THE WATER WHEEL

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ESTUARIES AND RIVER MOUTHS

New report seeks solutions for Durban Bay plastic pollution problem

SLUDGE MANAGEMENT

New strategy sets out sustainable path for sludge management in SA

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A project funded by the Water Research Commission (WRC) sought to find sustainable solutions to the ecological degradation of Durban Bay. *Article on page 10.*

NEWS

New water research centre focused on arid regions

Sol Plaatje University (SPU), in collaboration with the Water Research Commission (WRC), officially launched the Arid Region Water Research Centre (ARWRC) on 14 April 2025.

The event marked a significant milestone in addressing critical water security issues affecting the Northern Cape and in other regional and global arid regions.

The launch brought together key stakeholders from the water, research, academic and policy sectors to celebrate a bold new chapter in interdisciplinary collaboration and scientific innovation. The official ribbon-cutting ceremony was led by Prof Debra Meyer, Deputy Vice-Chancellor: Research, Innovation and Postgraduate Studies at SPU; Dr Jennifer Molwantwa, CEO of the WRC; and Prof Martin Ntwaeaborwa, Dean of the Faculty of Natural and Applied Sciences at SPU.

Prof Meyer described the centre as "a partnership of high hopes", expressing confidence that the ARWRC will contribute to reshaping water security in the Northern Cape and similar regions globally. She affirmed SPU's commitment to enabling research that delivers long-term societal impact, particularly in the face of climate and infrastructure challenges.

Dr Molwantwa highlighted the centre's pivotal role in addressing water challenges through the integration of indigenous knowledge systems, active citizen participation and a strong focus on groundwater resilience. She also praised Sol Plaatje University's dedication to training future researchers and supporting the centre's mission to develop locally grounded, globally relevant expertise.

The ARWRC will serve as a national hub for interdisciplinary research, policy development, and capacity building. It will focus on water quality, sanitation, alternative water sources, the water-energy-food nexus and long-term climate adaptation strategies for arid environments.

Source: Sol Plaatje University

Irrigation sector stalwarts recognised at symposium

Four of South Africa's irrigation sector stalwarts were recognised at the recent symposium of the South African National Committee on Irrigation and Drainage (SANCID). The symposium was held in Bloemfontein from 6-8 May with the theme 'Sustainable irrigation towards food and water security in an era of increasing climate change threat'.

At the gala dinner, Profs Chris du Preez and Leon van Rensburg, both formerly from the University of the Free State, received awards for their contribution to capacity building and research. Meanwhile, a special Lifetime Achievement Award was awarded to Dr Pieter van Heerden, for his contribution to SAPWAT, an international award-winning program for estimating irrigation water requirements of crops, farms and drainage or administrative regions for planning purposes.

Lastly, a leadership award was given to Prof Sylvester Mpandeli. Prof Mpandeli, a Senior Research Manager at the Water Research Commission, is the youngest ever recipient of the SANCID Leadership Award. He sits in several strategic advisory committees across the globe, and is the Vice President of the International Commission on Irrigation and Drainage (ICID).

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Call for climate-smart cattle breeding to promote food security

Heat stress is among the most urgent climate-related challenges affecting beef cattle productivity, requiring South African cattle breeders to adopt climate-smart strategies to bolster food security under changing environmental conditions.

"Heat stress is becoming a major threat to livestock productivity," said Prof Giel Scholtz of the Agricultural Research Council (ARC) in an online guest lecture hosted by the North-West University's (NWU's) Faculty of Natural and Agricultural Sciences on 24 April 2025. Prof Scholtz is a specialist researcher in applied animal breeding at ARC Animal Production and a researcher focused on sustainable livestock systems.

He explained that when humidity levels rise above 80%, the temperature threshold for heat stress in beef cattle drops from 30°C to 27°C. This heat stress reduces feed intake, delays growth, impairs fertility and affects meat quality. Heat stress can also lead to reproductive inefficiency in both male and female cattle, Prof Scholtz said. "If the temperature goes above 27°C, semen quality decreases and some sperm die. It takes eight weeks for new sperm to be formed, meaning even one day of extreme heat can influence bull fertility."

He presented data showing how indigenous breeds such as the Afrikaner and Nguni are more resilient than exotic breeds. "In 2015/16, the hottest and driest year recorded, Angus and Simmental types showed a 70% decrease in growth rate during heat waves, while the growth rate of Afrikaner and Nguni only dropped by 9%."

The importance of feed efficiency under climate pressure was also raised. "We saw bulls eating less but weighing more, probably due to increased water intake," he noted. "Nguni bulls increased water intake by up to 50%, while the Afrikaner bulls did not change their water intake at all."

Prof Scholtz stressed the importance of using indigenous or adapted breeds for future breeding strategies. "Our indigenous breeds are our heritage for food security," he said. "They are better adapted to survive and reproduce under harsh environments."

He concluded the lecture by calling for new breeding priorities focused on smaller body size, lighter hair colour, darker skin pigmentation and the effective use of crossbreeding. "We need animals that are resilient, that recover quickly, and that can bounce back after extreme climatic events."

Source: NWU

Diary

Aquatic science
29 June-3 July
The annual congress of the Southern African Society of Aquatic Scientists Congress will be held in Pietermaritzburg, KwaZulu-Natal with the theme, 'Aquatic Science and Practice'. The event is hosted by the Institute of Natural Resources and the University of KwaZulu-Natal.
For more information, visit: https://sasaqs.wixsite.com/sasaqs2025/

Water and sanitation
8-10 July
IFAT Africa is the ultimate platform to showcase technologies and solutions for water, sewage, refuse and recycling for the sub-Saharan Africa market. The trade fair is the gateway for international companies to the African market and for African enterprises to the global market, connecting key industry players with senior buyers and decision makers in the region.
For more information, visit: https://ifat-africa.com/en/

Water treatment
10 July
The Water Institute of Southern Africa (WISA) is offering an online masterclass in coagulation and flocculation aimed at process controllers.
For more information, visit: https://wisa.org.za/event/masterclass-coagulation-flocculation-water-treatment/

Groundwater
15-19 September
The 52nd Congress of the International Association of Hydrogeologists will be held in Melbourne, Australia. This event, held in conjunction with the 2025 Australasian Groundwater Conference, marks a significant return of the World Groundwater Congress to Australia after 12 years. Organised by ICMS Australasia.
For more information, visit: https://iah2025congress.com/

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Inactive components in agricultural runoff may be hidden contributors to drinking water hazards

Inactive ingredients in agricultural, pharmaceutical and other common products have typically been excluded from consideration as potential contaminants in drinking water. However, while these chemicals are inert in certain products, they can still pose hazards when combined with other materials during the drinking water treatment process.

A new study from researchers in the McKelvey School of Engineering at Washington University in St Louis reveals how large this impact might be. Jean Brownell, a graduate student working with Kimberly Parker, associate professor of energy, environmental & chemical engineering, led the investigation. Brownell examined the use of amines in herbicides and their potential role as precursors to nitrosamines, harmful byproducts formed during water disinfection.

Brownell discovered that inactive amines, which are used as stabilising agents in herbicides to increase solubility and reduce drift, may be more important than active agents in herbicides when it comes to forming disinfection byproducts (DBPs) linked to various health risks, though the impacts vary by region and time. The results were published in the April 15 issue of ***Water Research***.

"Everybody needs healthy food to eat and clean water to drink, so there is clear motivation for us to look at how herbicides used in agriculture impact water treatment downstream," Brownell said. "We need herbicides to support effective modern farming, but we also need to examine our assumptions about these products to make sure we haven't missed side effects that might pose risks to people's health and safety. That's why we're analysing trends in herbicide use that have changed over the past 20 years but have not been reevaluated in terms of how those changes also impact chemical precursors of DBPs."

Brownell compared the annual use of amines in herbicides to other known nitrosamine precursors, such as the widely used pharmaceuticals ranitidine and metformin. She found that the use of amines in herbicide formulations has increased in recent decades. Because of the quantity of amines used, Brownell found that these inactive agents are potentially much more important nitrosamine precursors than researchers previously thought. Amines from herbicides have the potential to enter the environment at rates similar to precursors from pharmaceuticals. This could have significant implications for water treatment processes, as nitrosamines are known to pose serious health risks even at low concentrations.

To read the original journal article visit: https://www.sciencedirect.com/science/article/pii/S0043135425000302?via%3Dihub

Mobile, low-cost arsenic detection tool for safe water

Researchers at the Indian Institute of Technology (IIT) Jodhpur have developed a new low-cost mobile tool to detect arsenic contamination in water sources, addressing a critical threat to human health and the environment.

Published in IOP Publishing's academic journal ***Nanotechnology*** the new tool offers a low-cost, onsite solution for monitoring water quality, especially useful in low-income regions where access to safe drinking water is a major challenge. The sensor is the first to provide on-site, accurate and repeatable results without the need for complex lab equipment or skilled labour.

Arsenic contamination in water is a serious health hazard, causing illnesses like skin cancer and other health issues even at very low levels. It is estimated that nearly 43 000 deaths annually are attributable to chronic arsenic exposure. Traditional methods for detecting arsenic in water, such as spectroscopic and electrochemical techniques, are highly sensitive but often require expensive, complex equipment and skilled labour. These methods are not practical for widespread, real-time monitoring, especially in low-income regions where the need is greatest.

The new detection tool uses advanced technology to detect arsenic ions in water quickly and at extremely low concentrations. The sensor can measure arsenic levels as low as 0.90 parts per billion (ppb) with a quick response time of just 3.2 seconds.

Mahesh Kumar, lead author of the paper says: "We've designed the sensor with usability in mind, ensuring that even people in remote areas can benefit from it. By connecting the sensor to a circuit board and an Arduino module for real-time data transmission, we've made it perfect for portable and onsite detection. Our ultimate goal is to reduce the number of deaths and prevent the serious diseases caused by arsenic contamination and to provide safer drinking water for everyone."

To view the original journal article, visit: https://iopscience.iop.org/article/10.1088/1361-6528/adcc37

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Harmful microplastics infiltrating drinking water

Despite advances in wastewater treatment, tiny plastic particles called microplastics are still slipping through, posing potential health and environmental hazards, according to new research from The University of Texas (UT) at Arlington.

"What our systematic literature review found is that while most wastewater treatment facilities significantly reduce microplastics loads, complete removal remains unattainable with current technologies," said Un-Jung Kim, assistant professor of earth and environmental sciences at UT Arlington and senior author of the study published in Science of the Total Environment. "As a result, many microplastics are being reintroduced into the environment, likely transporting other residual harmful pollutants in wastewater, such the chemicals Bisphenols, PFAS and antibiotics. These microplastics and organic pollutants would exist in trace level, but we can get exposure through simple actions such as drinking water, doing laundry or watering plants, leading to potential long-term serious human health impacts such as cardiovascular disease and cancer."

According to the study, one of the main challenges in detecting and mitigating microplastics is the lack of standardised testing methods. The researchers also call for a unified approach to define what size particle qualifies as a microplastic. "We found that the effectiveness of treatments varies depending on the technology communities use and how microplastics are measured to calculate the removal rates," said the study's lead author, Jenny Kim Nguyen. "One way to better address the growing microplastics issue is to develop standardised testing methods that provide a clearer understanding of the issue."

"This work helps us understand the current microplastics problem, so we can address its long-term health impacts and establish better mitigation efforts," said Karthikraj Rajendiran, a co-author of the study and assistant professor of research from UTA's Bone Muscle Research Centre within the College of Nursing and Health Innovations.

The team also emphasizes the need for greater public awareness of microplastics to help consumers make more eco-friendly choices. "While communities must take steps to improve microplastic detection and screening at the wastewater and water quality monitoring, consumers can already make a difference by choosing to buy clothing and textiles with less plastics whenever feasible, knowing that microfibers are the most common microplastic continually released through wastewater," Kim concluded.

To read the original journal article, visit: https://www.sciencedirect.com/science/article/abs/pii/S004896972500453X?via%3Dihub

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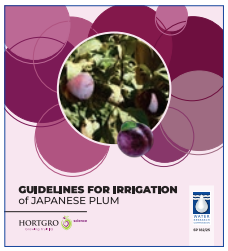
NEW WRC REPORTS



Guidelines for irrigation of Japanese plum

In order to achieve maximum production potential of Japanese plums and use water efficiently, farmers need to know the crop water requirements, the type of soil and optimal cultivation and management practices to be applied in each orchard. Understanding these relationships will make a difference between success and failure in the production, yield and economics of fruit production. Irrigation is even more critical in high-density orchards, where the economic success depends on obtaining high yields after a few years to be able to repay the investment costs. This booklet provides a visual guideline to plum farmers in order to optimise irrigation.

WRC report no. SP182/25
Link: https://bit.ly/4j1vwt3

Infrastructure performance, water governance and climate change impacts on water resource management for smallholder farmers in the Western Cape, South Africa

Water security is a persistent challenge for South Africa's agricultural sector, with smallholder farmers facing disproportionate impacts due to limited access to resources and systemic inequities in water governance and infrastructure. Climate change, manifesting through extreme weather events such as droughts, has intensified these challenges by reducing water availability and increasing competition for resources. Ageing, inadequate water infrastructure, and governance inefficiencies have further hindered smallholder farmers' access to reliable water supplies. This project sought to evaluate the intersection of climate change, water governance, and infrastructure performance, specifically focusing on smallholder farmers in historical towns in the Western Cape.

WRC report no. 3194/1/24
Link: https://bit.ly/4mbKgZ7

Implementation guideline for managed aquifer recharge (MAR) in combination with blue-green infrastructure (BGI) at local settlement level

Existing water resource management practices in many South African cities are not resilient to climate change impacts. This has necessitated the consideration of more adaptive urban water supply, sanitation and stormwater management systems that focus on diverse sources for water supply, improved water quality, flood protection, amenity and biodiversity. These include blue-green infrastructure (BGI) which can help to address some of the deficits of conventional urban water services provision. This project contributes to the need to build the evidence base for urban place-specific resilience-building initiatives, and the widening of state-of-the-art knowledge, by providing ethnographic and policy-focused research, and developing implementation guidelines based on a City of Cape Town demonstrative case study on managed aquifer recharge in combination with BGI for stormwater recharge at local settlement level.

WRC report no. TT 950/24
Link: https://bit.ly/3YdqHFw

Strengthening the Community of Practice working on the integration of water-related ecological infrastructure and built infrastructure in South Africa's water management areas

The Ecological Infrastructure for Water Security (EI4WS) Project is implemented by the Development Bank of South Africa (DBSA) and executed by the South African National Biodiversity Institute (SANBI). It has the long-term goal of integrating biodiversity and ecosystem services into planning, finance, and development in the water sector to improve water security. A critical component of the EI4WS project is to strengthen the institutional capacity and operational governance of catchment management agencies (CMAs). This research project acknowledges the many challenges facing the CMAs and aims to develop recommendations for a sustainable community of practice that can facilitate capacity-building and learning within and across the CMAs. This investment in CMA institutions is seen as critical in supporting the effective management of water resources and the longer-term protection and management of ecological infrastructure.

WRC report no. 3182/1/24
Link: https://bit.ly/4k9GZIx

A framework to support investment in ecological infrastructure: How to bring investors into the funding landscape

Ecological Infrastructure (EI) offers a variety of essential ecosystem services, including improved water quality, reduced flood risks, and opportunities for recreation, thus enhancing human health and wellbeing. With the ongoing degradation of EI, there is a growing need for investment in interventions aimed at protecting, rehabilitating and maintaining EI and the valuable services it provides to society. In the past, EI investment in South Africa was predominantly from government. However, there has been a growing need to source investment finance more broadly, including a variety of Development Finance Institutes (DFIs) and the private sector. In response to this tremendous need for EI investment, this framework has been developed to support DFIs and the private sector with investment in EI.

WRC report no. 3183/1/24 and 3183/2/24
Link: https://bit.ly/3GNYQWt (Framework) and https://bit.ly/4iWXWUM
(case studies)

The development of a locally based weather and climate model in southern Africa

South Africa has been using numerical weather and climate models, developed in the global north, where they are also tested for operational forecasting and informing policy developments for decades. Consequently, these models are generally optimal for the regions where they are developed, leading to potential biases and limitations in other areas.

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This project addressed the need for South Africa to actively contribute to and engage in model development. The project focused on enhancing the Conformal Cubic Atmospheric Model (CCAM), developed at the Council for Scientific and Industrial Organisation (CSIRO) of Australia, and has been in use in South Africa for over two decades. The aim of this project was to incorporate local expertise in model improvements, which is crucial for accurate simulations of weather and climate over the Southern Africa Development Community (SADC) region and the surrounding oceans.
WRC report no. 3181/1/24
Link: https://bit.ly/4mcoF2w

Determining water use and impacts on water resources of cannabis in the Eastern Cape and KwaZulu–Natal provinces
Interest in ***Cannabis sativa*** is growing globally and in South Africa, and the reasons for this are varied as it is a multipurpose crop that can be grown for fibre, seed, oil and medicinal properties. Hemp and marijuana both come from the same species ***C. sativa***, with the difference being that hemp has a tetrahydrocannabinol (THC) content of less than 0.3% and is typically cultivated for fibre or seeds, whilst a THC percentage higher than 0.3% classifies the plant as marijuana. Despite the potential benefits, economic and environmental, the water use of ***C. sativa*** remains largely unknown beyond the understanding that it is a water thirsty plant. The water use, or total evaporation of ***C. sativa*** has not been measured for growing conditions in South Africa, and estimates in the international literature are nearly non-existent. Given the growing interest in and promotion of ***C. sativa*** cultivation in South Africa, the need to determine the water use of this crop and the associated impacts on hydrological response has become critical. Understanding the water use and related impacts will allow for informed decisions regarding ***C. sativa*** cultivation to be taken and will prevent adverse impacts on already stressed water resources. This project aimed to address this lack of knowledge surrounding water resources and cannabis.
WRC report no. 3190/1/24
Link: https://bit.ly/4ka6gBD

Current status and future predicted distribution patterns of bilharzia-transmitting snails under climate change and implications for vector-borne diseases in South Africa
Schistosomiasis, commonly known as bilharzia, is an infection caused by the trematode parasites of the genus Schistosoma transmitted to humans through contact with water bodies that contain the molluscan vectors contaminated with the parasite. This disease is most prevalent in tropical and subtropical areas, particularly in poor and rural communities. Schistosomiasis is a serious public health issue in South Africa, with at least 4.5 million people infected with the disease annually and approximately 20 million people at risk of infection. The overarching aim of this research project was to determine whether the distribution ranges of the snail vectors and associated parasites of schistosomiasis have expanded in recent years, how affected human communities perceive and experience these changes, and whether changes in distribution may further expand and increase the potential prevalence of the disease in humans and animals in South Africa given future predicted climate change.
WRC report no. 3186/1/24
Link: https://bit.ly/4iTG8tP

The state of water quality in South Africa: A citizen science perspective
South Africa faces increasing pressure on its freshwater resources due to population growth, development, and reduced supply capacity. In light of the reality of growing freshwater resources challenges and the country's limited ability to comprehensively monitor the condition of these vital resources, citizen science (CS) has been recognised as a readily available technique for monitoring the state of freshwater resources. In the South African context, the application of CS techniques to monitoring water quality, particularly in rivers, can prove extremely useful considering the capacity limitations impacting monitoring acknowledged by the Department of Water and Sanitation. South African water management authorities face significant challenges in monitoring water resources due to capacity limitations and a lack of collaboration between government, private sector, and civil society. This research aimed to evaluate the potential which innovative citizen-based techniques could have on water resources monitoring, and subsequently, management. This research also evaluated the potential alignment of CS with tertiary education curricula, and future recommendations and plans for CS to explore the continuity of the practice.
WRC report no. 3189/1/24
Link: https://bit.ly/4m2OySq

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ESTUARIES AND RIVER MOUTHS

New report seeks solutions for Durban Bay plastic pollution problem

Durban's once pristine Bay is awash with plastic. A new Water Research Commission (WRC) report looks at what can be done to stem the wasteful tide… with lessons that should have wider application. Matthew Hattingh reports.

From the accounts of early visitors and settlers, it must have been a natural paradise.

In ***The History of old Durban and Reminiscences of an Emigrant of 1850***, George Russell writes of the Bay: "A large area between the town and the [Salisbury] island was covered with a grass-like seaweed, which… formed the happy hunting ground of various queer fishes as diverse, if not so melodious, as the imps who troubled St Anthony, skate, cuttlefish, small sand-shark, and even the turtle being plentiful. Seaweed washed up in heaps on the Bay foreshore, and the primitive [settler's] wife adopted it for mattress making until she found that no amount of fresh water would remove the ingrained salt."

Melodious imps and salty mattresses… Victorian chroniclers could be delightfully florid. Accounts today deploy more technical terms like "biodiversity" and "ecosystem services". No doubt the Bay is much changed from what Russell recalled. Indeed, a 2009 study of estuaries within the municipality of eThekwini (the name derives from ***itheku***, Zulu for bay or lagoon) rated the health of the Bay system as "highly degraded".

The country's extraordinary economic expansion, particularly after the discovery of diamonds and gold in the latter half of the nineteenth century, stoked the development of Durban harbour infrastructure: dredging shipping channels; draining wetlands; building piers and wharves; and canalising the Bay's principal rivers. The last seagrasses disappeared in the mid-1960s along

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with most of the mangroves. By 2009, only about 15 ha, or about 3%, of the original mangroves remained.

The destruction and development impeded the natural circulation of water, causing polluted water entering the Bay to accumulate. The 2009 study focuses on chemical and wastewater pollution, but does mention the litter pouring into the Bay from the Umbilo, Umhlatuzana and Amanzimnyama rivers and from 50 stormwater drains.

A new report, ***Transforming the future of Durban Bay: Strengthening socio-ecological resilience*** (**WRC Report no. TT 945/24**), which focuses on plastic pollution, reminds us that in 1950 about 2-million tons of plastic pollution were produced worldwide; in recent years the figure reached 450-million tons. Its harmful effects are increasingly well documented and the report, published by the WRC earlier this year, tells how plastic degrades into microplastics and chemicals, in time poisoning water and soil, and threatening the health of humans and animals.

It disrupts natural systems and smothers living creatures. It forms dense mats with other debris, particularly from alien plant species, to block watercourses, causing flooding and damage to property. It's ugly too, discouraging tourism and necessitating beach and harbour cleanups. Storms in 2016, 2018 and 2019 dumped many tons of debris in the Bay, including considerable plastic, disrupting harbour operations and costing millions to clear — more than R5.6-million in 2019 alone.

Less well studied, said the report, were the "plastic pathways" connecting land and sea, and the causes of plastic pollution and its effects on society and ecosystems. Aiming to bridge this gap, the report draws on the work of authors Kendyl Wright, Sibusiso Mkhabela, Michelle Fourie, Catherine Sutherland, Nadia Sitas, Maike Hamann, Odirilwe Selomane, Wendy Dunn and Lindani Mtshali. The cross-disciplinary team represents Wildtrust (Wildoceans programme); uBoomi; the University of KwaZulu-Natal; Stellenbosch University; the Climate and Development Knowledge Network; the University of Exeter; and the University of Pretoria.

They noted a decline in water quality in the Bay and that more than 90% of its estuarine habitats have been lost. They hoped a deeper understanding of plastic pollution in the Bay's river catchments would help devise and apply policies and action

Mnqobi Zuma

A Blue Port team separates waste into different categories.

Kendyl Wright

Report co-author and Wildtrust research assistant Sibusiso Mkhabela beneath a canopy of mangroves in the Bay, inside what resembles a "cathedral of trees". Although degraded, the Bay remains ecologically important.

in the places likely to have the most leverage. Dr Wright, lead author, and a specialist on marine protected areas, said they had also sought to understand the governance, social and economic factors involved in plastic pollution.

Speaking at a report pre-launch in February, she sounded a call to action while offering the audience glimpses of hope. Wright shared a striking photograph of fellow author and Wildtrust colleague, Sibusiso Mkhabela, standing beneath a canopy of mangroves in the Bay, inside what truly resembled a "cathedral of trees". In another photograph, she pointed out textured patterns on a sandbank – evidence of crabs at work – vital creatures nearer the bottom of a food chain that supported fish and birds. Despite its degradation, the Bay remained ecologically important. Its natural systems, including surviving mangroves, offered a bulwark against climate change.

A socio-ecological system model, which revealed how most waste in the Bay has its origins upstream, forms the report's bedrock, tracing the effect of people on the ecology of the Bay and its rivers, and vice versa. It drew on earlier studies of river management and rehabilitation projects in eThekwini, notably of the Umbilo River. We learn how a vicious circle developed: The more rivers became degraded, "due to chronic issues such as aging infrastructure, pollution, a lack of service delivery and waste management systems, poor sanitation… floods and drought", the less people felt a "duty to care".

The river studies shared common threads. Settlements have grown and multiplied and are increasingly dense. The municipality struggled to provide regular services, including domestic solid waste collection. Black bags left at roadsides

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for collection were often ripped open by monkeys and other animals; waste-pickers (an important link in the recycling chain) when careless, damaged bags and spilled waste. This, and rubbish dumped in unserviced areas, was frequently washed or blown into rivers. Governance was failing, "with no-one taking responsibility or showing the leadership required to address the problem".

Yet it was neither reasonable nor realistic to expect the municipality to shoulder the burden alone, especially given its limited resources in a fast-growing city where illegal dumping was rife and people careless with their litter. Many of us toss chip packets and cold drink bottles from car and taxi windows thoughtlessly, leaving it to be buffeted along by traffic or wind until it reaches rivers flowing into the Bay.

Notably, most people interviewed for the Umbilo study claimed "plastic came from elsewhere" and that others were to blame for the high levels of plastic pollution. The levers for change in this instance, the authors felt, were education and communication campaigns aimed at "getting everyone… reflecting on their role in producing the waste". People needed to understand how plastic moved through catchments and take responsibility for its disposal and for their choices in buying or consuming plastic.

The report identified around a dozen drivers of plastic waste in catchments, along with levers to initiate corrective change. These included understanding the way plastic becomes hidden in the environment, in bushy riverbanks, only to be released during heavy rains. Fostering citizen awareness, responsibility and ubuntu were suggested levers, with the famed monthly citizen clean-ups practised in Kigali, Rwanda, given as an example worth emulating.

Mnqobi Zuma

A Blue Port waste picker weighs a sack of waste collected in Durban Bay. Tallies are kept of the quanities and types of plastic and other waste collected.

Mnqobi Zuma

Plastic, glass and other waste collected in the Bay.

To firm up initial findings and recommendations, the views of individuals and institutions with a stake in the state of the Bay were canvassed through an online workshop. Meanwhile, an ecological study helped the authors broaden their understanding of the problem beyond the anecdotal. From September 2023 to February 2024, a Wildtrust Blue Port project team completed a standing stock survey of litter accumulated in different Bay habitats. Of the 5.6-tons collected and sorted, 90% was plastic, including buckets, containers, tubs, disposable nappies, straws, cups, and variously sized fragments. Of this, macro-plastic pollution, single-use bags and chip and biscuit packets were the most commonplace.

"Further analysis of sufficiently intact plastic items identified… nine parent companies that were the main contributors to plastic waste in Durban Bay: Simba, Frimax, Imbazo Foods, Coca-Cola, Mondelez International Inc, Truda, Unilever, Tiger Brands, and Sun Foods." Truda and Frimax topped the list. The survey and analysis underscored the dominance of plastic pollution and the complexity of its pathways, said the authors. They called for comprehensive waste management strategies to address the sources and movement of plastic pollution, identifying three main themes.

The value of plastic is one theme. We use so much of it partly because it's so cheap. Thus, it's easy to toss after use and therefore more convenient. But this cheap plastic, especially the single-use stuff used in packaging, isn't particularly valuable to recyclers. The Blue Port initiative, established in 2015 to help rejuvenate the Bay and whose clean-up crew did the grunt work for the stock survey, was busy when your correspondent joined them at the Durban Yacht Mole on 18 March.

We clambered down the rocks that form a breakwater around the mole, collecting plastic and other waste — some recyclable, some destined for the landfill. Concentrating on one sort of waste at a time to save on sorting later, we easily filled our sacks. Styrofoam punnets and fast-food boxes might make up one load, followed by a sack of high-density polyethylene and polypropylene – bottle caps, sealing rings, and a surprising number of snuff tubs and Aromat containers.

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The storms that lashed Durban from 19 February to 15 March, claiming six lives, brought a deluge of debris into the Bay. Spill Tech, a private contractor, had been at it for weeks clearing the bigger stuff, including lots of vegetation, with heavy equipment. But there seemed no end to smaller plastic rubbish, among rocks or half buried in the sand below the mole.

Tea break brought a pause to the back-testing tedium. Sitting on the rocks looking across the sandbanks towards Bayhead, I chatted to a few of the crew. Nobuhle Luthuli, 21, told me she has a child and was the sole breadwinner at her Umlazi home. The Blue Port crew of 44 mostly women, received R4700 monthly, thanks to support from the Youth Employment Services programme and sponsors like Nedbank. Luthuli wasn't sure what she would do for a living once her one-year contract ends. The job was OK, she said, but the crew was sometimes underappreciated by the public, who seemed only to see what hadn't been collected: "Lots of people say we are not doing anything."

Nearby, traffic roared beneath the tall palms on Margaret Mncadi Avenue, the historic Esplanade skirting the Bay's northern shore that still wears a certain gritty charm. Waterbirds flew overhead while house crows pecked at the contents of a takeaway box exposed by the tide.

The other two big themes flagged by the report were political will, and human-nature values.

The authors felt short-term, election-driven goals and the many pressing problems like poverty and unemployment sapped political leaders of the will to tackle pollution. This delayed or rendered action ineffective, corroding public trust. Corruption and governance snafus worsened matters.

Human-nature values concerned the disconnection many feel to the natural world, leading to apathy, and a belief that "the environment offers a seemingly unlimited waste removal service". People often believed waste management was the responsibility of the government. Meanwhile businesses folded their hands in the absence of "real consequences for the continued production and use of plastic". The authors felt support must continue for voluntary cleanups and the ongoing cleanup and waste-trap work of initiatives like the Blue Port. But in the long-term, more sectors must be roped in to tackle the pollution blight, especially businesses who profit from single-use plastic.

Carrots must be dangled and sticks wielded to promote deposit-return schemes and to require producers to set collection and recycling targets in line with new regulations. And policies were needed to "phase out or tax single-use plastics, including plastic bags, chip packets, straws and polystyrene containers". Better municipal waste collection, particularly in poorly serviced areas, and collaboration between the government, businesses and NGOs, were essential and this must be bolstered by dialogue, education and awareness campaigns.

"Ultimately, addressing plastic pollution in Durban Bay is not just about cleaning up the waste that currently exists but about transforming the underlying systems that drive plastic production consumption and disposal," the report said.

St Anthony, mentioned earlier in Russell's rhapsody on a once unsullied body of water, is revered as the patron saint of lost things, and invoked for the return of items, people… even spiritual goods. Time, perhaps, for a quiet word about our Bay.

Lethu Ngubane

Waste is recorded by category during work on the Durban Bay Yacht Mole.

RURAL WATER SUPPLY

Research project paints sober picture of rural water services

The Water Research Commission (WRC) co-hosted a webinar in April on rural water supply in South Africa, reviewing progress in service delivery and the challenges faced. Article by Sue Matthews.

Luke Romick/WMO

Last year, in an article titled 'Water and Sanitation Services – how are we doing?' in the September/October issue of ***The Water Wheel*** (see here https://bit.ly/4jRf1kE) I gave an overview of key findings from Census 2022, the General Household Survey 2023 and the most recent Non-financial Census of Municipalities, as detailed in publications by Statistics South Africa (StatsSA).

At that stage, I wasn't aware that a team from Partners In Development (PID) engineering consultancy were doing a much deeper dive into StatsSA and other data for a multi-year WRC-funded project focusing on rural water supply and sanitation services. Project leader and PID director David Still presented the findings in a webinar on 2 April, revealing the stark reality that – at the current rate and cost of backlog eradication – it will take another 20 years and more than R186 billion before all rural inhabitants have a piped water supply within 200 m of their dwelling.

Back in 2003, the then Department of Water Affairs and Forestry published targets in its Strategic Framework for Water Services for all people in South Africa to have access to functioning facilities for basic water supply by 2008 and basic sanitation by 2010. Admittedly, in his preface to that document, Minister Ronnie Kasrils wrote: "The targets we have set for ourselves are

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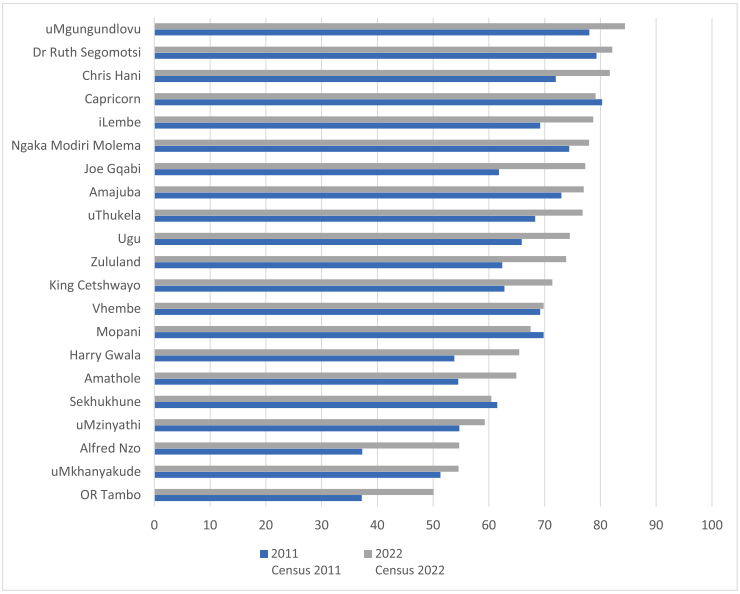
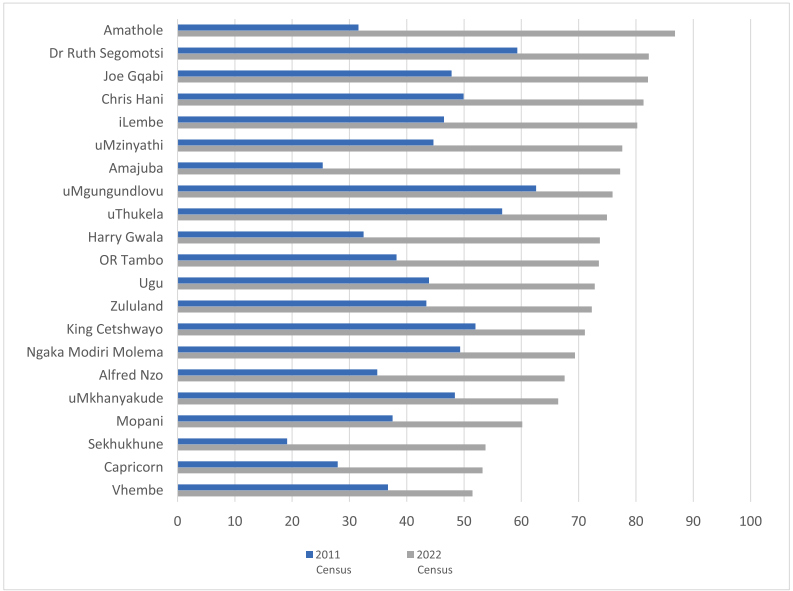
aspirational. The targets for access to water supply and sanitation services exceed those set out in the Millennium Development Goals. To meet them will require a concerted and collaborative effort on the part of all roleplayers."

Still remarked that those working at the coalface of rural water supply at the time certainly felt that the targets were overly ambitious, but there was good progress initially. According to Department of Water and Sanitation (DWS) data, only 44.4% of people in rural communities had access to a piped water supply within 200 m of their dwelling in 1994, and this had increased to 67% by 2011.

"I think there were some quick wins in the early years, but in more recent times it's getting harder to push that envelope," he said, pointing out that those still unserved live in communities more difficult to serve – apart from the fact that increasingly more money will have to be spent on maintaining existing infrastructure. The current low expenditure on maintenance can be seen as a time bomb for service reliability, suggesting longer and more frequent water outages in rural areas in the years to come.

The project focused on the period 2002 to 2022 and was confined to district municipalities that are also water service authorities. There are 21 of these so-called C2 district municipalities countrywide, with 10 in KwaZulu-Natal, five in the Easten Cape, four in Limpopo and two in North West. Together they serve over 17 million people according to Census 2022 data, which amounts to 28% of South Africa's total population and 65% of the rural population. Still noted that not all of those 17 million people are rural inhabitants because the districts do include some towns, but they are far more rural than urban. Vhembe DM in Limpopo has the largest population, with some 1.65 million people, and Amajuba DM in KwaZulu-Natal the smallest, with just under 180 000 people. The median population for all 21 C2 districts is 782 000.





The percentage of households with access to water within 200 m of the dwelling (top) and with improved sanitation (bottom) in 2011 and 2022 according to Census data.

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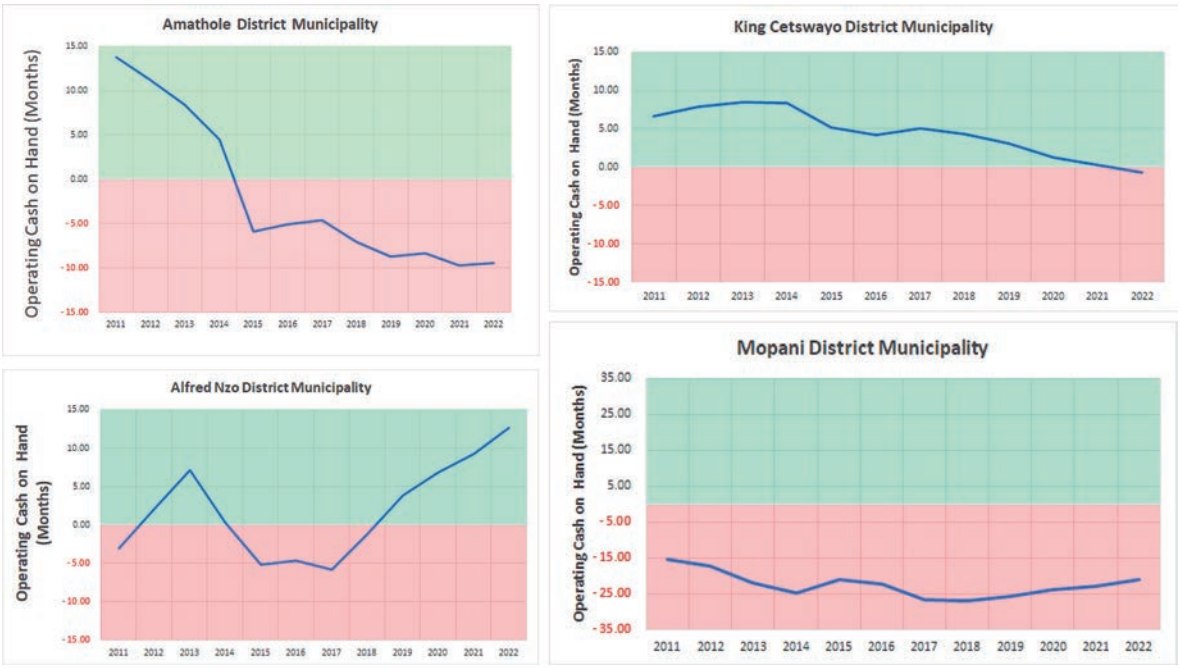

Operating Cash on Hand (OCoH) for four C2 municipalities during the period 2011 to 2022. While Alfred Nzo DM had more than a year's worth of OCoH by 2022, Mopani DM was effectively using that year's income to pay costs from two years previously.

More importantly, the C2 districts vary vastly in size, from Dr Ruth Segomotsi Mompati DM in North West at over 43 700 km^2 to iLembe DM in KwaZulu-Natal at just 3 270 km^2, with the median being 13 527 km^2. In comparison, the metropolitan municipalities serving Johannesburg, Cape Town and Durban (eThekwini) cover 1 645 km^2, 2 446 km^2 and 2 556 km^2 respectively. Of course, those three metros have considerably larger populations – each over 4 million according to the 2022 Census – but they don't have the district municipalities' logistical challenges of remote areas with poor roads.

District municipalities came into being with the municipal elections of 5 December 2000, but it took several years before their roles and responsibilities were resolved with the local municipalities within their borders, as well as other roleplayers such as water boards and DWS. So although a Census was carried out by StatsSA in 2001, the project team used the 2011 Census as the baseline for measuring progress in service delivery, comparing data on access to water supply and basic sanitation to that from Census 2022.

This revealed that the median of household access to piped water within 200 m of the dwelling in the C2 districts increased from 65.9% in 2011 to 73.8% in 2022. The lowest access, at only 50%, was in OR Tambo DM in the Eastern Cape, closely followed by uMkhanyakude DM in KwaZulu-Natal, where access had increased only marginally. In fact, the percentage access had declined in three of the districts because the population had increased faster than delivery of water services!

In the case of sanitation, the C2 median for households with access to 'improved sanitation' – in other words, a flush toilet connected to a public sewerage system, septic tank or conservancy tank, or a pit toilet with a ventilation pipe, known as a Ventilated Improved Pit (VIP) – had increased from 43.9% to 73.5%.

"These rural districts have been building hundreds of thousands of VIP toilets, so there's been quite significant progress there," said Still. "But the four in Limpopo – Mopani, Sekhukhune, Capricorn and Vhembe – seemed to be quite far behind."

Turning to Blue Drop and Green Drop scores, for which monitoring resumed in 2021 after being halted in 2013, Still mentioned that many people think these are a measure of the quality of water supply or final effluent.

"Quality is only part of it. Much of it is how organised are you, how well qualified are your operators, do you have the right kind of planning documents in place – a lot of it is about administrative compliance," he explained. "For Blue Drop, the median for the C2s is 55%, which puts them on the bottom end of what Blue Drop calls 'average', and for Green Drop it's 38%, which is considered 'very poor'. Only 15% of your Green Drop score is the quality of your effluent – 85% is to do with compliance issues. So if you have a 38% score, you don't know exactly how good or bad the effluent is, but the general principle is that if you're administratively not well organised, chances are your effluent is probably not so good either. The Green Drop score also does not tell you what percentage of your sewage actually reaches the treatment plant."

The star performers in the top two positions of both the Blue Drop and Green Drop scores were uMgungundlovu DM and iLembe DM, both in KwaZulu-Natal. In the project's summary report, it is noted that the uMngeni-uThukela Water (previously Umgeni Water) supplies most of the bulk water for these two districts, which considerably reduces their workload and provides them with a reliable supply of good quality water. Likewise, a perusal of the Green Drop National Report reveals that all of uMgungundlovu's six wastewater treatment works (WWTW) are operated by uMngeni-uThukela Water. All performed well, with scores above 80%, and one was awarded

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Green Drop Certification, resulting in uMgungundlovu being named the best performing municipality in KwaZulu-Natal. Siza Water operates two of iLembe's 12 WWTW, and both achieved Green Drop Certification, which pulled up the municipality's overall score. These were the only Green Drop Certificates awarded in the province, which has 147 WWTW in total.

Still drove home the point that the C2 districts contain a large number of treatment plants, whether for potable water or wastewater, and they are spread over an extensive area. While some may be operated by a service provider, many are not. "Amathole is operating 30 of its own water treatment plants, and another seven of its treatment plants are operated by Amatola Water, the water board. OR Tambo is operating 20 and Chris Hani is operating 22. That's pretty challenging! So these municipalities have got their work cut out for them."

Apart from evaluating the C2 municipalities' performance with respect to service delivery, the project team assessed their financial health by reviewing their audited financial statements, available from National Treasury, for the period 2011 to 2022.

"All of them show a profit every year, and all of them have a positive net asset value, which is just your assets minus your liabilities. If you have a positive net asset value, it means you are solvent in theory," said Still. "But there's a problem with that because for municipalities most of the asset value is actually the value of the infrastructure they own, in the form of property, plants and equipment. If you subtract the infrastructure from the net asset value, you actually get negatives with quite a few municipalities – in other words, the net asset value excluding property, plants and equipment for at least half of them is negative, which means technically they're not solvent."

How does one gauge the true financial health of a municipality then? Still showed the performance of a few of them over the years according to the liquidity ratios used by National Treasury – the current ratio and cash ratio. Current ratio is essentially current assets divided by current liabilities, while cash ratio is cash and cash equivalents divided by current liabilities. He noted that current assets include money that is owed, which means it can be skewed by creative accounting. In the case of Joe Gquabi DM, the 'consumer receivables' had ballooned from 25 million in 2015 to over R467 million by 2022. As Still remarked, they're never going to see it.

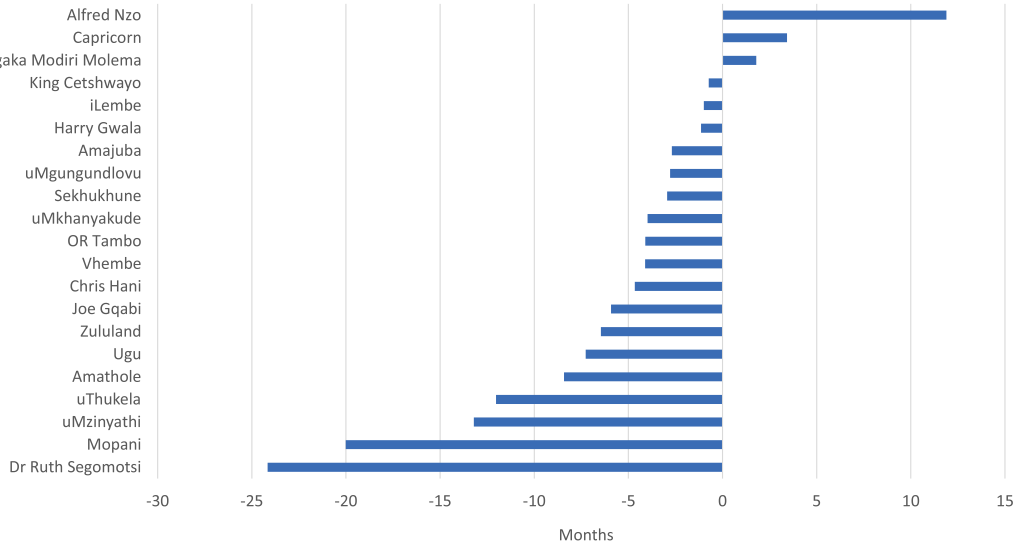
"So a better indicator is operating cash on hand, which we've called in our report OCoH, measured in months. Basically, it's a measure of how long you can continue operating even if you have no more income. Without income, how long can you coast before you're broke. You take your cash and your cash equivalents divided by your annual operating cost, times by 12. How many months can you survive? And obviously for a healthy organisation, you'd want to have several months of cash in the bank – at least a year would be great – but not negative."

Still then showed OCoH timelines for the period 2011 to 2022 for four of the C2 municipalities, with very different trajectories, as well as a graphic for all 21 depicting OCoH as of June 2022.

"Most of them are negative, down to Dr Ruth Segomotsi Mompati and Mopani, which are really catastrophically negative. And the median is minus 4.2 months. That's not a good situation. It means your service providers are going to be a bit scared to do business with you. They're not going to take a lot on trust, so that's not healthy."

One consequence of running at a loss is that municipalities stop paying the water boards, which is why some of the country's water boards are in financial trouble – or have already been liquidated in the case of Sedibeng Water, owed R600 million by Ngaka Modiri Molema DM. Alarmingly, municipal debt to water boards has grown from R8 billion in 2018 to R22 billion in 2024!

Another thing that municipalities stop doing is maintenance. Still noted that information was not easy to find because municipalities report on maintenance in their financials in different ways, but the project team's analysis found that maintenance expenditure as a percentage of the book value of property, plant and equipment for the period 2011 to 2022



In 2022, only three of the 21 C2 district municipalities had Operating Cash on Hand, and the median was minus 4.2 months.2022, Mopani DM was effectively using that year's income to pay costs from two years previously.

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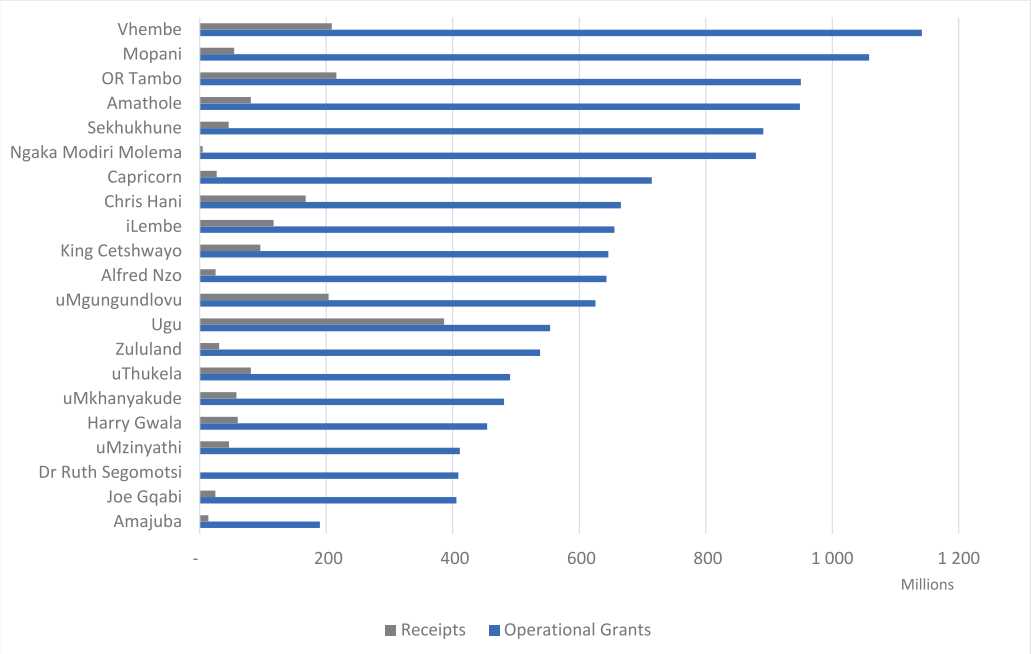

Operations grants versus receipts for services for 2022. Still pointed out that given this imbalance, it is not surprising that C2 municipalities are more incentivised to please National Treasury and comply with the Municipal Finance Management Act than they are to deliver services to the people.

averaged 1.2%, with a median of 0.6%. The Treasury guideline is 8%.

A possible solution to improve the municipalities' financial health might be to increase their operations grants, but those receiving higher grants to date are not necessarily financially stronger. And what about income from service delivery, where the collection rate is only 60%? Still remarked that the free basic water policy has led to widespread misunderstanding that all water services are free.

"The operations grants are 10 times more than what's collected for service charges, so for the 21 C2 municipalities, 90% of their income on average comes from operations grants. What they get from service delivery is quite a small share of that. So even if they got their collection rate up to 80–90%, it wouldn't make that much difference to their overall income."

Currently, much of the municipalities' money is going to their own staff. The project team found that they are typically spending 45% of total income from operations grants and service charges on salaries, and the median average staff cost in 2022 was R524 000, which would be 15% higher today. But even reducing the wage bill would probably not be enough to make the municipalities financially sustainable. The project team conducted a modelling exercise on what it should cost to operate and maintain the infrastructure the municipalities have, with a key input being the current replacement cost of infrastructure. The median modelled replacement cost of infrastructure was found to be R13.4 billion at 2024 values.

"For our 21 district municipalities, 16 of them are operating with less cash than they need to actually run these systems, and only five have got just enough. Most of them are working on about 70% of what they need, and you could argue that we may have underestimated the cost," said Still. He suggested that rather than building expensive infrastructure in places where there's very little money to sustain it, simpler technology should be adopted where possible. "We need to use modular, standardised and decentralised technology. The large regional schemes have been getting bigger and bigger, but they're very complicated, and if one thing goes wrong, then nobody gets water."

He stressed the need to increase expenditure on maintenance, recommending that the existing policy be changed to ensure that at least 50% of capital grants is spent on capital maintenance. Supply chain management practices also need to be reformed and the Municipal Finance Management Act amended to facilitate service delivery, rather than obstructing it.

At the district level, much can be done to improve cost efficiency and effectiveness. "If the municipality is failing, change the management team. We found a few examples where just overhauling the management team led to a turnaround in how things are going." He also recommended that municipalities get much tougher on consumers who do not pay for services. "There's got to be a change in South Africa on people not paying their bills. It's just not sustainable."

Still's presentation was very well received by the attendees, and a long Q&A session followed. In closing the webinar, WRC Executive Manager Jay Bhagwan, who oversaw the project, said that other platforms would be found to continue this dialogue and share the information and knowledge, with the aim of stimulating the discussion towards solutions.

"I think we are at a space in the sector where the winds of change are blowing quite strongly, and we should voice our views and our suggestions," he concluded.

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THE WATER WHEEL

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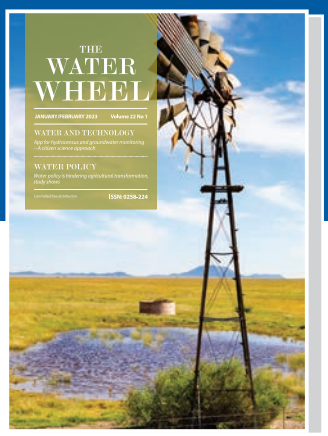

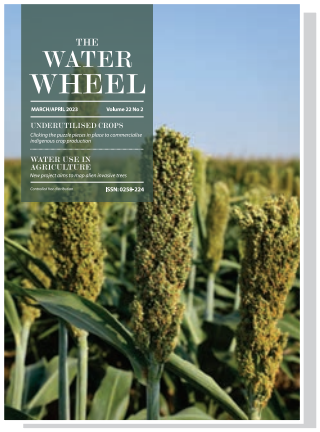

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WATER RESEARCH COMMISSION

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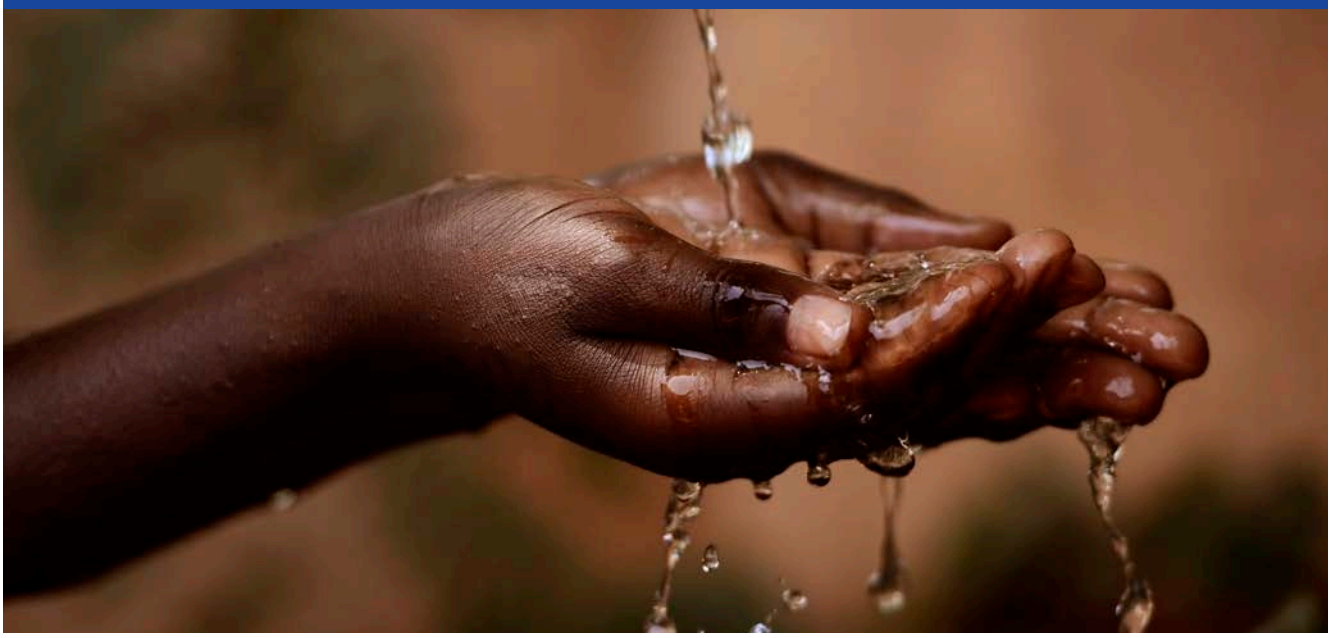
WRC STRATEGY

WRC tables new strategy aimed at ensuring water research remains real and relevant

Science, technology and innovation are the cornerstone of sustainable water resource management. Having a water science sector that is adaptive to the needs of society and has the ability to create real and relevant solutions that can improve lives on the ground is at the heart of the Water Research Commission's (WRC's) new five-year strategy, which was recently tabled in Parliament.



Established more than 50 years ago following a period of intense drought, the primary functions of the WRC are to promote coordination, cooperation and communication in the area of water research; establish water research needs and priorities; stimulate and fund water research according to priority; promote the effective transfer of information and technology; and enhance knowledge and capacity building in the water sector.

Water is recognised as a strategic resource, critical for basic human needs, and a driver for powering key economic sectors. The sustainable management of this scarce and finite resource underpins the well-being and prosperity of South Africa and its people. For the water science community, the mandate is to coordinate and promote research, development and innovation (RDI) and translate it into real solutions contributing towards addressing poverty, inequality and unemployment, while applying knowledge solutions to advance opportunities to enable economic growth, improve competitiveness and ensure prosperity.

Under the leadership of the WRC Board, and CEO, Dr Jennifer Molwantwa, the WRC has adopted a particularly 'stakeholder-centric' strategy, "We look at all stakeholders; identify and consult with them. Once we understand what the challenges are for each stakeholder, we prioritise and incorporate them to form part of our research agenda. Once that is done, we are able to identify where we are lacking in each province of South Africa in terms of water management, water and sanitation service access to citizens, including areas where availability of water is constrained," she explains.

The WRC seeks partnerships and opportunities to collaborate with various key partners to implement the solutions emanating from its RDI programme. "These partnerships include dissemination and transfer of knowledge, co-funding of Research, Development and Innovation (RDI) projects to

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co-create innovative water solutions, and supporting individual and institutional capacity building aimed at addressing the challenges of the water sector."

It is explained as follows in the ***WRC Strategic Plan for the 2025/26 to 2029/30 planning cycle***: "The WRC is accountable to stakeholders who have legitimate and reasonable expectations for the research that the WRC enables. An informed society relies heavily on impactful stakeholder engagement that integrate the perspectives of various stakeholders. Such processes not only build trust but also enhance the relevance and acceptance of interventions by aligning them with local needs and contexts. Impactful stakeholder engagements are a means for the WRC to close the gap between knowledge production, the use of research and innovation products, and influencing policy and broader water sector decision-making. The WRC is moving towards stakeholder engagement organised to promote science, technology and innovation for socio-economic impact, striking an appropriate balance between academic, instrumental, and conceptual impact."

A practical example of this is the recent launch of the Arid Region Water Research Centre in collaboration with Sol Plaatje University aimed at addressing critical water security issues affecting the Northern Cape and in other regional and global arid regions.

WRC supported research projects are subjected to various intensive peer reviews from initiation to completion, with nominated proposal stage reviewers as well as project reference group members being experts representing various backgrounds and organisations. This review practice ensures that RDI projects and ensuing products remain relevant. The WRC further works through a wide network of communities of practice which is serviced by the WRC workshops, meetings and conferences.

The Commission's research, development and innovation (RDI) activities are being executed through five thematic areas:

- **Water availability** – This thematic area seeks to ensure sustainable water availability across all scales and contexts, and to produce innovations that resolve water challenges and improve water management practices.
- **Water use** – This thematic area seeks to provide knowledge and innovation that ensures reliable, affordable and efficient water use services in the domestic, industrial, agricultural and mining areas to enhance the quality of life and contribute to economic growth and improved public and environmental health.
- **Water quality and health** – This thematic area drives integrated research and innovation to generate new knowledge, insights and data to inform the establishment of appropriate health-based targets and thresholds for different water uses; as well as for the development and deployment of appropriate and innovative water treatment and ecological infrastructure rehabilitation methods.
- **Water advisory support** – This thematic area seeks to support extension services and strengthen capacity-building instruments through support for centres of excellence, communities of practice, research chairs and advisory panels, in areas of importance at the local, district, provincial and national levels. It is expected that the WRC, through this theme, will accelerate development support for technologies ready for demonstration and transfer, and provide support to grassroots innovators, startups and entrepreneurs.
- **Knowledge services** – Water RDI products reach target audiences with different levels of expertise. Among its main stakeholders the WRC counts academia, students, regulators and policy developers, water services and resource entities, the Department of Water and Sanitation and other associated government departments. An unremitting goal for the WRC is to improve the accessibility of knowledge generated through WRC support research to the stakeholders it is intended to reach, in a format that is acceptable and understandable for each stakeholder type.

"While we understand that water is cross-cutting, the WRC has opted for a themes-based approach to allow the organisation to organise its impact on two fronts: firstly, it allows for a more efficient administrative process, and secondly, it allows the Commission to highlight key identified priority areas," notes WRC RDI Executive, Dr Stanley Liphadzi.

In addition to these themes, the WRC has placed strategic focus on projects aimed at strengthening South Africa's resilience and adaptation to climate change. As pointed out by the Commission's strategy, climate change is one of the most powerful global forces, with the ability to destabilise markets and curb economic growth. Weather patterns are increasingly becoming less favourable, and the frequency and severity of extreme events are increasing. "There is already abundant evidence indicating the vulnerability of society, water infrastructure and the economy to climate change," pointed out Dr Liphadzi. "Our water security at local scale cannot be realised if there are no tools or products equipping communities to appropriately respond to climate change. Therefore, the WRC has to focus on increasing knowledge solutions which can contribute to enhancing and strengthening particularly climate sensitive sectors (such as agriculture) while reducing their vulnerability and improving adaptive capacity."

The WRC RDI programme has identified a number of priority research areas to address the needs and priorities of South Africa and its water and sanitation sectors. These include, among others, addressing water service delivery, particularly at local government level; increasing water use efficiency across all water use sectors; enhancing South African water management's resilience to global changes (including climate change, urbanisation and population growth, among others); enhancing digital transition for improved water and sanitation management, and pursuing new, emerging and fundamental RDI.

Water RDI remains essential to ensure a secure water future for all South Africans. By sustaining a small, but productive, water science sector in this country, the WRC is ensuring that it provides the knowledge and tools to understand and address society's water-related challenges while developing the necessary innovative technologies and tools and practices that promote efficient water use, conservation and protection.

To access the WRC Strategic Plan, visit: https://bit.ly/3SuTOR9

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SLUDGE MANAGEMENT

New strategy sets out sustainable path for sludge management in SA

As part of a broader project on sludge management, a research strategy has been developed to guide research in this field over the next decade. Article by Sue Matthews.

In the November/December 2024 issue of ***The Water Wheel***, Matthew Hattingh put an entertaining nautical spin on a topic many of us prefer to steer well clear of (See - https://bit.ly/3YxRwUW). Sludge – the word itself tends to conjure up an unappealing image and visceral response, and in this case referred to both sewage sludge from wastewater treatment works (WWTW) and faecal sludge from pit latrines and other forms of non-sewered sanitation (NSS). The article covered an online workshop titled "Sludge Management in South Africa: What's Possible, What's New and What's Next?", co-hosted in August by the Water Research Commission (WRC) and Isle Utilities, which was conducting a WRC-funded project aimed at analysing trends, innovations and advances in sludge management practices and technologies in low- and middle-income countries.

Although we might prefer to give sludge a wide berth – to continue the nautical metaphor – the topic is important in light of circular economy and decarbonisation agendas, policy shifts, and the environmental and public health risks of ineffective sludge management. The project team presented a thorough review of these issues in the research report (**WRC Report No. 3178/1/24**), which addressed the volume of sludge produced and how this can be reduced, the quality of sludge produced and how this can be improved for use or disposal, the management of faecal sludge in the context of South African sanitation, the beneficiation of sludge, and trends in innovation of both technologies and approaches to addressing sludge management.

Based on priority areas and challenges identified in that report, the project team also developed a high-level research strategy (**WRC Report No. TT 946/24**) to address key priority areas in the short, medium and long term over the next decade.

"The strategic priority areas were developed and aligned in a

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nested structure, with shorter term priorities supporting the achievement of longer-term targets," they note. "For instance, the development of regulatory frameworks for emerging sludge management technologies will expand market opportunities and guide skills development programmes in the longer term, which in turn will support the continued development of sound governance practices within the industry and build resilience to adapt to the evolving needs of the sector in coming years."

Each priority area is presented as a challenge statement, after which a research design and methodology is proposed, and success criteria and outputs recommended. For the sake of brevity, the following summary merges these sections into a brief overview of each priority.

Short-term priorities (2025–2027)
The short-term priorities aim to tackle the most pressing research gaps that can be addressed rapidly.

- *Prioritising key sludge management challenges*

The top priority is to understand and reduce the volume of waste sludge, given that many WWTW are currently stockpiling sludge on site in response to national government's ban on the disposal of liquid waste to landfill. The ban, which came into effect in August 2019, applies to waste with a moisture content higher than 40% – and untreated sludge typically has a moisture content approximately double that. Stockpiling is clearly not a sustainable solution, so market-ready alternatives such as sludge volume reduction or beneficiation routes should be evaluated, considering their financial, technical, socio-economic, regulatory and environmental suitability. Current sludge production, stockpiles and space constraints at individual utilities and municipalities should also be surveyed to determine the greenhouse gas emission implications from sludge stockpiles, the volumes of sludge available for beneficiation, and the urgency of adopting alternative strategies.

One tool that could be useful in this regard is the Shit Flow Diagram (SFD), which helps understand how faecal waste moves through a municipal area, from containment at the point of origin to final disposal or reuse. To date only eight SFDs have been produced in South Africa, but the Sustainable Sanitation Alliance (SuSanA) has developed a digital SFD generation tool that produces the SFD graphic and accompanying report using data such as census results, Green Drop reports and surveys. The project team suggest that prioritising SFDs in the short term can support more informed decision making and planning for infrastructure development, deployment of novel solutions and capacity provision in wastewater treatment, as well as the development of emerging non-sewered sanitation technologies and value chains.

"The water sector is a notoriously slow adopter of innovation and highly resistant to the change brought about by innovation. Wastewater treatment operators are concerned with implementing untested and unfamiliar processes when existing systems are not functional," they note, pointing out that this resistance is a major barrier to the adoption – or even testing – of novel treatment technologies, and should be investigated further so that such concerns can be allayed.

- *Technology, innovation and markets*

Technology development and innovation are vital for finding new solutions and improving existing methodologies to address sludge management challenges. While much of the focus globally is on sludge beneficiation, the market for value-added products is still developing, and this is partly due to health and environmental safety concerns. Further research is needed to understand the willingness of markets to purchase sludge-derived products, particularly those making use of faecal sludge from NSS, which offers opportunities for local economic development and job creation. The project team suggest that business cases and financial models be developed for different sludge beneficiation and treatment technologies, as well as feasibility studies on both currently available NSS technologies and viable alternatives.

- *Regulatory framework*

South Africa's regulatory framework relating to sludge and its beneficiation is difficult for service providers and public sector entities to navigate, because individual pieces of legislation are not well aligned. The existing sludge management guidelines, published in five volumes between 2006 and 2009, are also incompatible with current legislation and circular economy principles, and do not cover NSS technologies. Regulations on novel solutions – anaerobic digestion sludge-to-energy schemes and Black Soldier Fly cultivation for protein and fertiliser production, for example – are lacking, which acts as a disincentive to the adoption of such innovations. New guidelines and regulations should therefore be developed through a consultative process, and research conducted to explore incentivisation and innovation adoption in sludge management.

"The development of regulatory frameworks for emerging sludge management technologies will expand market opportunities and guide skills development programmes in the longer term, which in turn will support the continued development of sound governance practices within the industry and build resilience to adapt to the evolving needs of the sector in coming years."

Medium term (2025–2029)
The medium-term priorities are aimed at tackling more systemic challenges that require longer timelines to address effectively.

- *Capacity building and training*

There is a dire shortage in South Africa of staff with sufficient competence to effectively operate anaerobic digestion systems and other novel approaches to sludge management, particularly those making use of digitisation and smart technologies. The

project team note that understanding the root causes of skills shortages, such as insufficient training opportunities or budgets, must be investigated. They recommend doing this through survey-based research and stakeholder interviews, with the findings documented in reports on the sector's capacity and capability shortages. Feasibility studies should be conducted on the implementation of mentorship programmes to transfer skills from senior operators to less-experienced staff. Developing new course materials and training programmes, or supporting existing training providers and SETAs, will also be crucial in building capacity and ensuring career progression.

- *Cross-sector approaches and integrated solutions*

While co-digestion and combined valorisation of sludge and solid organic wastes have been investigated from a technical perspective, the financial and economic implications as well as the supply-chain requirements to enable such integrated waste management systems need to be explored. Market readiness studies on products derived from these systems, such as fertiliser, also need to be conducted, because current technologies are not cost-competitive with chemical fertiliser production.

"In addition, public perception regarding sludge-derived products is poor, as an extension of poor confidence in public sector utilities to provide basic services such as water, sanitation and energy efficiently, let alone monitor and/or efficiently manufacture safe products using hazardous wastes as feedstock," note the project team.

- *Pilot scale to implementation*

Although anaerobic digestion potentially allows beneficial products, such as biogas and production feedstocks, to be produced from sludge, low bio-availability and biodegradability of sludge in South Africa creates challenges. Technologies to address this have yet to be tested in large-scale settings, highlighting the need for feasibility assessments that consider both the financial implications and energy demands of full-scale operation. Similar studies are needed to identify better and cheaper sludge drying and dewatering technologies, which are used to reduce sludge volumes and improve sludge quality for beneficial use.

Furthermore, the National Faecal Sludge Management (FSM) Strategy – finalised in April 2023 – prioritises the rapid deployment of NSS solutions to peri-urban and rural communities, but research on the barriers to adoption is essential. So too is the development of viable business and operational models that support adoption by providing low-skilled employment opportunities within the communities. The project team therefore suggest that community-based research and citizen-science approaches to the deployment and sustainable management of NSS technologies are tested and implemented.

"Inclusive and collaborative development, testing and deployment of sanitation solutions – where the communities benefiting from the solution are heard and their needs considered – will support sustainable and impactful implementation of NSS solutions," they note.

Long term (2025–2035)

The long-term priorities are aimed at building resilience in the research and innovation pipeline.

- *Advanced treatment and resource recovery*

The health concerns about contaminants of emerging concern (CECs) in wastewater, such as plastic particles, pharmaceuticals and personal care products, also apply to beneficiation of sludge. In the case of sludge-to-energy, air pollution and climate change impacts are additional concerns, given that existing WWTW have high carbon footprints. Further research is needed to build knowledge on the toxicological activity of various CECs present in sludge-derived products, including briquettes, construction materials, soil enhancers and fertilisers, and to develop technologies to remove or mitigate any negative effects. Climate-conscious solutions must also be identified and trialled to support the sector's contributions to emissions reduction targets and the Just Energy Transition.

Digital automation and smart technologies offer opportunities to reduce costs, improve efficiencies and support infrastructure and process management. Research and development of technologies such as AI and artificial neural network integrations in wastewater treatment and sludge valorisation systems will also open new opportunities for economic growth and employment in wastewater-related treatment systems. The project team suggest that digitisation strategies be developed for common technologies in sludge management – for example, anaerobic digestion and sludge minimisation approaches – and recommend that smart metering technologies be considered for sludge quantity estimation systems.

- *Governance*

"Overlapping authority on water treatment, pollution, waste management and resource recovery complicates the adoption of technologies, since multiple government departments and entities must designate resource recovery and sludge-based technologies, parts and components manufacturing. The overlap in authority also delays adoption due to bureaucratic barriers," note the project team, adding that the effort required to navigate procurement processes acts as a major barrier to innovation uptake. They recommend that policy-impacting research is undertaken on governance structures, and a greater understanding developed of the challenges and opportunities for procurement and beneficiation within the current regulatory framework. Adapted or novel contracting models for procurement that support rapid adoption and deployment of sludge management technologies should also be explored.

In addition, although regulations and policies are a critical element of South Africa's public services infrastructure, they become outdated if not reviewed and evaluated against modern research findings and international best practices. The project team therefore suggest that policy recommendations and updated regulations are produced on a continuous basis to ensure good governance.

- *Adaptation to evolving needs and challenges*

Currently, very few smart and digital technologies are available for sludge handling and disposal systems. Research and development of such technologies for monitoring and

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digitisation of these systems will improve cost-efficiency and performance, while allowing operators finer control. Implementation strategies and regulatory support for their deployment will also be needed in the long term.

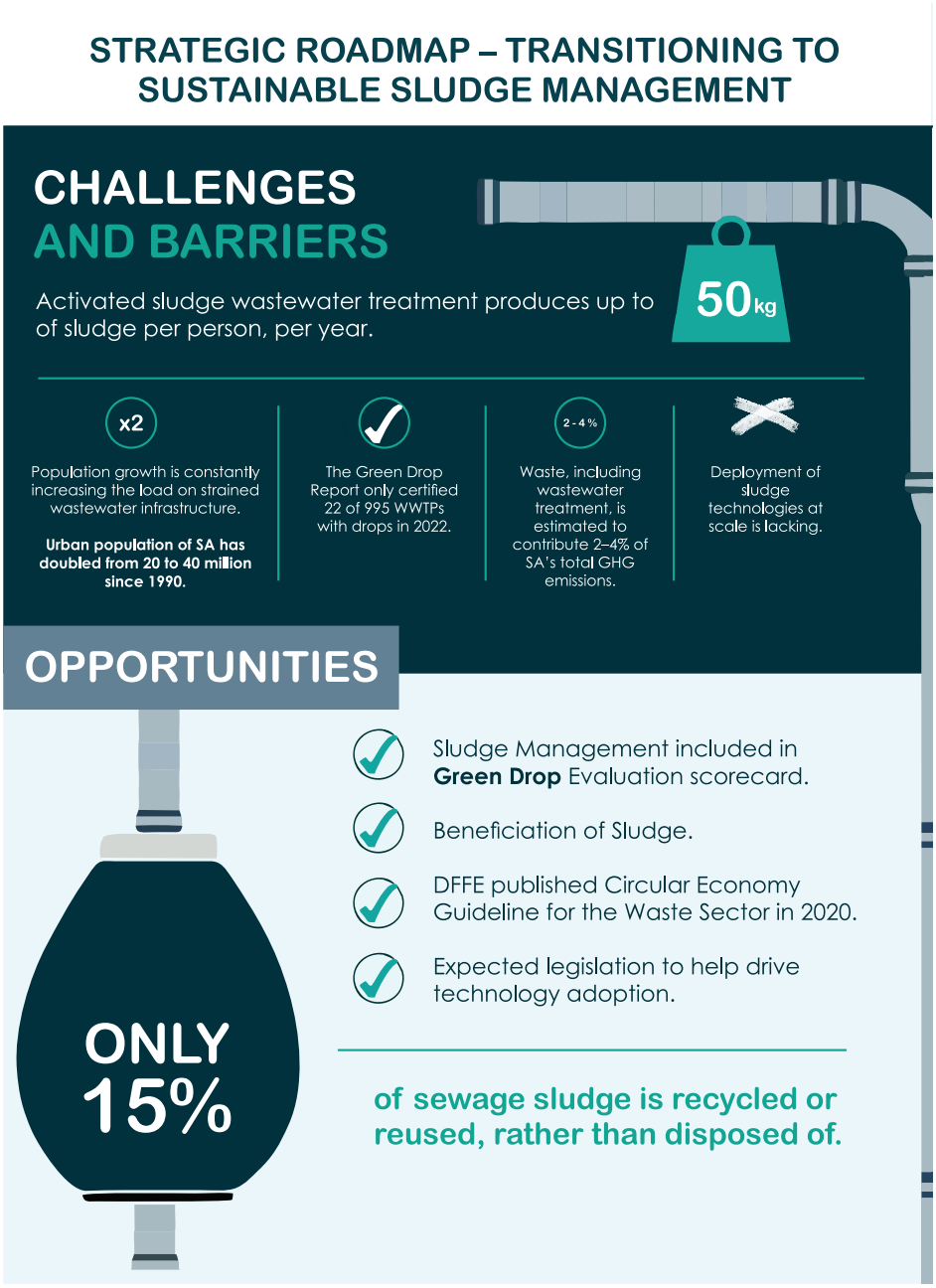
Further development of climate-smart technologies is recommended to address the current carbon emissions and high energy use involved in sludge management systems. Deployment of solutions should keep pace with climate research, and ensure that sludge can be handled, monitored and treated in more environmentally sustainable ways.

Take-home message

The project team emphasise that research and innovation in sludge management approaches and technologies is an active field of development, and there are already solutions available for many of the challenges faced. It is largely institutional and regulatory barriers that are inhibiting their adoption, so while the strategy lays out a roadmap for future research in the field of sludge management, the project as a whole has revealed a stark reality.

"More research will not move the needle substantially if technical solutions are not supported by application and scaling on the ground. An enabling regulatory and procurement environment is needed, and development of business models essential to ensure that the deployment deficit is addressed," they conclude. "This is important for further investment into the future of the water and wastewater sectors."

To view the original report, ***Sludge Management: A research strategy towards innovative and sustainable practices and technologies*** (**WRC Report No. TT 946/24**) by F Gouws, JE Burgess, C Ramcharan-Kotze and S Woolley, visit: https://wrcwebsite.azurewebsites.net/wp-content/uploads/mdocs/TT%20946%20final%20web.pdf



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WATER RESOURCE MANAGEMENT

Rethinking water management in a changing climate

It is ironic that water, the most essential resource for life, is also the medium through which an increasingly hostile climate is presenting itself; water brings life but also threatens it in anger. Water managers have long been aware of this dual nature of water, but as climate change gains momentum, the stark impact of freshwater scarcity and extreme weather events running in parallel is compelling a rethink on how water should be managed. Article by Dawid Bosman, Senior Manager: Strategic Advisory at the Trans-Caledon Tunnel Authority.

Climate change has arrived, like an unwelcome guest in our home, and will bring ever more trauma and disruption in the years and decades to come. Early in 2024, and again in 2025, news came that the global average temperature of the prior year had increased by more than 1.5°C, relative to the pre-industrial level. This was disturbing news; as recent as 2021, the projection was that this threshold would only be breached by 2040. And yet, here we are. The collective commitment by 196 industrialised nations to reduce greenhouse gas emissions were lacking in ambition or execution, and the latest trajectory from the Intergovernmental Panel on Climate Change (IPCC) is that the global average temperature increase should reach 2.7°C by 2100 – also referred to as an intermediate trajectory. We are learning that the mitigation of global warming is proving very hard to do. More focus will now shift to adaptation, how we reconfigure our economies, cities, agricultural activity and catchment basins to be more resilient to the climate disruption that is upon us.

The 6th Assessment Report (AR6) of the IPCC elaborates on the impacts. It projects that in the near term, every region in the world will face "further increases in climate hazards" and "increasing multiple risks to ecosystems and humans". It anticipates an increase in heat-related human mortality and

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morbidity, food-, water-, and vector-borne diseases, mental health challenges, flooding in coastal and other low-lying cities and regions, biodiversity loss in land, freshwater and ocean ecosystems, and a decrease in food production in some regions. The risks and projected adverse impacts, along with losses and damages, will escalate with every increment of global warming. And, with further warming, climate change risks will become increasingly complex and more difficult to manage.

It is a tragedy that vulnerable communities, often reliant upon climate sensitive livelihoods, will be hardest hit by climate change and in particular, the loss of ecosystems; this will provide further impetus to migration, growing inequality and urbanisation. This is the broad spectrum of challenges that our economies will need to adapt to, and it will require exceptional leadership to do so.

The global water sector will be in the center of this turmoil. Intuitively, this makes sense; so much of the effects of climate change are delivered through the hydrological cycle. The AR6 points out that for every degree Celsius rise in average temperature, the atmosphere can hold about 7% more moisture, resulting in more severe storms and greater precipitation volumes.

The water sector will need to adapt, fundamentally, in several ways. Whereas sustainable water management practices remain foundational, there is now also the need for vast investments in resilient infrastructure, such as flood barriers to protect critical infrastructure, aquifer storage, and the mainstreaming of non-conventional water resources such as large-scale desalination and reuse. Innovation will be required to develop new business models for sustaining this diverse portfolio, such as the dual use of surface water infrastructure for both storage and flood protection.

"Whereas sustainable water management practices remain foundational, there is now also the need for vast investments in resilient infrastructure"

The good news is that we can already produce as much water as we need, within a manageable envelope of cost, energy and environmental impact. We also know how to deal with too much water, through green and grey infrastructure. While all this is expensive, there is an opportunity here; adaptation to climate change can reverse decades of under-investment in water infrastructure and technology, because the models adopted are equally applicable to closing the water infrastructure gap and building environmental protection.

The key challenge lies in developing the capacity within the global water sector to attract and meaningfully absorb a vast surge in capital flow. A 2024 white paper by Global Water Intelligence (GWI) and XPV Water Partners titled 'Investing in a water-secure future' tried to quantify this surge. It found that 69% of insured losses arising from climate-related disasters were likely caused by extremes of droughts and floods, which points to at least this proportion of climate adaptation expenditure having to be spent on managing water more acutely. The GWI and XPV researchers estimate that in 2024 the capital employed in water security came to $4,321 billion, of which the public sector carried about $3,000 billion. However, by 2034, this figure could stand at $12,580 billion, with the public sector comprising only $5,700 billion. Overall, it comes to a three-fold increase in capital deployed in water security within a decade, largely the result of climate change, and a five-fold increase in the private share of that, largely because of weakness of public balance sheets and the growth of water as a strategic theme for investors.

So, what should the strategy be to respond to these challenges? GWI has an interesting perspective on it. As for the influx of private capital, water can offer the returns necessary to sustain a surge in capital employed; the fundamental importance of water for the economy and for life on earth is simply strong enough. But it would require that fund managers begin to recognise water security as a risk in every investment made. Water managers, in turn, need to make better connections between water and money, and deliver the financial returns necessary to attract the investment needed by the water sector.

To summarise and conclude: As our efforts to mitigate climate change stutters, we are facing a distressing climate future, to which we will need to adapt. Much of the adaptation will involve how water is being managed, dealing with unprecedented scarcity or excess, and requiring innovation of both infrastructure and business models. The sector will see a vast influx of capital, increasingly from private balance sheets. Water managers will need to generate returns that could attract private money. While the product has a most compelling value proposition, robust governance will be non-negotiable. As things stand, the water sector, here and abroad, is not ready for what is to come. The urgent imperative must be to build institutional capacity and strategize for what is to come.

WATER REUSE

Experts gather at international water reuse conference in Cape Town

Water scarcity and sustainable water management are pressing global challenges, with demand for water expected to rise dramatically – particularly in sub-Saharan Africa – by 2050. In response, the 14th International Water Association (IWA) International Conference on Water Reclamation and Reuse brought together leading experts, researchers, policymakers, and industry professionals from around the world to explore innovative solutions and advancements in water reuse. Article by Kim Trollip and Lani van Vuuren.

Minister of Water and Sanitation, Pemmy Majodina, emphasised the importance of the role of water reuse in ensuring national water security.

Jointly organised by the IWA Specialist Group, the Water Research Commission (WRC) and the Water Institute of Southern Africa (WISA), the conference was held in Cape Town from 16 to 20 March. Held biennially, the conference unites water leaders worldwide, connecting top professionals from various countries to shape the future of water reclamation and reuse. This year saw no less than 699 people from 42 countries attend the conference.

As the largest and most influential forum in water reclamation and reuse, the IWA Reuse Specialist Group continues to champion the safe and sustainable implementation of water reuse practices. By fostering dialogue through its international knowledge network, publications, and conferences, the group plays a pivotal role in shaping policies and technologies that contribute to a water-wise future. Water reclamation is the process of treating wastewater (like sewage or industrial runoff) to make it reusable for various purposes, while water reuse is the actual use of that reclaimed water. In essence, reclamation is the treatment, and reuse is the application of the treated water.

Against this backdrop, the 14th edition of the conference aligned with the IWA's broader change agendas – Digital Water, Basins of the Future, Cities of the Future, and Water and Sanitation Services. These initiatives drive sustainable water management worldwide, ensuring that innovations presented at the

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conference have a lasting impact on both local and global water security.

In her introduction during the opening ceremony, conference host, Suzie Nkambule, CEO of Nafasi Water Technologies, laid the foundation for the discussion: "The primary objective of this gathering...is to answer one critical question: What will it take to scale [up] sustainable water reuse? The strain that continues to affect the water resources industry is not only a depleting supply availability, but also the usability of some water resources is becoming more strained."

In her opening address, Minister of Water and Sanitation, Pemmy Majodina, emphasised the urgency of the water crisis, reiterating that access to water is a fundamental human right. She also highlighted President Cyril Ramaphosa's designation of water as a national priority.

The minister outlined the national water strategy, which includes sustainable groundwater use, seawater desalination, treated wastewater return flows, and water reclamation and reuse. She identified critical areas for the conference's focus, namely financing, project delivery models, operations and technological innovation.

Water Global Practice Director of the World Bank, Saroj Kumar Jha, presented a sobering global perspective, noting that water demand already exceeds supply in many regions. He stressed the need for robust policies, advanced technologies and substantial financing to address the crisis – interventions that are currently lacking. Jha highlighted water reuse as a viable option, contingent upon proper regulations and standards to ensure safety and public acceptance.

Conference chair, Jay Bhagwan of the WRC, emphasised that water reuse is no longer optional – it is essential. "Hosting [this conference] in South Africa is both timely and significant. As we recover from Cape Town's wake up call, we are also witnessing bold steps being taken. The City of Cape Town is now planning of the world's largest water reuse facilities, while leading South African examples – from Emalahleni to Beaufort West and Mossel Bay – showcase practical successes in reuse for industry, agriculture and domestic supply."

Water Global Practice Director of the World Bank, Saroj Kumar Jha, delivering his address at the conference.

The conference explored several key themes, including:

- Decentralised and small-scale solutions: Sessions focused on decentralised wastewater treatment systems, such as membrane bioreactors and nature-based solutions, which are crucial for addressing water scarcity in rural and peri-urban areas.
- Risk management: Discussions centred on health risk assessment and management in water reuse systems, ensuring public safety and confidence in reused water.
- Industrial reuse: Presentations highlighted successful industrial water reuse projects, emphasising efficiency and sustainability in sectors such as mining and manufacturing.
- Innovative technologies and application: The latest advancements in water treatment technologies, such as advanced oxidation processes and membrane filtration, were showcased.

In addition to technical sessions, the conference featured nine workshops covering topics from policy frameworks to innovative technologies. These interactive sessions provided attendees with hands-on experience and insights into practical implementation strategies.

The role of the WRC

As a co-host of the conference, the WRC plays a pivotal role in

WRC senior manager and conference chair, Jay Bhagwan with Minister of Water and Sanitation, Pemmy Majodina, and WRC Board member, Dr Harrison Pienaar.

During her address, WRC CEO, Dr Jennifer Molwantwa, noted that research had to translate into either policy influence, into new knowledge, and/or into supporting government spheres in order to find answers for the country's complex water challenges.

promoting sustainable water management practices in South Africa. The WRC supports research and development in water reuse, informing policy- and decision-making processes. By collaborating with international partners, such as IWA, the WRC contributes to the global dialogue on water security and resilience.

WRC CEO, Dr Jennifer Molwantwa, said that research has to translate into either policy influence, into new knowledge, and/or into supporting government spheres in order to find answers for the country's complex water challenges. "In this issue around water reclamation and reuse, we know that the WRC has been in this business for a very long time. However, it is remarkable that when names of those countries that have pioneered this or that are leading in these technologies are mentioned, South Africa is not mentioned…and we are here to change that."

Key takeaways from the conference

- **Recognition of southern Africa's leadership in water reuse** – Southern African experts emphasised the nation's significant contributions to water reuse technologies and practices. Dr Molwantwa highlighted the need for South Africa to be acknowledged globally for its advancements in the field: "We are here to say that we need to be counted, we need to be acknowledged…we here to also teach others a lot."
- **Diversification of water sources** – Cape Town's experience with the 'Day Zero' crisis underscored the importance of diversifying water sources. MMC for Water in the City of Cape Town, Dr Zahid Badroodien, discussed the city's shift from reliance on surface water to incorporating desalination and water reuse. He mentioned the development of the Faure New Water Scheme, one of Africa's largest water reuse projects, as a testament to this commitment.
- **Emphasis on collaborative approaches** – The conference highlighted the necessity for multi-agency collaboration in implementing successful water reuse initiatives. Experts noted that cooperation among water and wastewater agencies, along with clear policy frameworks, is essential for scaling up water reuse projects effectively.
- **Addressing public perception challenges** – Public acceptance remains a significant hurdle in the adoption of recycled water for potable use. Discussions at the conference stressed the need for comprehensive public education and transparent communication to overcome misconceptions about water reuse. Examples from Namibia and Singapore were cited, where public engagement strategies have successfully facilitated the acceptance of recycled water.
- **Integration of advanced technologies** – The adoption of state-of-the-art technologies is crucial for producing high-quality treated wastewater. Sessions focused on innovative treatment methods, such as advanced oxidation processes and membrane filtration, which are essential for ensuring the safety and reliability of reclaimed water. However, it was acknowledged that these technologies require significant investment and expertise.

The way forward

The conference underscored the global urgency of adopting water reuse practices and showcased Cape Town's proactive measures as a model for other regions facing similar challenges. Sydney, Australia, was announced as the host of the 15th Water Reuse Conference in 2027.

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DEEPLY ROOTED IN SOUTH AFRICA WATER SOCIETY

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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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THE POWER OF KNOWLEDGE TO THE PEOPLE