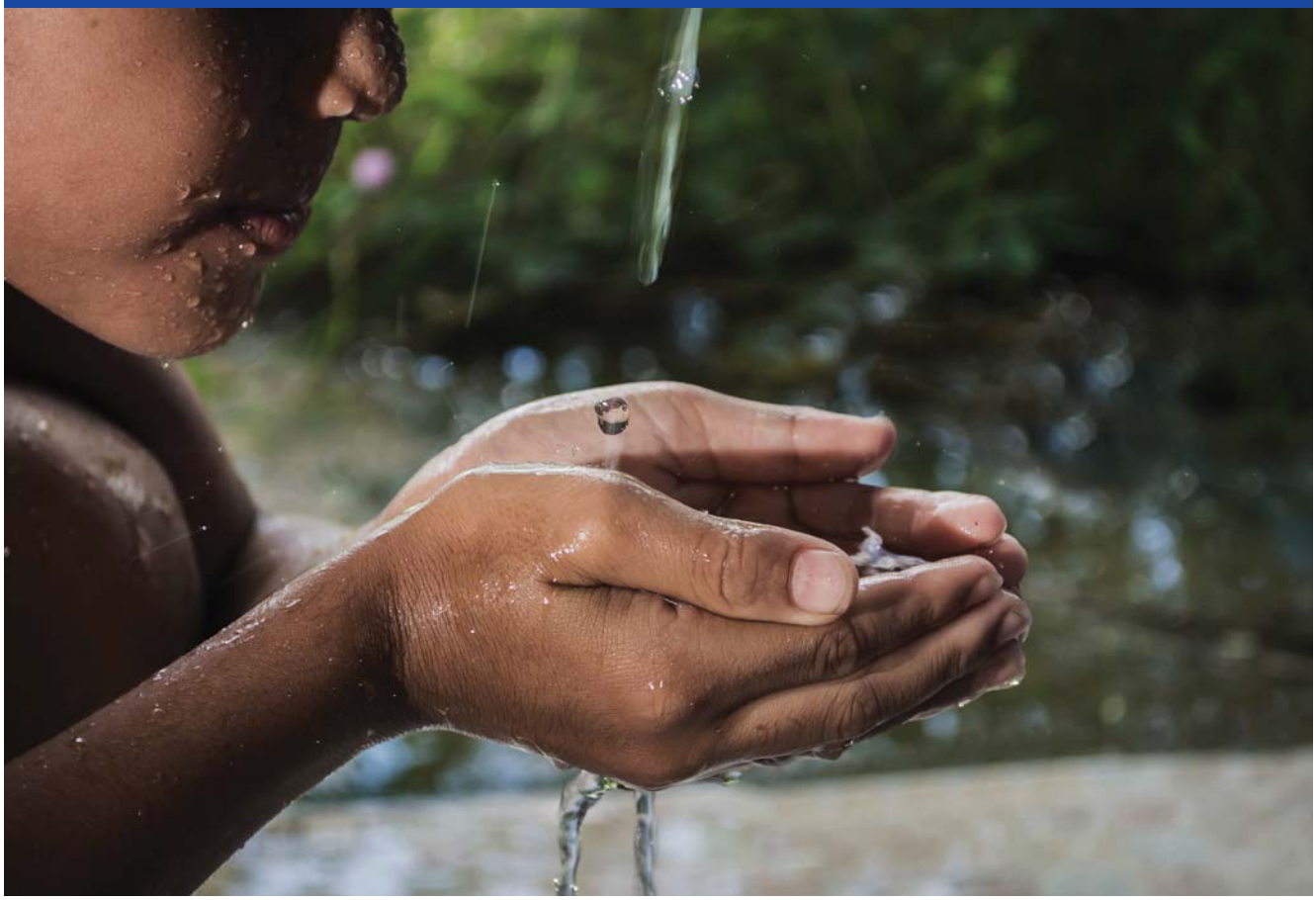
OPINION

Out-of-the-box thinking required to secure SA's water future

We need to unlock more water resources and drive efficiency in our existing supplies to stimulate the economy and job growth. This is the opinion of Dr Shafick Adams, Executive Manager of the Water Research Commission (WRC).



As our climate is changing and the main input into our water resources, rainfall, becomes more variable in time and space we need to adjust how we manage and value our water resources. Water is an important cog in our economy. The challenges we face are not only on the supply-side, but also on the demand-side.

On the one side the custodians of our water resources are blamed for our water woes through poor planning and operation and maintenance. Water users are blamed for excessive water use. South Africa's per capita water use is of the highest in the world. The world average is 170 L per day compared to our average of 235 L per day, and in some metropolitan areas can reach 600 L per day. This is while we have rural communities that still do not have adequate access to water – some below 50 L per day.

There is a need to radically change how we supply and use water in this country. As our water demands grow we should do things differently while tackling our challenges head-on.

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Access to water is a key requirement to grow the economy at all levels. Three barriers to economic growth are recognised by economists – improper infrastructural investment, skills and education development and public service delivery.

The traditional and established means of water supply have worked well when only a small population was served. It is increasingly more difficult to serve scattered communities owing to challenges in settlement densities and topography among others. The way we manage our water resources also needs radical transformation. Post-1994, we have achieved a great deal in getting people connected to water infrastructure. However, the question remains, are these connections supplied with water all the time? Did we only add how many water supply points we have installed? We have reported for the Millennium Development Goals 88.3% safe water access. Did we also subtract the failed or unsustainable systems? Basic domestic water supply remains a challenge.

Let us consider what is called the "Priority District Municipalities that are dysfunctional" – these municipalities sit on top of our higher exploitable groundwater resources areas. Yet the resource is ignored in the main or poorly managed.

Because we are obsessed with building dams; groundwater can be considered the Cinderella resource. What are some of the root causes? Firstly, groundwater is an invisible resource to the layperson. It is difficult to determine its volumes as opposed to a dam this leads to a perception problem about its assurance of yield – it needs to be developed and managed by skilled personnel. Secondly, it has a lower capital expenditure cost compared to dams but a higher long-term operational cost.

It seems that our financial systems cannot deal with this phenomenon and most favoured projects are those with higher capital expenditure over a shorter period. In addition, the financial burden is on the municipality for local water schemes and they tend to prefer receiving piped water from another Water Services Provider to externalise planning and logistics.

Thirdly, the distribution infrastructure and abstraction systems need to be operated, maintained and managed in addition to how the aquifers respond to the abstraction – this is no easy task. Lastly, the institutional biases to dams and now desalinisation plants. At the local municipality level where groundwater is a conjunctive or sole source of supply management is poor or absent.

A WRC study recently surveyed 24 municipalities that uses groundwater as a domestic supply source and 71% of these municipalities do not have a groundwater management plan and 17% do not know if they have a plan while only 13% of the municipalities have plans. This is also reflected in the lack of specialised groundwater personnel in the employ of the municipalities – 79% do not have the required skill to manage their groundwater supply schemes.

This is clearly a recipe for disaster and points to poor governance provisions. When a groundwater scheme fails, the tendency is to blame the resource as unreliable while the real reason is poor management and institutional arrangements. The myth that groundwater is always cheap to manage, available in exploitable quantities all over the place, always potable and free are some of the factors that creates the perception that it needs limited management.

Groundwater is but one example of how we do not use available resources to meet our increasing demands. By including this under-utilised resource in our water supply mix with other water sources like direct wastewater reuse, rain and stormwater harvesting we can improve our water security.

At the same time, we need to overhaul our deteriorating water infrastructure. The WRC estimated that our non-revenue water loss amounts to around R7 billion and a large part is because of leaking infrastructure. The War-on-leaks programme and artisan training programmes is a step in the right direction.

On the demand side, we need to radically change our approaches to water use across all sectors. We need to upscale sanitation technologies that uses no or significantly less water to flush our toilets. The WRC has have prototyped toilets that can be flushed with less than one litre of water.

The way we design our buildings and cities need to radically change to become water and energy efficient. Imagine the manufacturing opportunities if we need to retro-fit cities and create new industries that supply water wise technologies. This needs to be supported by an increase in research and development spending. Our declining manufacturing sector certainly needs this push.

The net benefit will be to the economy; water innovations and technologies can contribute to get us out of this 'growth trap' that we find ourselves in. South Africa's water economy can reduce the high levels of unemployment, poverty, and inequality. Water and sanitation wise manufacturing is a great way to achieve this. Inefficient use and management of our water resources hampers our growth efforts and water needs to be better valued as a major direct and indirect contributor to GDP.

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Water KIDZ

Urban wetlands – prized land

When you think about a city, you usually think about scyscrapers, busy roads and bustling sidewalks. But many cities are also home to some very special water ecosystems – urban wetlands.

Every year, the world celebrates its wetlands with special events held on or around 2 February. The theme for this year's World Wetlands Day is urban wetlands. The theme is decided by the Ramsar Convention on Wetlands, an international organisation which promotes the conservation and wise use of all wetlands.

What are wetlands? Commonly referred to as marshes, bogs or vlei's, wetlands are land areas that are flooded with water, either seasonally or permanently. Urban wetlands are those wetlands that are found in and around cities. As cities expand and demand for land increases, the tendency is to encroach on wetlands. Thousands of urban wetlands around the world have been polluted, filled in and built upon.

Yet, when left intact or restored, urban wetlands makes cities liveable. First of all, wetlands reduce flooding. Wetlands act as giant sponges that absorb flood waters. Wetlands also filter waste and improve water quality – the silt-rich soil and abundant plants in wetlands function as water filters, which absorb some harmful toxins, agricultural pesticides, and industrial waste. Urban wetlands also help treat sewage from households.

Did you know that wetlands can also help improve urban air quality? Wetlands radiate moist air thanks to their high water levels and lush plant life. This naturally cools the air in the local surroundings; a relief both in tropical cities and in extremely dry climates.

When preserved as green spaces in cities, wetlands offer residents a space for recreation and access to diversity of plant and animal life. Studies confirm that interacting with nature

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reduces stress and improves our health. South Africa has many urban wetlands that play an important part in the way people live and work in our cities. Here are just a few of them.

Rietvlei wetlands, Pretoria
Hidden in the Rietvlei Nature Reserve, an urban nature reserve owned and managed by the City of Tshwane, lies an important wetland. The Rietvlei wetland is a rare example of peatland in South Africa, and plays an important part in purifying water that enters the Rietvlei Dam. This dam provides around 15% of Pretoria's water. A few years ago the government, through its Working for Wetlands initiative, launched a project to rehabilitate the Rietvlei wetland special peatland, which was drained decades ago for peat mining, dryland cropping and irrigation purposes.

Blesbokspruit, Ekurhuleni
Located on the East Rand of Gauteng in Ekurhuleni Municipality, the Bleskbokspruit is one of the largest wetlands on the Highveld. This wetland has especially known for its birds, and more than 220 species have been recorded. In the past the wetland has supported up to 20 000 waterbirds, and for this reason Bleskbokspruit has been designated a Ramsar Wetland of International Importance.

The Blesbokspruit is valuable to the ecosystem of the area because of its ability to purify industrial and domestic discharge from local industries, sewage works and mines. This reduces the amount of pollution entering the Vaal River, one of the most important rivers in the country. Unfortunately this pollution has degraded the wetland, leading to a reduction in bird populations.

Colbyn valley, Pretoria
Located just 5 km from the Union Buildings in Pretoria, the Colbyn Valley wetland is another rare example of a peat wetland in South Africa. The peat layer in Colbyn has been estimated to be about 7 000 years old. The wetland plays a vital role in groundwater retention, which helps to ensure year-round flow in the Hartbeesspruit. Despite being situated next to busy roadways and a railway line, the wetland is home to at least 150 bird species, and animals such as genets, duikers, hedgehogs, elephant shrews, water mongooses and even red rock rabbits (a threatened species) have been spotted there. Voluntary organisation, Friends of Colbyn, have worked tirelessly over the years to protect the wetland against potential development, and hold regular walking tours and other activities to make people more aware of the value of the wetland.

Klip River, Soweto
Stretching over 25 km, the Klip River wetland, south of Johannesburg, has proven one of Gauteng's most valuable natural assets through its ability to treat heavily polluted water. This poor wetland receives water that has been contaminated by acid mine drainage, industrial sources and from sewage treatment plants. The purified water flowing out of the wetland eventually enters the Vaal River, making this one of the economically most important wetlands in the country.
You can make a difference to South Africa's wetlands all year round in a number of different ways. The Endangered Wildlife Trust, who does much around the protection of wetland habitats for threatened bird and animal species, suggest the following:

The Rietvlei wetland is home to many animal, bird and plant species.

Courtesy Tamsyn Sherwill

The peat in the Colbyn valley wetland is an estimated 7 000 years old.

- Plan a wetland clean-up in your community.
- Reduce your waste, reuse bottles and containers you would normally throw away, use reusable shopping bags and recycle!
- Report any illegal dumping in wetlands and rivers to your municipality.
- Find a 'friends' group near you and volunteer your services to protect wetlands and river ecosystems.

Want to know more? Here are some Web resources
- Ramsar Convention, www.ramsar.org.
- What is a wetland?, https://www.youtube.com/watch?v=E_EBcJy335s
- Working for Wetlands, https://www.environment.gov.za/projectsprogrammes/workingfowetlands
- Friends of Colbyn Valley, https://www.facebook.com/Friends-of-Colbyn-Valley-113301492142149/
- Friends of Rietvlei, www.friendsofrietvlei.org

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RIETVLEI DAM – FAITHFUL SUPPLIER OF WATER TO THE CAPITAL

For over 80 years the Rietvlei Dam, located south east of Pretoria has been providing the South African capital with water.

Constructed between 1930 and 1934 by the then Pretoria municipality, Rietvlei Dam is located in the Sesmylspruit, a tributary of the Hennops River. Prior to the construction of this dam the only water supply to the town, which by 1928 had around 75 000 residents, came from dolomitic resources in the Fountains valley.

The dam was built on the farm Rietvlei, which is today managed as a nature reserve. Most of the construction work on the dam was done by hand, including construction of the dam wall and all associated brick work. All the soil was carted away by mule carts and oxwagons (numerous horse shoes can still reportedly be found on the site). The dam wall, an earthen structure with a central concrete core and hand-packed rip -rap, was constructed to a height of 32 m, and a length of 350 m. A concrete-lined chute spillway varying from 90 m wide at the crest to 47 m wide at the discharge end is located on the left flank. The concrete outlet tower feeds water to the adjacent purification plant through a concrete culvert beneath the wall.

Today, Rietvlei Dam still provides around 15% of the City of Tshwane's water requirements. In 1990, the spillway capacity was increased from 1 100 m^3/s to 2 500 m^3/s for the dam to meet modern safety requirements. In addition, dam wall stability and the security of the outlet works were improved.

Constructed during the economic depression years of the 1930s, most of the original dam wall was built by hand.

The concrete outlet tower feeds water to the adjacent purification plant.

Rietvlei Dam forms part of the scenic Rietvlei Nature Reserve.

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WATER RESEARCH COMMISSION

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WATER TECHNOLOGIES DEMONSTRATION PROGRAMME
An initiative of the Department of Science and Technology and the Water Research Commission

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Accelerate technologies to the market

SERVICE OFFERINGS FROM WADER

01 Some funding for technology demonstrations

02 Access to information on a range of technologies

03 Credible technical information

04 Opportunities to connect/link with other entrepreneurs/innovators/ test bed partners

05 Matchmaking with municipalities, innovation players, funding organisations & investors

06 Growth of SMMEs and enterprise development

07 Technical advice using scientific protocols

08 Driving innovations in priority areas of the Water RDI Roadmap and the NWRS II

KEY STAKEHOLDERS FOR WADER

- Entrepreneurs/ innovators
- Water boards/ utilities/municipalities
- SMMEs
- Investors/funders (local and international)
- Government departments
- Technical consultants

Website: www.wader.org.za

DEEPLY ROOTED IN SOUTH AFRICA WATER SOCIETY

www.wrc.org.za

The Water Research Commission not only endeavours to ensure that its commissioned research remains real and relevant to the country's water scene, but that the knowledge generated from this research contributes positively to uplifting South African communities, reducing inequality and growing our economy while safeguarding our natural resources. The WRC supports sustainable development through research funding, knowledge creation and dissemination.

The knowledge generated by the WRC generates new products and services for economic development, it informs policy and decision making, it provides sustainable development solutions, it contributes to transformation and redress, it empowers communities and it leads various dialogues in the water and science sectors.

The WRC Vision is to have highly informed water decision-making through science and technology at all levels, in all stakeholder groups, in innovative water solutions through research and development for South Africa, Africa and the world.

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