THE
WATERWHEEL

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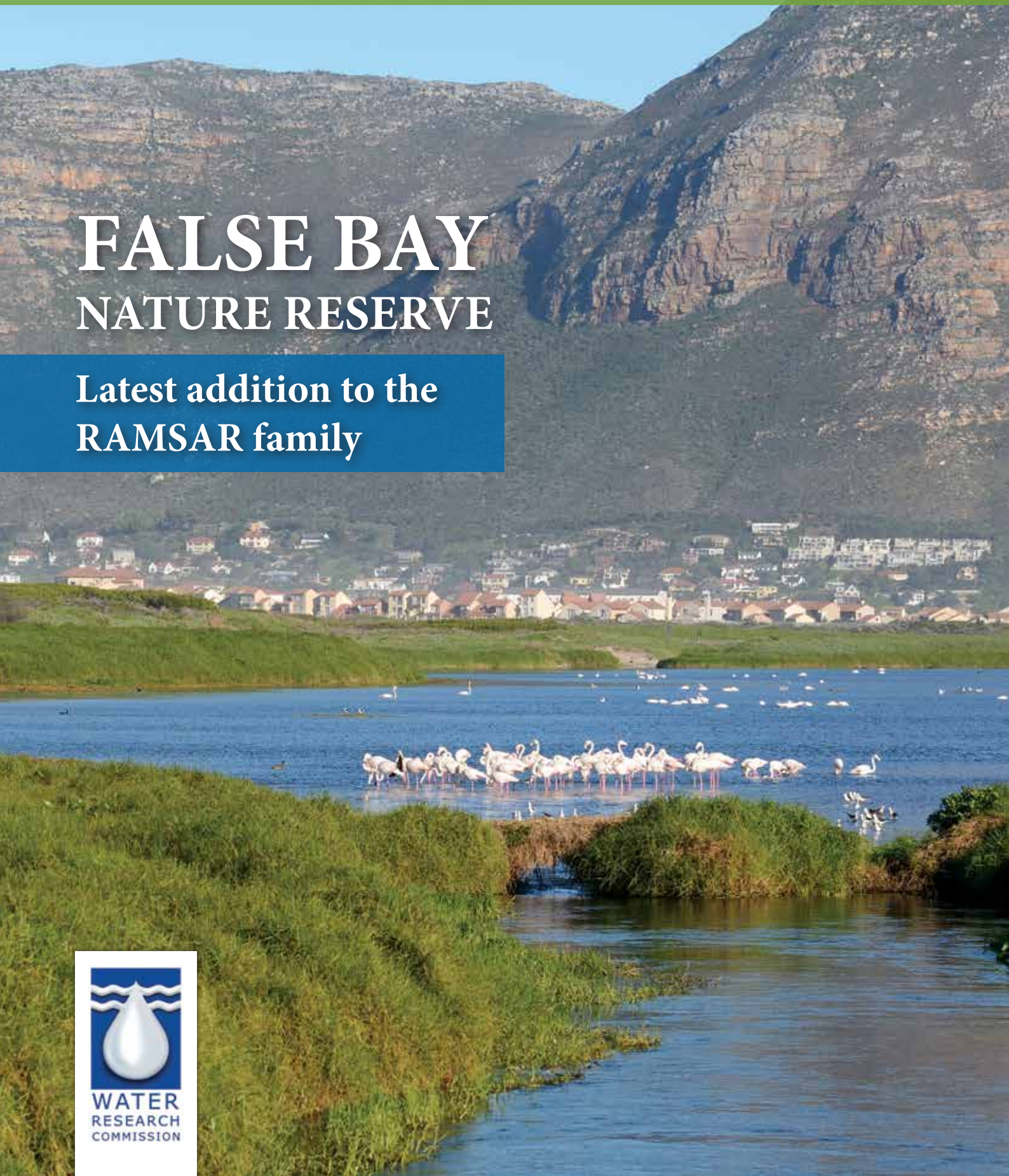

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Cover: *The Water Wheel visits False Bay Nature Reserve, South Africa's latest wetland of international importance. See story on p. 12. Cover photograph by Sue Matthews.*

Fluid Thoughts

WRC CEO, Dhesigen Naidoo

The promise of a new global agenda

Global agendas have all had their successes and failures. The latter may have been dominant, but it is difficult to ignore such feats as all UN countries joining hands to effectively ban ozone-depleting substances, in particular CFCs, and actively reversing the ozone layer depletion. More recently, the Millennium Development Goals (MDGs), in spite of having an extended lag phase has managed to dominate the global development agenda. The progress with the MDGs, across the world, including those regions that have fallen substantially short of the targets, like Sub-Saharan Africa are encouraging nevertheless. The close links between the progress toward the MDG targets and other global targets like reducing hunger are both admirable and logical as folk all around the world are organising their national and regional strategies to engage the complexity of sustainable development.

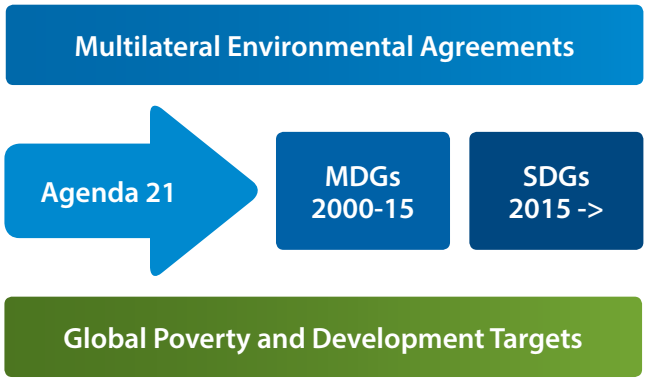


Figure 1. The global negotiated environment within the UN system can largely be divided into the Multilateral Environmental Agreements (MEAs) and the Socio-economic agreements. Many argue that based on the hierarchy of representation, the latter enjoy much more mainstream support and implementation. There is even and argument that the MDGs, while being prolific for its time enjoyed the high levels of support because of its predominant alignment with the socio-economic agenda. This is ironic since the very purpose of Agenda 21 was to effect the convergence. The promise of the SDGs is that they are much more inclusive of both the socio-economic as well as the global environmental ambitions of Mankind in the paradigm of its nomenclature – Sustainable Development.

> *"In 2015 as opposed to 2000, we are more acutely aware of the mainstreaming of the Earth's resources in our global economy risk registers."*

The even greater promise of the Sustainable Development Goals (SDGs) lie on three pillars. The pillars are not in the environmental domain, and in many ways are a tribute to those campaigners that have managed to mainstream sustainable development. The first is that the current draft of the proposed SDGs much more effectively embrace the three pillars of sustainable development than its predecessor. Its ability to marry in each target the need for shifts in the global economic growth model, the international social development agenda, and both on a sound and proactive ecologically sensitive manner must be applauded.

Further encouragement is garnered by the fact that in 2015 as opposed to 2000, we are more acutely aware of the mainstreaming of the Earth's resources in our global economy risk registers. The placement of 'water' as the number one risk in the World Economic Forum 2015 Risk Register is compelling, as is the reclassification of the risk from an 'environmental' one as in previous years to a 'societal' one, as expressed in the 2015 risk register.

The third pillar of optimism comes from further afield. While the run-up to the UNFCCC Paris COP later this year is currently wrapped in a cloak of very cautious optimism at best, the events in the Real Economy may prove to the unlikely vanguard for a guarantee of a 2 degree increased temperature future (this is the optimistic Carbon friendly scenario of a maximum 2 degree average temperature increase for a warmer Earth but within

the CO_2 budget of 1000Gt). This third pillar is a combination of the changes in the global fossil fuel dependency map and the rise of "Clean Energy" solutions as a market winner. The latter is personified, in part, by the dethroning of Jack Ma as China's richest man by Li Hejun, the chairman of Hanergy Holdings. Hanergy is described as a producer of clean energy solutions and technologies which has seen unbelievable growth last year. This is not only an indicator of increased global demands for clean energy, but also that China has clean energy as a major growth sector in its economy.

The former is more complex. We have witnessed recently major changes in global fossil fuel dependence from traditional sources. These are driven by very different forces including major substitution of fossil fuels with gas (primarily shale gas) in the United States, the fossil fuel price wars as a tool in the new Cold War (with Russia and Venezuela as targets), and the possibility of a completely new Middle East Roadmap with the impending nuclear deal with Iran.

While these processes are not converged, and their complexity dictates that many scenarios are possible, one very important scenario is a change in the global energy picture moving toward higher investment and use of renewable energy options. All this away from the current heavily fossil fuel dependent global economy, led perhaps ironically by players that have been generally regarded as Climate Change laggards in the UNFCCC negotiations.

Global agendas have generally not been the vehicles for step changes in human development. It is however also true that the nature of a truly multi-polar world like the one we currently have also does not have an historic precedent. This may well be precisely why it may work.

A summary of the current draft of the Sustainable Development Goals (SDGs)

1. End poverty in all its forms, everywhere.
2. End hunger and achieve food security and improved nutrition while promoting sustainable agriculture.
3. Ensure healthy lives and promote well-being.
4. Ensure inclusive and equitable quality education and promote lifelong learning.
5. Achieve gender equality and empower all women and girls.
6. Ensure availability and sustainability of water and sanitation for all.
7. Ensure access to affordable, reliable, sustainable and modern energy for all.
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
9. Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation.
10. Reduce inequality within and among countries.
11. Make cities and human settlements safe, resilient and sustainable.
12. Promote sustainable consumptions and production patterns.
13. Urgent actions to combat Climate Change and its impacts.
14. Conserve and sustainable use of oceans, seas and marine resources for sustainable development.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt land degradation and biodiversity loss.
16. Peaceful and inclusive societies for sustainable development.
17. Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Source: Technical report by the Bureau of the United Nations Statistical Commission (UNSC) on the process of the development of an indicator framework for the goals and targets of the post-2015 development agenda

Diary

Residuals and biosolids: June 7-10
The Water Environment Federation, together with the International Water Association, is hosting a conference on Residuals and Biosolids in Washington, USA. Visit: www.residualsbiosolids-WEFIWA.org

Aquatic science: June 28 to 2 July
The Southern African Society of Aquatic Scientists will be holding its annual conference at the Champagne Sports Resort, in the Drakensberg, with the theme 'Water resource research, policy and people'. Enquiries: Petrie Vogel (Conference Secretariat); Tel: +27 (0)12) 346-0687; Fax: +27 (0)12) 346-2929; Email: petrie@savetcon.co.za.

Large dams: July 13-20
The 25th Congress of the International Commission on Large Dams will take place in Stavanger, Norway. Visit: www.icoldnorway2015.org

World water: August 23-28
The annual World Water Week will take place in Stockholm, Sweden, as usual. Visit: www.worldwaterweek.org

Social science: September 13-16
The World Social Science Forum will be held in Durban. A broad range of topics will be discussed under the theme of 'transforming global relations for a just world'. Visit: www.ssf2015.org

Large dams: September 1-3
The South African National Committee on Large Dams (SANCOLD) is hosting its annual conference in Cape Town with the theme 'Dam safety, maintenance and rehabilitation of dams in southern Africa'. Apart from the technical presentations, the conference also includes the SANCOLD Young Engineer's Forum as well as technical site visits to the Clanwilliam and Bulshoek dams, as well as the Table Mountain Dams. Enquiries: Nom Buthelezi (Conference Secretariat) at Tel: +27 (0)11 676-3417; Email: secretariat@sancold2015.org.za or Visit: www.sancold.org.za

Groundwater: September 21-23
The 14th Groundwater Conference will be held at Muldersdrift with the theme 'From theory to action'. This conference aims to highlight the issue of improving the uptake of existing knowledge and experiences of groundwater in South Africa to assist in solving environmental and societal problems. Email: info@gwd.org.za or Visit: www.gwd.org.za

Municipal engineering: October 28-30
The annual conference of the Institute of Municipal Engineering in Southern Africa will take place at the Grand West Hotel and Casino, in Cape Town. Visit: www.imesa.org.za

Young Water Professionals: November 16-18
The theme for the 4th YWP South African biennial conference, which will be held in Pretoria, is 'Stop talking, start doing'. Conference topics include domestic and municipal water and sanitation; drinking water and bulk water supply; industrial and mine-water; environment water; and capacity building and training. Enquiries: Jaco Seaman (Conference organiser), Tel: +27 (0)11 805-3537; Email: events@wisa.org.za; Visit: www.ywp-za.org/

Getting to grips with the issue of water use licences

South Africa's farming sector is still getting to grips with the issue of water use licences after these became a legal requirement for many business five years ago, according to leading engineering consultants SRK Consulting.

"Most farms that use water for irrigation – or for watering livestock in feedlots – will be required to apply for a water use licences, in the same way as the mining and industrial sectors," said Lindsay Shand, principal and environmental geologist at the company's Cape Town office. "The aim of this process – driven by the National Water Act – is to ensure that the distribution of this increasingly scarce resource is fair and sustainable."

According to Shand, obtaining legal authorisation as a water user allows farmers to strengthen the risk profile of their business, as it may become difficult to sell or re-develop the property if the entity is not fully compliant. Without carrying out the investigations required for licencing, there is the danger of impacting negatively on neighbours and other water users, possibly leading to expensive remediation processes in future.

She says that there is still a lack of knowledge in the agricultural sector about the need for these licences, mainly because this sector was traditionally not required to hold them. Now, however, any farmer taking water from a surface water of groundwater resource, storing water, discharging effluent water, altering banks or impeding and diverting the flow of

water in a watercourse falls under Section 21 of the National Water Act – depending on the volume of water involved and the present aquifer status of the quaternary catchment in which it is situated.

The licencing process was initially hampered by long delays within the Department of Water and Sanitation in getting the applications processed and licences issued. There were also numerous incidents of content errors within the issued licences, making it difficult for the water user to strictly comply.

"Fortunately, there have been better systems put in place in recent years to speed up the licencing process, so this need not deter water users from pursuing their applications," notes SRK hydrogeologist, Candice Lasher.

Acute water skills shortage a water quality risk, says SAICE Vice President

South Africa is in the throes of an acute water sector skills shortage that is already threatening water quality in parts of the country.

This is according to Dr Chris Herold, Vice President of the South African Institution of Civil Engineering (SAICE). He was speaking during a panel discussion held at the University of South Africa's (UNISA's) Science Campus in Johannesburg earlier this year.

"The skills shortage in the water sector is a very serious problem and it is not a future or potential problem, we have it already," he said. "A few years back, local authorities had a seventh of the engineering professionals they had 20 years before. The situation is even worse today. Many of the smaller municipalities do not have a single engineer or engineering technician – not just for water but also for roads, electricity and housing."

According to Dr Herold, the skills shortage in the water sector was not limited to local authorities, but also had an impact on the Department of Water and Sanitation (DWS).

In 2008, based on 2007 figures, only 38% of the department's engineering positions were occupied; furthermore, forecasts projected that it would lose 42% of its senior engineers over the ten years to 2017. "Only one or two years later, the DWS has already lost more than 42% of its senior engineers," noted Dr Herold.

Exacerbating the skills crisis in government is the lack of candidate engineers coming up through the ranks of the department. On the positive side, the DWS Candidate Academy is doing a great job to nurture young graduates to the stage where they can attain professional registration, although these efforts are hampered by a lack of mentors within the organisation.

However, it will take years before new recruits can gain enough experience to fill the yawning middle and senior management chasm. In the meantime, it is essential to draw on the wealth of talent in the private sector and to 're-tread' experienced retirees to keep the core functions going.

Other speakers at the UNISA event expressed concern about water quality, especially in rural areas. "Our studies in the rural areas of the Eastern Cape, KwaZulu-Natal, Mpumalanga and Limpopo show that water quality is of high concern," said Prof Maggie Momba of the Tshwane University of Technology. "Every year, especially during the rainy season, we have [outbreaks of] waterborne diseases."

She attributed the water-quality problems mainly to a lack of capacity. "South Africa does not really have capacity building in the water sector," Prof Mamba noted, citing areas in the Eastern Cape where 'very expensive' drinking water treatment plants were being run by people lacking water treatment expertise.

Although home water treatment systems may not be the ultimate solution, home treatment could play a role in areas where waterborne diseases are rife, according to Prof Momba.

Source: UNISA

Exploring the role of traditional leaders in managing rural water resources

On 17 March, the Institute for Poverty, Land and Agrarian Studies (PLAAS) and the Water Research Commission brought together policy-makers, traditional leaders and members of rural communities, community-based organisations and non-governmental organisations for a policy dialogue on water governance in traditional rural community contexts of South Africa.

The dialogue was held in Cape Town.

It is argued that managing water resources in South Africa is subject to political contestation, as not all water users are allocated rights equally, with licenses for water use often issued to industrial enterprises, mines, game lodges, and commercial agriculture without consideration to communities' water needs and water quality needs.

Given the capacity constraints in provincial governments, the question that needs to be asked is whether traditional leaders can help government to manage water resources?

The workshop aimed to generate policy recommendations to assist water institutions and national government to better deliver on their primary mandate of access to water resources and infrastructure for productive purposes and improved livelihoods. Among others, the workshop explored the challenges to effective water governance in traditional rural communities, the benefits and dis-benefits of creating an institutional environment for a legally pluralistic system of water governance in South Africa, and what roles traditional leadership can play in decentralised and democratised water governance, resource management and services institutions.

In addition, representatives of rural communities explored how indigenous knowledge systems can support water governance, how gender can be given consideration, and how to link water access to water market value chains.

Schools water projects takes home international award

A joint water project initiated by the Department of Water and Sanitation (DWS) and by the Wildlife and Environment Society of South Africa (WESSA) Eco-Schools has won a United Nations 'Water for Life' Best Practices Award.

The project was awarded in the category 'Best participatory, communication, awareness-raising and education practices' and shares the award with Project India.

The annual Water for Life Best Practices Award acknowledges and promotes efforts to meet international commitments made on water and related issues. The award recognises outstanding projects that are working to ensure sustainable long-term management of water resources and to help achieve the water and sanitation targets of the Millennium Development Goals, Agenda 21 and the Johannesburg Plan of Implementation. The theme of the awards for this year was 'Water and Sustainable Development'.

The DWS/WESSA Eco-Schools Water Project – officially launched at the Youth Summit on Water and Climate Change in July last year – encourages water conservation and the wise use of water resources at school level from grades R to 12. The 50 participating schools, located in eight provinces in South Africa, are required to set up a water action project that includes the entire school and members of the local community.

The project's main objective is to strengthen water and sanitation education in South Africa through implementation of the international Eco-School Programme's 7-step framework for education for sustainable development, learning and change.

These steps guide schools through a learning process which promotes water conservation and sanitation education, as well as engaging learners in enquiry-based learning methods which empower them to better understand their local water context and to take action to improve this. The project has a strong inclusivity focus, emphasising public participation, participatory learning processes and action taking.

Activities are focused on better water management and ensuring water security for the more disadvantaged communities that may not have access to potable water. This is especially problematic in areas where water is increasingly scarce due to poor catchment management practices.

The success of the project, now recognised by this international award, is an example of government and civil society organisations working together effectively in the education and environmental conservation fields, WESSA and DWS said in a statement.

Source: WESSA

Projects in progress

South Africa's first comprehensive water resources website launched

South Africa's first publicly-accessible water resources website has been launched.

The website, www.waterresourceswr2012.co.za, forms part of the country's latest water resources assessment study, known as WR2012, funded by the Water Research Commission (WRC). WR2012, launched three years ago, is the sixth comprehensive national water resource assessment to be undertaken in South Africa since 1952.

The study has, for the first time, created a publicly-accessible, Web-based and interactive reporting system to continually quantify both the surface and groundwater resources of South Africa, notes WRC Research Manager, Wandile Nomquphu. "While it was originally planned for the website to only be up and running once the project is completed in 2016, the high level of interest in the information the project has to offer has prompted the WRC to bring the Web launch date forward."

It is well known that water is South Africa's scarcest resource, and that the country counts among the world's parched, with a mean annual precipitation of only half the world average, and a total surface runoff of less than 50 000 million m^3/annum. As a result of this inherent scarcity, the country uncomfortably walks a tightrope between socio-economic development and protection of its water resources. This makes quantifying exactly how much water South Africa has one of the most important tasks to be undertaken in the water sector.

According to WRC CEO, Dhesigen Naidoo, undertaking regular water resource quantification assessment not only informs the country of its available water resources, but helps to augment decision-makers' and specialists' understanding of how the natural hydrological cycle behaves.

The study is being executed by a consortium of consulting engineering firms, led by Royal Haskoning DHV (RHDHV). One of the most important aspects of the study is the improvements made on the WRSM2000 catchment model (popularly known as the Pitman model), which is widely used in the South African water resource assessment process.

"The WRSM2000 model is undergoing some major improvements," reports WR2012 project leader Allan Bailey from RHDHV. "As this model has links to the models of the Department of Water and Sanitation for analysing yield of dams and future water resource planning, it is extremely important that all three models are continually improved."

Allan Bailey, project leader for Royal HaskoningDHV, Dr Ronnie McKenzie, keynote speaker for WRP Engineers, Dr Bill Pitman, key team member for Royal HaskoningDHV and developer of the Pitman-model, Wandile Nomquphu, Water Research Commission Research Manager, Deborah Mochotlhi, Deputy Director General at the Department of Water and Sanitation, and Prof Geoff Pegram, Professor Emeritus University of Kwazulu-Natal.

Enhancements to the WRSM2000 model include the inclusion of a number of statistical graphs for checking the consistency of catchment rainfall and natural streamflow and storage yield; grouping of runoff models with similar hydrology for more rapid calibration; and addition of an observed storage trace to the reservoir plot so that reservoirs with only storage data can be calibrated among others.

Compared to the previous water resource study, WR2005, the level of detail of water resource information in the WR2012 study has been broadened to include information on reservoirs, land use/water use and other water resource aspects. New spreadsheets have been compiled which provide details of land use/water use, which will make the future planning easier. The project also intends to continually incorporate recent work by other consultants on various catchments, and to update all data.

Other progress for the year includes the creation of land use/water use spreadsheets for all water management areas, with worksheets with data on dams, abstractions and return flows, irrigation, alien vegetation and afforestation. The project team has also started to determine the optimal water resource observation network which has to be maintained at all costs in order to continuously enhance the assessment and understanding of the country's water resources.

As part of the capacity building efforts of the project, the research team has presented a number of training courses on the newly-improved WRSM2000 model at several universities, with great success. The purpose of the training is to broaden awareness of the various water resource models available, and how to set up and use the WRSM2000 model for a water resource system.

"Determining monitoring of South Africa's rainfall and streamflow as well as groundwater levels remains the biggest challenge to the successful completion of the project," notes Nomquphu. "Spatially representative, long-term consistent records of rainfall, streamflow, groundwater levels and water quality data are essential for achieving a high-level of understanding about water resources. Good quality data are a serious impediment to the sustainable management of South Africa's water resources. Not only are the observation networks shrinking, the quality is deteriorating."

Apart from the troubling rainfall, streamflow and groundwater level data issues, which have been reported on, the research team has also discovered that reservoir data records – key to analysing the water resources of South Africa – have declined alarmingly, with quite a number of missing data points and suspect readings. "However, the WRC is exploring ways to establish a central home for water data from all its projects in which hydrological data are collected," noted Nomquphu.

The WR2012 study is due for completion in 2016.

Global News

Sustainable development Africa's greatest challenge – UN

Achieving socio-economic development while sustainably managing its water resources and avoiding the mistakes for the developed world, is Africa's great challenge at present.

This is according to the latest United Nations World Water Development Report. The report, *Water for a Sustainable World*, was launched head of World Water Day on 22 March.

"Africa's key policy goal is a transition and transformation from political to economic independence. The fundamental aim is to achieve durable and vibrant participation in the global economy while ensuring that the abundant natural resources are managed sustainably and equitably to serve the needs of present and future generations of Africans," the report points out.

Many African economies are now growing faster than they have in 40 years. The backbone of many African economies is agriculture, which is dependent on highly variable and unpredictable rainfall patterns. Assured and timely water availability is a major constraint in sustainable agricultural production.

As other regions around the globe gentrify and reach fertility rates below those needed to replace current populations and thus a productive workforce, Africa has a different problem – that of rapid population growth, which can be seen as an opportunity to transform African economies to sustainable and inclusive growth for the next half century.

This population must be fed, educated and kept healthy and productive. It is in this context that water for food, for health and for energy is critical to the continent's sustained development, says the report. Important progress has been made towards attaining the Millennium Development Goal target for access to improved drinking water, especially for urban populations, but much less progress has been made with respect to sanitation.

Currently, only 5% of Africa's potential water resources are developed and average per capita storage is 200 m^3 compared to 6 000 m^3 in North America. Only 5% of the continent's cultivated land is irrigated and less than 10% of hydropower potential is utilised for electricity generation.

Despite these challenges, significant progress has been made by many African countries in the utilisation of water resources for socio-economic development. Looking forward, the key will be not only achieving economic growth but also sustainable and inclusive growth.

To access the full report, Visit http://unesdoc.unesco.org/images/0023/002318/231823E.pdf

Global News

Drought could be factor in Syrian conflict – researchers

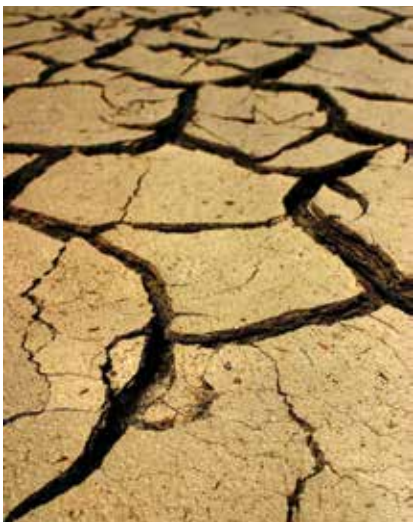
A growing body of research suggests that extreme weather – including high temperature and droughts – increases the chances of violence, from individual attacks to full-scale wars.

The latest research by the University of California Santa Barbara's (UCSB's) Colin Kelley is perhaps the first to look closely and quantitatively at climate change in relation to ac current war. The study, which combined climate, social and academic data, appeared in the Proceedings of the National Academy of Science in March this year.

The research suggests that a record drought, which ravaged Syria from 2006 to 2010, was likely stoked by ongoing manmade climate change and that the drought may have helped propel the 2011 Syrian uprising. According to Kelley the drought – the worst ever recorded in the region – destroyed agriculture in northern Syria's breadbasket, driving dispossessed farmers to cities, where poverty, government mismanagement and other factors created unrest that exploded in the spring of 2011. The conflict has since evolved into a complex multinational war that has killed at least 200 000 people and displaced millions.

"While we are not saying that drought caused the war, we are saying that it certainly contributed to other factors – agricultural collapse and mass migration among them – that caused the uprising," noted Kelley, a postdoctoral researcher at UCSB.

The study reports that agricultural production, typically a quarter of the country's gross domestic product, plummeted by a third and as many as 1.5 million people fled from the countryside



to the peripheries of cities already strained by influxes of refugees from the ongoing war in neighbour, Iran.

"There was a huge population shock in a very short period of time in these urban areas, which were already marginally sustainable in terms of their resources," explained Kelley. "This kind of rapid change in demographics encourages instability. The combination of large acute geographic and demographic changes created a huge vulnerability."

Source: University of California

Stockholm Water Prize awarded to India's 'water man'

The Stockholm International Water Institute (SIWI) has awarded the 2015 Stockholm Water Prize to Rajendra Singh of India for his innovative water restoration efforts, improving water security in rural India, and for showing extraordinary courage and determination in his quest to improve the living conditions of those in need.

Born in 1959, Singh lives and works in the arid Indian state of Rajasthan, where he for several decades has dedicated himself to defeating drought and empowering communities. Through his efforts several rivers have been revived, while water has been brought to thousands of villagers.

"Today's water problems cannot be solved by science or technology alone," noted the Stockholm Water Prize Committee in Singh's citation. "They are instead human problems of governance, policy, leadership and social resilience. Singh's life work has been in building social capacity to solve local water problems through participatory action, empowerment of women, linking indigenous know-how with modern scientific and technical approaches and upending traditional patterns of development, resource use and social norms."

Singh's work reveals a true humanitarian and firm belief in empowerment, according to SIWI. Following his studies he went to Rajasthan to open up health clinics, but instead found the greatest need to be water. So he set out to build johads, or traditional earthen dams.

Two decades after his arrival, 8 600 johads and other structures to collect water have been constructed. Water has been brought back to a 1 000 villages across the state. The methods used by Singh are modernisations of traditional Indian ways of collecting and storing rainwater, dating back thousands of years. The methods fell out of use during British colonial rule, but have now brought water back to the driest state in one of the world's most populous nations, thanks to the 'Water man of India' and his colleagues.

New from the WRC

Report No. KV 337/14

Conceptual project on using the pumping scheme to eliminate acid mine drainage (C Sheridan; R Bonner; L Bruyns; D Drake; K Harding; JP Janet; K Rumbold; N Saber)

Acid mine drainage (AMD) poses a serious threat to water quality in the Witwatersrand region, owing to extensive, abandoned mine voids that have subsequently flooded. In response to the severity of the current situation, the South African government has undertaken construction and expansion facilities to lower the water table to a safe level in the worst affected portion of the basins through pumping and effluent treatment. This study proposed using the same infrastructure that is currently being installed to manage the problem more effectively and sustainably by pumping from a greater depth. It was hypothesised that the anoxic conditions at this depth (ca. 2 km) will effectively preclude the generation of AMD and hence reduce the need for effluent treatment while maintaining the desired water level.

Report No. KV 335/14

South African national water game competition aimed at eliciting the perceptions that youth in South Africa hold towards water and water-related careers (A Pott and M Lethela)

The primary aim of this project was to elicit the water and possible water career-related perceptions of young South Africans in high school and at university. A novel approach was used in which the questions were embedded within a water game. The game is based on the Mid-Olifants catchment in South Africa, and observed river flows are used in the game.

Report No. 2142/1/14

A detailed acid base accounting study of the coal-bearing Karoo formations in the Waterberg coalfield (L Deysel; N MacDonald; V Aphane and PD Vermeulen)

The large resource base coal zones of the Waterberg Coalfield, located in Limpopo, will enable the mining of coal in this area and will continue into the future. As the demand for energy in South Africa increases in the coming years, the coal produced from this area will prove essential. This study sought to identify the potential of acid generation from the overburden, interburden and plant discard that will be removed and placed on the discard dumps, and possibly used as backfill material. More specifically, the study mainly aimed to determine the acid-base potential of all the different geological layers, and the best methods of how to handle these spoils and discards in order to reduce the risk of acid generation. Acid base accounting was used as a prediction tool to determin e the acid potential of the lithological units.

Report No. TT 611/14

Wastewater reclamation for potable reuse. Volume 2: Integration of MBR technology with advanced treatment processes (G Metcalf; L Pillay; C Murutu; S Chiburi; N Gumede and P Gaydon)

This report follows on from Wastewater reclamation for potable reuse Volume 1. Evaluation of membrane bioreactor technology for pre-treatment (Report No. 1894/1/14). There are a range of technologies and combinations of treatment technologies that can be used to reclaim water from domestic wastewater effluent. The choice of treatment train that will meet quality, cost and operational requirements is a difficult one, however. The intention of this research project was to test a range of treatment technologies in different combinations and to establish a preferred reclamation treatment process train for water reclamation. The product water quality derived from the reclamation process should meet both South African and international drinking water standards. Volume 1 contains the results of an assessment of MBR technologies as a pre-treatment step in wastewater reclamation. In phase 2 of the study, described in Volume 2, laboratory scale pilot trials were undertaken using MBR technology in combination with ozonation, granular activated carbon, nanofiltration, reverse osmosis and advanced oxidation processes.

Report No. KV 336/14

Water and emplacement: New perspectives from displacement and resettlement to enhance IWRM practice (C de Wet)

This project sought to apply concepts from the field of displacement and resettlement studies to develop a framework to understand, assess and respond constructively to the socio-economic, institutional and ecological impact experienced by people in human settlements, and the options and constraints created, when they are affected by planned changes in access to water supply, quality and habitats.

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Wetlands

No false start for South Africa's newest Ramsar site


Sue Matthews

The False Bay Nature Reserve in Cape Town has been designated as South Africa's 22nd Ramsar site. Sue Matthews explored what makes this site so special.

At a celebratory function held on 2 February – World Wetlands Day – the Ramsar certificate declaring the False Bay Nature Reserve a 'wetland of international importance' was presented by Deputy Minister of Environmental Affairs, Barbara Thomson. The reserve includes three large wetlands – Rondevlei, Zeekoevlei and the manmade Strandfontein pans – as well as numerous small seasonal or ephemeral wetlands that appear with good rains and a high water table. Together, these wetlands make up just over 50% of the reserve.

The Ramsar status has been a long time coming, having first been mooted some 15 years ago by residents of the short peninsula jutting out into Zeekoevlei, the city's largest natural inland waterbody. This small enclave of dinghy sailors, rowers, and lovers of wide-open spaces is accessed along a narrow strip of land separating Zeekoevlei and Rondevlei, so the cause was soon taken up by the Friends of Zeekoevlei and Rondevlei, a local community group. However, the Ramsar submission needed to be made by the 'owner' of the site, the City of Cape Town, so it was only after the City council had approved the boundaries of the False Bay Nature Reserve a few years ago that the application process could begin.

The 2 300 ha reserve – still awaiting its official proclamation at the time of writing – is a consolidation of six sections, two of which were already municipal nature reserves. The Rondevlei Nature Reserve was originally proclaimed in 1952 as a bird sanctuary, consisting only of the waterbody and its shoreline, but it has been expanded over the years to cover a 290 ha area that includes a small patch of Cape Flats Sand Fynbos, a critically endangered vegetation type. There are six bird hides and two observation towers along the northern shore, and a variety of birds are readily seen, but the same cannot be said for the resident population of six hippos. After an absence of almost 300 years, hippos were re-introduced to Rondevlei in 1979 to control an invasive alien grass species, but are rarely seen by visitors, given their nocturnal habits.

They have made the national news on a few occasions over the last decade, though, when individuals have escaped from the reserve and taken up temporary residence in either Zeekoevlei or the Strandfontein pans.

Jan van Riebeeck's naming of Zeekoevlei – Dutch for 'hippo lake' – in 1656 attests to its suitability as a home for hippo, before they were shot to extinction in the Cape. Since then, the waterbody has been degraded by hardening of the banks, construction of a weir to maintain a high water level for boating, and input of both stormwater runoff from urban and industrial development, and nutrient-rich groundwater seepage from the Philippi agricultural area and nearby sewage works. It has been plagued by pollution problems, sedimentation, toxic algal blooms, proliferation of reeds and water hyacinth, and the loss of natural weed beds, but the Zeekoevlei Nature Reserve was nevertheless proclaimed in June 2000. Beginning in 1997, sluice gates in the weir have been opened each autumn to allow an annual 'drawdown' of the waterbody to flush out nutrients and allow litter, water hyacinth and excess reed growth to be removed, while a cut-off drain constructed in 2008 has reduced nutrient seepage from the sewage works.

The Strandfontein pans had no formal protected area status until their inclusion in the False Bay Nature Reserve, largely because they were constructed as oxidation ponds for sewage treatment. Since the upgrade of the Cape Flats Waste Water Treatment Works in 1980 they have served as settling ponds for the final effluent, providing a rich feeding ground for a variety of birds.

The Cape Bird Club has been conducting regular counts here since 1983, and over the years has recorded almost 200 species, with bird numbers averaging 15 000 in the summer months. The data revealed that the site met the criteria for Important Bird Area status – hosting species of global and regional conservation concern, assemblages of birds with restricted range, and large concentrations of congregatory species – which resulted in the site being designated an IBA in 1998. From 2004 the Cape Bird Club used a bequest from Mrs Julie te Groen to co-fund the appointment of a conservation manager for the site, in a partnership arrangement with the City of Cape Town.

The other three sections that make up the False Bay Nature Reserve are areas to the west (Slangetjiebos) and east (Pelican Park) of the Strandfontein pans, and the coastal strip (Zandwolf). Slangetjiebos is a somewhat degraded piece of land squeezed between a major landfill site, the Capricorn Business and Industrial Park, and the Vrygrond township, a mix of informal settlement and low-cost housing, but it is important as a buffer zone protecting the Strandfontein birdlife. Pelican Park is an area of vegetated dunes, where Cape Flats Dune Strandveld – the dominant vegetation type throughout the False Bay Nature Reserve – is in particularly good condition. The final piece of the puzzle, Zandwolf, not only links the freshwater wetlands to the sea, but also provides an ecological corridor between Zandvlei Nature Reserve in the west and Wolfgat Nature Reserve in the east.

What is the Ramsar Convention?

The Ramsar Convention, formally known as the Convention on Wetlands of International Importance, provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

The treaty was negotiated by countries and non-governmental organisations concerned about the increasing loss and degradation of wetland habitat for migratory waterbirds. It was adopted in the Iranian city of Ramsar in 1971 and came into force in 1975. There are currently 168 contracting parties.

The False Bay Nature Reserve includes Rondevlei, Zeekoevlei and the Strandfontein pans, as well as a number of small seasonal wetlands.

Manager of the False Bay Nature Reserve, Asieff Khan, with the Ramsar certificate awarded on World Wetlands Day.

Top: Zeekoevlei is the main recreational node of the reserve, popular for watersports such as rowing and dinghy sailing, as well as fishing.

Left: Cape Bird Club stalwart Felicity Ellmore shows nature conservation student Adriel Cloete how to measure wing-length during a bird-ringing exercise at Rondevlei.

The different characteristics of the various sections are key to meeting the objectives of the False Bay Nature Reserve. While conserving and rehabilitating indigenous biodiversity is its primary purpose, secondary objectives are to promote environmental education, create recreational and tourism nodes, and provide job opportunities.

"We've got something for everybody here, and try to tick all the boxes," says reserve manager Asieff Khan.

Two overnight facilities at Zeekoevlei accommodate 40 and 120 learners respectively for programmes run by the Cape Town Environmental Education Trust, which is partly funded by the City of Cape Town. The more rustic Otter Bush Camp at Rondevlei catered for 20 youth until it was destroyed by a veld fire in January.

Rondevlei also has an island bush camp operated by a private tour company, which offers boat cruises too between August and February, when the water level is high enough. Staying overnight or taking a sunset cruise offers the best chance of seeing the elusive hippos, otherwise evident only from footprints or dung left behind on their nightly wanderings. The camp is particularly popular with birders and carp-fishers, but also provides a wonderful outdoor adventure for families.

The Strandfontein pans are considered the best waterbird locality in Cape Town, and would be on the 'to do' list for any serious birder visiting the city. The good gravel roads between the pans allow visitors to use their cars as mobile hides, but maximising the ecotourism potential must clearly be weighed against unnecessary disturbance to the birds.

Zeekoevlei is the main recreation node of the reserve, and has also had the most impact in terms of job opportunities. The vlei has long been popular for watersports, but the eastern shore – a previously neglected area that attracted a 'bad element' – has undergone a major upgrade over the past two years, and now has lush lawns, paved parking areas, smart new ablution facilities and formal braai areas to lure local residents.

The project was made possible by a R25-million contribution of Expanded Public Works Programme funding from the national Department of Tourism and R1-million from the provincial government, and provided temporary jobs for 160 previously unemployed and unskilled people drawn from the surrounding communities. The training they received and experience gained has improved their chances of finding other employment now that the project is complete.

"And then there's Pelican Park, where there are fantastically beautiful dunes – 40 m high in places – with dune-slack wetlands at the base of them," says Khan. "The vegetation there is quite unique, and is home to a butterfly species found nowhere else in the world, so we try to keep human impacts out of that area."

"Obviously with people living right on the reserve's boundary it does present challenges, and there will be impacts – we've had metal poles stolen for scrap and reports of quad bikers in

the dunes, for example – so we try and establish relationships with as many people as possible. But that takes time and effort, and you only see the results on a long-term basis."

He adds that one advantage of having employed people from the local community for the eastern shore development is that they've become protective over the infrastructure they built, which should help limit the amount of vandalism.

Another 30 people were taken on for the reserve's two-year Skills Development Programme, which provides on-the-job training in alien-clearing, chainsaw operation, plant cultivation, fire-fighting and first aid, amongst others. In this case, the EPWP funding was from the Department of Environmental Affairs' Natural Resource Management Programme, under which the 'Working for' programmes now fall.

One of the alien-clearing projects tackled by these workers is the manual removal of water hyacinth, which seems to have achieved its eradication from Zeekoevlei and some of the Strandfontein pans. A few of the other pans are so completely covered by the weed that herbicides may need to be used – the biocontrol agents released to date have not been effective.

The clearing work at Strandfontein started in 2011 under the supervision of the conservation manager funded by the Cape Bird Club. Now that this post has been absorbed into the reserve's management structure, the Cape Bird Club is supporting conservation at the site in other ways.

"We're funding research by the conservation manager, Erica Essig, on how we can improve the habitat for birds using the shore line, and also employing a foreman to assist her," says Dr Dave Whitelaw, who set up the club's conservation committee in 1989 and has chaired it ever since. He himself has played an instrumental role in enhancing the birdlife at the site by encouraging the sewage works staff, some 15 years ago, to manipulate water levels in the pans.

"We started with a pan or two and the spectrum of birds changed quite impressively, and things developed from there!" Today there is a mix of water depths, exposed sandbanks and fringing reedbeds, catering for a variety of habitat preferences.

"Obviously with people living right on the reserve's boundary it does present challenges, and there will be impacts…so we try and establish relationships with as many people as possible."

For a time during the early 2000s, though, the future of the Strandfontein birdlife looked rather bleak. A private consortium proposed building an extension of a major highway, the R300, to form a tolled 'ring road' linking the False Bay coast to Blaauwberg on the west coast. A section of the road was planned to pass through the narrow strip of land between Zeekoevlei and the Strandfontein pans, which would have resulted in considerable disturbance to birds, as well as injuries and deaths due to bird strikes. Fortunately, after five years of EIA preparation, public participation, petitions and protests, the proposal was quashed – or at least put on the backburner indefinitely.

"This is where the Ramsar designation is so important, because it would have to be taken into account if anybody wanted to build a toll road through there now," says Dr Whitelaw. "It has certainly elevated the status of the False Bay Nature Reserve, and would give us a bit more clout to debate the issue."

As reserve manager, Asieff Khan has noticed an additional benefit.

"More than anything it's given the staff recognition for what they are doing, and they have a whole new healthy respect for themselves," he says. "I can see they're working harder than they ever had. It's just done marvels for people's morale!"

The rich birdlife at the Strandfontein pans was a contributing factor for the designation of the reserve as a Ramsar wetland of international importance.

Agricultural water management

Paying more due to pollution – The impact of algae on SA's fruit and wine sector

South African wine (and fruit) consumers may soon be faced by a different kind of 'sin tax' in the form of raised consumer prices if the freshwater algae choking some of the country's irrigation channels cannot be brought under control.

Article by Dr Willem de Lange, CSIR senior economist.

Scientists at the CSIR have calculated the Rand value of the impact of algae pollution on commercial agriculture in the Berg River, in the Western Cape. This value not only comes in handy when comparing different ways to manage the problem, but it also provides a glimpse of how much the price of deciduous fruit and wine grapes could increase if nothing is done about the problem.

The study was undertaken in the Dwars River, which is a tributary of the Berg River. Its source lies within the Banghoek valley between the northern side of the Jonkershoek valley and the Drakenstein Mountain range and is part of G10C quaternary catchment with an average rainfall is 877 mm/year and a mean annual runoff of 96.7 million m^3/year. The geology of the source areas is Peninsula sandstone formation from the Table Mountain group which forms coarse, sandy, low-nutrient soils and is characterised by dark brown, humic-acid tinted water with a low pH. The riverbed is typically rocky due to high water flow rates, especially in winter which removes finer sediments except in sheltered locations. The middle and lower reaches has significantly lower flow rates and consequently more sand and sediment from the alluvial and colluvial deposits.

It is in these middle and lower reaches where algae growth has become a problem for commercial agriculture, which has led to a CSIR research project tasked to find a solution for the algae problem. Part of this study focused on calculating the Rand value of the problem – i.e. the focus of this article.

It is intuitively understood that pollution mitigation strategies tends to increase the production cost of agricultural enterprises. Commercial agriculture in the area is dominated by deciduous fruit and wine grape industries. Tree census data confirmed that

Jessica Chamier

plums represent 70% of hectares under deciduous fruit while 355 hectares is coved with vines. Consequently, plums were taken as representative deciduous fruit while no distinction was made on cultivar level for neither plums nor vines.

The cost implications algae pollution was determined in close collaboration with farmers because each farmer manages the impacts slightly differently. Farmers in the study area were asked to explain the impacts of algae pollution on their business and what they do to manage the problem. They were asked to try and distinguish between a 'heavy' load and a 'normal' algae pollution load since it was understood that algae is always present in the water and that differences in concentration levels are actually the distinguishing factor that affect farming practice and hence profitability.

The cost implications were systematically captured in a spreadsheet which was fed into a standard crop enterprise budget for plums and vines. These budgets are based on industry information (data obtained from leading input suppliers and agri-databases maintained by Hortgro, SAWIS,

VINPRO, Nulandis and KaapAgri) and provide an indication of the gross farm income also known as 'income at the farm gate'. It was noted that these crop enterprise budgets already account for the 'normal' pollution load and that last mentioned could be used as a point of departure to compare against a 'heavy' pollution load scenario.

Most farmers were aware of the direct relationship between bio-available phosphate (nutrient enrichment) and algae growth. Although algae poses no direct threat to crops, its impact is felt via increased operation and maintenance cost of irrigation infrastructure. It thus came as no surprise that although pollution loads vary throughout the year, algae affects farmers only during the irrigation. Algae not only obstructs and clogs strainers, intake valves and manifolds, but also places a higher load on impellers and bearings of pumps, while decreasing the volume delivered per pump-hour. Micro-jets and dripper lines are also clogged which leads to uneven and thus suboptimal moisture management in orchards and could affect crop yield if not cleaned.

Standard practice to manage algae comes down to more frequent cleaning of the complete irrigation system. Although, all irrigation systems requires a minimal amount of cleaning and flushing prior to the irrigation season, the challenge here was to differentiate between cost relating to standard practice vs. cost relating to high algae loads. Farmers were asked to systematically describe the steps in their standard practice of dealing with algae within a typical pump station on their farm and to explain the difference between a 'high' and 'low' load scenario. The following table summarises the basic difference between a normal and high algae load scenario:

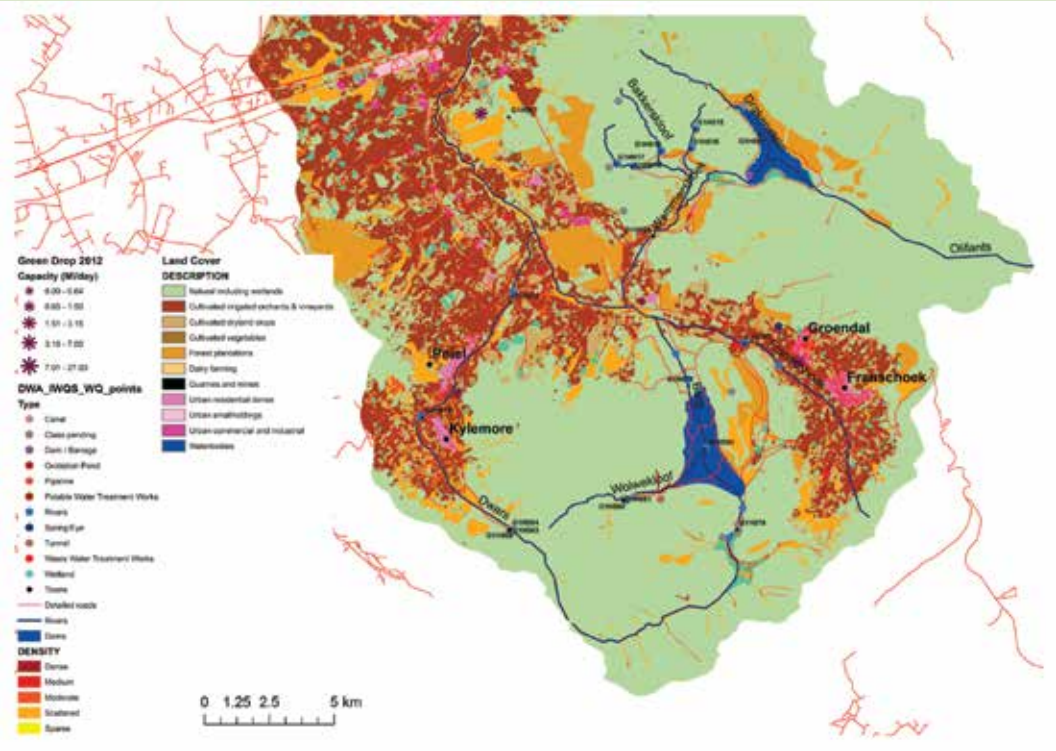
Activity	Normal load scenario	High load scenario
Servicing of pumps	Every third year	Every second year
Replace filter sand	Every third year	Annually
Clean strainers, disc filters and sand filters	Once a week	Daily
Required man-days per hectare per week to clean micro jets and drippers (during irrigation season)	1	7

The following table presents the time and or energy component associated with each activity (as reported by the respondents)

Activity	Time required
Clean strainer and foot valve	15 minutes
Clean disc filter	10 minutes
Backwash sand filter	10 minutes and 0.55 kilowatt
Transport	20 minutes

Some additional input variables being used to do the calculation:

- The irrigation season lasts for 20 weeks (i.e. 120 days).
- Farm labour cost is R15 per hour.
- A typical pump station serving 10 hectares consists of a strainer, foot valve, 3.3 kilowatt pump, Conn 80 sand filter and an Arkal disc filter.
- Electricity cost is R1.20 per kilowatt hour.



The study area.

Farmers mentioned that the service cost of their irrigation pumps is approximately R9 000, which implies that the annual service cost for a pump under low load conditions is approximately R3 000 per year and R4 500 per year under high load conditions, i.e. an R1 500 per year difference. Filter sand costs R1 875 per filter, which implies an annual cost of R625 cost for low and R1 875 for high load conditions, i.e. R1 250 per year difference.

The following table compares the cost implications of the two scenarios:

Activity/input	Low algae load conditions		High algae load conditions		Difference
	Total time during irrigation season	Rand value	Total time during irrigation season	Rand value	
Clean strainer and foot valve	300 minutes	R 75.00	2100 minutes	R 525.00	R 450.00
Clean disc filter	200 minutes	R 50.00	1400 minutes	R 350.00	R 300.00
Backwash sand filter	200 minutes	R 50.00	1400 minutes	R 350.00	R 300.00
Transport	400 minutes	R 100.00	2800 minutes	R 700.00	R 600.00
Electricity	11 kilowatt	R 13.20	77 kilowatt	R 92.40	R 79.20
Servicing		R3000.00		R4500.00	R1500.00
Sand		R625.00		R1875.00	R1250.00
Sub-total: Additional cost due to algae pollution per pump-year					R4479.20
Additional cost due to algae pollution per hectare pump-year (A)					R447.92
Cleaning of micro-jets per hectare per year (B)	960 minutes	R240.00	6780 minutes	R1680.00	R1440.00
Total additional cost due to algae pollution per hectare per year (A + B)					R1887.92

Given an estimated 307 ha of deciduous fruit in the study area, and assuming that all farmers struggle with algae, it was estimated that above-mentioned R1 887 per hectare per year is equivalent to R579 591 per year for deciduous fruit in the study area. This figure could be extrapolated to R98-million per year for the South African deciduous fruit industry (52 000 ha) assuming that all areas struggle equally with algae problems.

Although vines employ drip irrigation while deciduous fruit uses micro jets, the labour component for cleaning these two types of irrigation system is essentially the same. The mitigation strategy for managing algae is therefore essentially the same for deciduous fruit and vines, which implies that the cost per hectare is comparable. Given an estimated 355 ha under vines in the study area, the cost of algae for the wine grapes is estimated at R670 400 per year. This figure could be extrapolated to R188-million per year for the 99 800 ha under wine grapes in South Africa (assuming all regions struggles equally with algae).

Given that the pre-harvest production cost for plums is R61 880 per hectare, the cost of algae pollution represents approximately 3.1% of pre-harvest cost. Pre-harvest production cost for wine grapes is R35 739 per hectare, which implies that the algae problem represents 5.2% of the pre-harvest cost. These figures might seem quite small, but within an industry with extremely small producer profit margins, these figures are substantial. It is likely that these impacts could be given through to consumers, which could imply that consumers could pay more for their fruit if nothing is done to curb the impacts of pollution.

The information generated in this study creates an overarching 'management budget' for algae pollution. This means that any overarching algae management strategy will be worthwhile from a financial perspective if the cost to mitigate the algae pollution impacts for plums and vines is less than R1.3-million per year in the study area. The information generated within this study also presents the initial market potential for tradable pollution permits as a mitigation practice to manage algae pollution in the study area.

Algae has become a significant problem in the Berg River system.

THE WATER WHEEL

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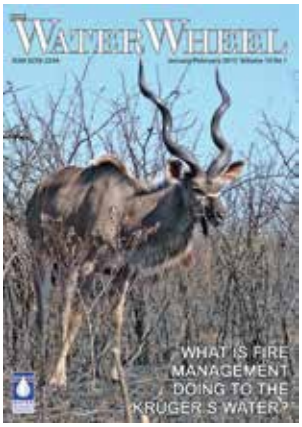

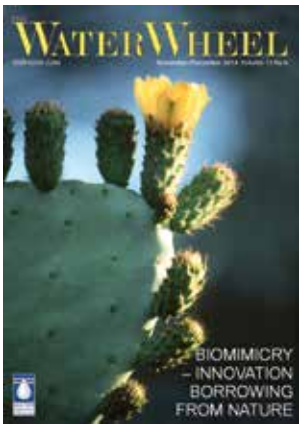

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WATER FOR A SUSTAINABLE WORLD

SOCIETY

THE WATER AND SOCIETY RELATIONSHIP

3 BILLIONS PEOPLE LACK ACCESS TO DRINKING WATER THAT IS REALLY SAFE

1/4 POPULATION LIVES IN DEVELOPING COUNTRIES THAT FACE WATER SHORTAGES DUE TO

INFRASTRUCTURES TO TRANSPORT WATER FROM RIVERS AND LAKES IS INSUFFICIENT

WEAK GOVERNANCE

1/5 POPULATION LIVES IN AREAS WHERE WATER IS PHYSICALLY SCARCE

INVESTING IN IMPROVED WATER MANAGEMENT AND SERVICES IS ONE PREREQUISITE TO REDUCING POVERTY AND ACHIEVING SUSTAINABLE ECONOMIC GROWTH

IN 2012 2,5 BILLIONS PEOPLE DID NOT HAVE ACCESS TO SANITATION FACILITIES

POOR PEOPLE RECEIVE VERY DIRECT BENEFITS FROM IMPROVED WATER SERVICES AND IMPROVED SANITATION SERVICES THROUGH

BETTER HEALTH · REDUCED HEALTH COST · TIME SAVING · INCREASED PRODUCTIVITY

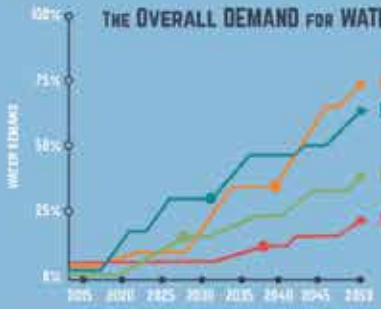
POVERTY

WATER

THE RELATION BETWEEN WATER AND POVERTY IS A TWO-WAY STREET

ACCESS TO ADEQUATE AND SAFE WATER SUPPLIES IS ESSENTIAL FOR POVERTY REDUCTION. YET POVERTY ITSELF CAN BE A DRIVER OF POLLUTION AND UNSUSTAINABLE USE OF WATER RESOURCES.

THE OVERALL DEMAND FOR WATER DEMAND THROUGH 2050



MORE THAN 80% OF THE WORLD'S POPULATION LIVES IN COUNTRIES WHERE THE INCOME DISPARITIES ARE WIDENING

TIME TO CHANGE

IMPROVED GENDER EQUALITY IS A KEY TO BOOSTING WATER MANAGEMENT AND ACCESS. ONE 2012 ESTIMATE SUGGESTS THAT CUTTING JUST 15 MINUTES OFF THE WALKING TIME TO A WATER SOURCE COULD REDUCE UNDER-FIVE CHILD MORTALITY BY 11% AND THE PREVALENCE OF NUTRITION-DEPLETING DIARRHOEA BY 41%.

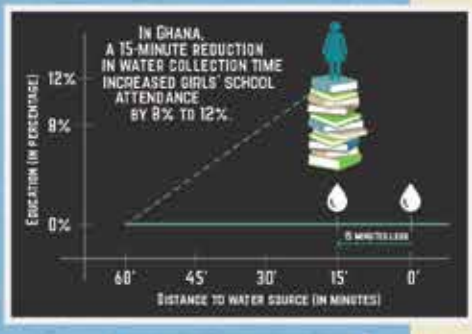
WATER MANAGEMENT CONTRIBUTES TO FOUR KEY DIMENSIONS OF POVERTY REDUCTION:

1. ENHANCED LIVELIHOODS SECURITY
A RANGE OF PRODUCTION ACTIVITIES REQUIRE RELIABLE WATER SUPPLIES

2. HYGIENE IMPROVES HEALTH AND REDUCES POVERTY
IMPROVED ACCESS TO SAFE WATER, BASIC SANITATION AND IMPROVED HYGIENE IS ONE OF THE MOST EFFECTIVE WAYS TO IMPROVE HEALTH

3. REDUCED VULNERABILITY
REDUCING THE RISKS AND IMPACTS OF HAZARDS RELATED TO VOLATILE POLITICS AND ECONOMICS AS WELL AS UNSUSTAINABLE ENVIRONMENTAL TRENDS AND SHOCKS FROM WATER RELATED NATURAL DISASTERS

4. ECONOMIC GROWTH
WATER PROVIDES LIVELIHOOD AND ENTREPRENEURIAL OPPORTUNITIES, GENERATING HIGH RETURNS FOR LOCAL ECONOMIES



ECONOMY

EXPANDING ECONOMIC OPPORTUNITIES THROUGH WATER

WATER IS AN ESSENTIAL RESOURCE IN THE PRODUCTION OF GOODS AND SERVICES, INCLUDING FOOD, ELECTRICITY AND MOST MANUFACTURED PRODUCTS.

WATER SUPPLY (QUANTITY AND QUALITY) MUST BE RELIABLE AND PREDICTABLE TO SUPPORT FINANCIALLY SUSTAINABLE ECONOMIC ACTIVITIES. INFRASTRUCTURE THAT REDUCES RISKS FROM WATER SCARCITY AND WATER-RELATED DISASTERS SUCH AS FLOODS AND DROUGHTS INCREASES THE RESILIENCE OF ECONOMIES.

IMPACTS OF NEGLECTFU

OVER … IS … SMALL… AND … UNTR… POSES A…

DEFORESTATION RESULTS IN DEGRADATION AND DESERTIFICATION OF WATERSHEDS AND CATCHMENT AREAS, AND REDUCES THE AMOUNT OF SAFE WATER AVAILABLE DOWNSTREAM.

BASIC PROVISION OF WATER AND SANITATION SERVICES IS REQUIRED TO UNLOCK THE POTENTIAL OF ECONOMIC GROWTH, PARTICULARLY TO BREAK THE VICIOUS CYCLE OF LOW PRODUCTIVITY LINKED TO POOR HEALTH AND LACK OF EDUCATIONAL OPPORTUNITIES THAT MAINTAINS POVERTY AND ECONOMIC STAGNATION.

THE FI…

ENHANCING WATER RES…

A US$15 TO US$30 BILLION INVESTMENT IN IMPROVED WATER RESOURCES MANAGEMENT IN DEVELOPING COUNTRIES CAN HAVE DIRECT ANNUAL INCOME RETURNS IN THE RANGE OF US$60 BILLION.

EVERY US$1 INVESTED IN WATERSHED PROTECTION CAN SAVE ANYWHERE FROM US$75 TO NEARLY US$200 IN COSTS FOR A NEW WATER TREATMENT AND FILTRATION FACILITY.

IN PAKISTAN

IMPACTS OF 3 YEARS OF REPEATED (2010-2012) FLOODS

CAUSED

- 3,072 LIVES LOST
- US$14 BILLIONS IN DAMAGES
- CUT THE EXPECTED ANNUAL GROWTH RATE IN HALF (2.9% INSTEAD OF THE PROJECTED 6.5%)

L WATER MANAGEMENT

80% OF WASTEWATER WORLDWIDE NOT COLLECTED OR TREATED.

-SCALE INDUSTRIES, SUCH AS AGRO-PROCESSORS, TEXTILE DYEING ANNERIES, CAN RELEASE TOXIC POLLUTANTS INTO LOCAL WATERS.

EATED EFFLUENT FROM URBAN SETTLEMENTS AND INDUSTRY MAJOR HEALTH THREAT TO PEOPLE, THE ECONOMY AND THE ENVIRONMENT.

DROUGHTS

IN THE UNITED STATES, THE 2012 DROUGHT AFFECTED 80% OF FARMS AND RANCHES, RESULTING IN CROP LOSSES IN EXCESS OF US$20 BILLION AND A WIDE RANGE OF RIPPLE EFFECTS.

LL COSTS ARE ESTIMATED TO BE AS HIGH AS US$50 BILLION.

SOURCES MANAGEMENT

THERE IS A NEED TO CHANGE THE WAY WE VALUE, MANAGE AND USE WATER AND THE ENVIRONMENT, AND TO REFOCUS INVESTMENTS

SUSTAINING THE GAINS OF ECONOMIC PROGRESS REQUIRES INVESTING IN THE PROTECTION OF ECOSYSTEMS FOR MAINTAINING THE VARIOUS WATER-RELATED ENVIRONMENTAL SERVICES THEY PROVIDE, AND UPON WHICH THE ECONOMY DEPENDS.

ENVIRONMENT

AQUATIC ECOSYSTEMS ARE CENTRAL TO SUSTAINING BIODIVERSITY AND ALL FORMS OF DEVELOPMENT.

THERE IS A NEED TO SHIFT TOWARDS ENVIRONMENTALLY SUSTAINABLE ECONOMIC POLICIES THAT ALSO CONSIDER THE INTERCONNECTION OF ECOLOGICAL SYSTEMS TO ADDRESS HUMAN IMPACTS AND MAINTAIN PRODUCTIVE ECOSYSTEMS.

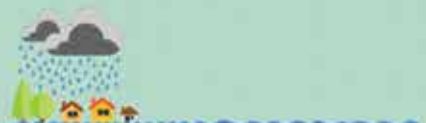
'NATURAL INFRASTRUCTURE' USES ECOLOGICAL PROCESSES TO PROVIDE MANY OF THE SAME SERVICES THAT HUMAN-BUILT INFRASTRUCTURE DOES. IT OFFERS MANY ECONOMIC BENEFITS, ESPECIALLY WHEN THE DESTRUCTION OF NATURAL INFRASTRUCTURE REQUIRES INVESTMENT IN BUILT INFRASTRUCTURE TO PERFORM THOSE SAME SERVICES.

IN SOME CASES, HUMAN-BUILT INFRASTRUCTURE CAN CAUSE BIODIVERSITY LOSS AND DEGRADATION OF ECOSYSTEM SERVICES.

THE CHALLENGE IS TO MANAGE WATER RESOURCES TO MAINTAIN A BENEFICIAL BALANCE BETWEEN BUILT AND NATURAL INFRASTRUCTURE AND PROVISION OF THEIR RESPECTIVE SERVICES.

CURRENT FOOD PRODUCTION PRACTICES ARE RESPONSIBLE FOR NITROGEN, PHOSPHORUS AND PESTICIDE LOADING AND FISHERIES DEPLETION.

IT IS ESTIMATED THAT BETWEEN US$4.3 AND US$20.2 TRILLION PER YEAR WORTH OF ECOSYSTEM SERVICES WERE LOST BETWEEN 1997 AND 2011 DUE TO LAND USE CHANGE.



CLIMATE CHANGE HAS A SIGNIFICANT IMPACT ON ECOSYSTEMS, THREATENING BIODIVERSITY, WHILE INCREASED FREQUENCY AND STRENGTH OF STORMS AND TIDAL SURGES WILL INCREASE DAMAGE AND VARIATION OF SEDIMENT TRANSFER IN RIVER FLOWS.

THE CREATION OF 'GREEN CORRIDORS' ALONG RIVERS, FLOODPLAINS AND STREAMS CAN LINK ECOSYSTEMS, THUS ABSORBING NUTRIENTS AND REDUCING WATER POLLUTION.

THE REAL CHALLENGE IS IN BUILDING AWARENESS OF THE ECONOMIC VALUE OF HEALTHY ECOSYSTEMS.

POLICIES SHOULD SEEK TO INCREASE PARTICIPATION OF ALL STAKEHOLDERS (LOCAL, REGIONAL AND NATIONAL) INCLUDING RURAL WOMEN IN DEVELOPING COUNTRIES, WHO ALREADY ACT AS GRASSROOTS ECOSYSTEM MANAGERS.

AS POPULATIONS INCREASE AND ECOSYSTEM SERVICES DECLINE, THE RISK OF RESOURCE CONFLICTS RISES ESPECIALLY WHERE TENSIONS ALREADY EXIST.

ECOSYSTEM VALUATION IS BASED ON WHAT USERS WOULD BE WILLING TO PAY DIRECTLY FOR SERVICES, OR WHAT IT WOULD COST TO REPLACE THE SAME SERVICES WITH BUILT INFRASTRUCTURE.

THE CONTENT OF THIS INFOGRAPHIC HAS BEEN EXTRACTED FROM THE UNITED NATIONS WORLD WATER DEVELOPMENT REPORT (WWDR) 2015.
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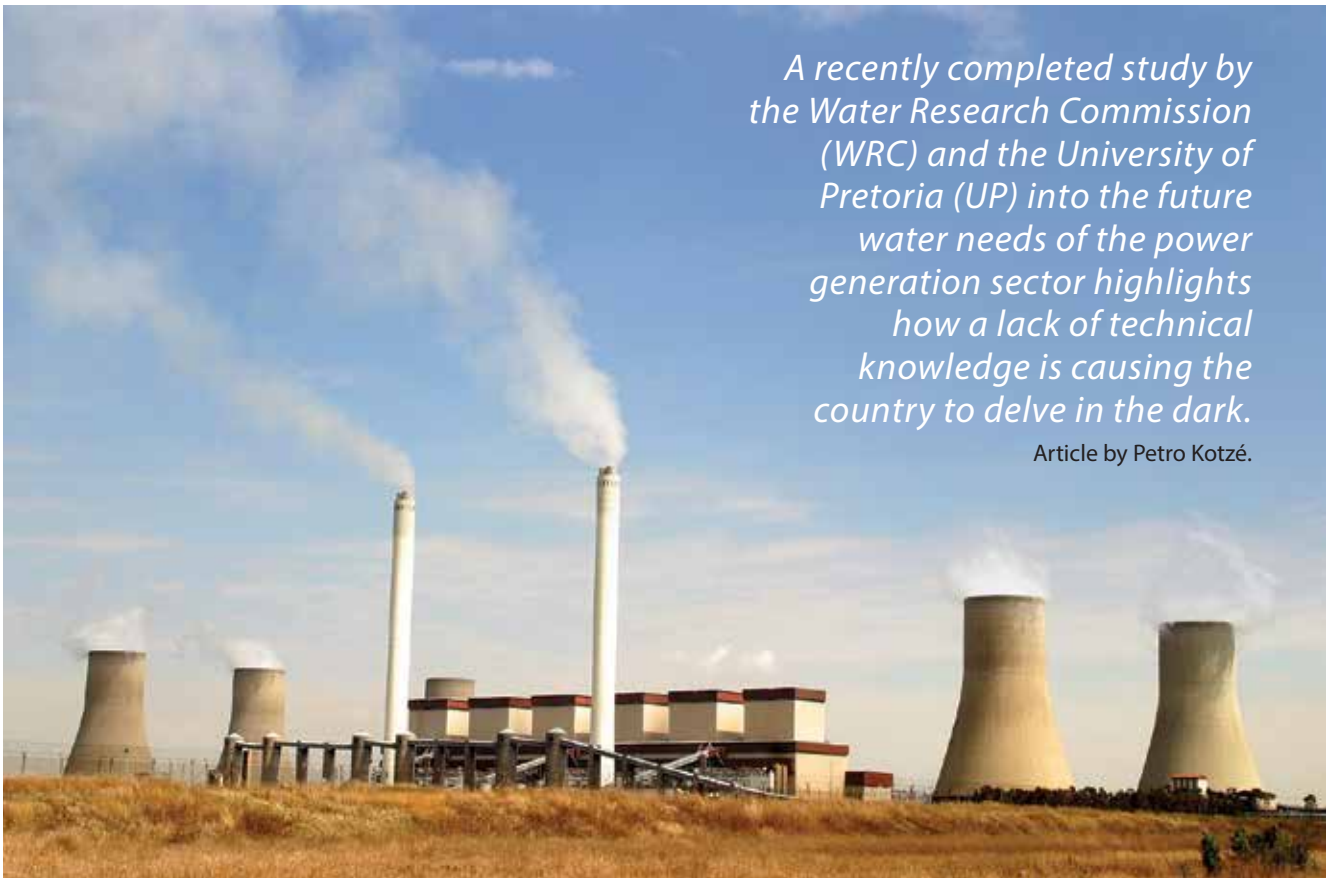
DESIGNED BY MARCO TONSINI

Water and energy

How much water will we need to keep the lights on?



A recently completed study by the Water Research Commission (WRC) and the University of Pretoria (UP) into the future water needs of the power generation sector highlights how a lack of technical knowledge is causing the country to delve in the dark.

Article by Petro Kotzé.

That there are challenges in South Africa to meet the country's electricity demand is no secret. Currently, our main electricity supplier, Eskom, is intermittently applying load-shedding in an effort to balance electricity supply and demand. In a nutshell, load-shedding means that Eskom is rotating and shedding the load in a planned and controlled manner to avoid the collapse of the electricity supply grid, which would have disastrous outcomes. Should this happen it could take up to a month to restore power to the entire country.

Yet, while much attention is given to the availability of electricity, one of the most integral resources necessary to generate it is not being talked about – water.

This is an important conversation to have, especially considering how scarce a resource water naturally is in South Africa.

While South Africa's electricity generation activities only account for 6% to 8% of the country's total freshwater resources used, power generation plants are mostly located within moderately to severely strained water management areas – close to coal reserves rather than water supplies. Seeing as conservative estimates would have it that South Africa is staring a 234 gigalitres shortfall of water in the face by 2025, water will have to be used more efficiently across all sectors in order to preserve the country's water security.

"The field of water supply shortage is a hidden crisis. We already have shortages of water in areas of South Africa, but we have not seen many studies investigating the expected demand for, and supply of water," says Prof Anastassios Pouris, Director of the Institute for Technological Innovation at UP.

Prof Pouris lead the WRC study that aimed to make a long-term forecast of water usage for electricity generation in South Africa until 2030. "It's been forecast that by 2030 water demand nationally and globally will exceed supply," says WRC Research Manager, Dr Jo Burgess, explaining the rationale behind the study. "We need to close the gap before then."

The study team used their findings to propose water saving measures for power generation. In order to do this, they first aimed to forecast water usage patterns associated with coal-based electricity generation as well as water consumption factors. Secondly, they assessed scenarios of water usage patterns based on cooling technology and power plant type, in particular wet-cooled and dry-cooled power plants. Necessary historical data for the project was readily supplied by Eskom.

While the study found that there are ways in which Eskom's water use can be curbed substantially in future, the application of promising technologies are scuppered by a lack of research.

Eskom's power supply setup

As much as 90% of the electricity that Eskom generates is fired by coal. There are 13 coal power plants spread across the country, of which ten are base-load power plants. These operate during normal demand. In order to meet growing energy demands, three power plants that were previously mothballed were brought back to the grid in recent years. Camden, Komati and Grootvlei, the so-called return-to-service (RTS) power plants, are used in conjunction with the base-load power stations during times of peak demand.

Water is used for a number of processes during power generation, such as operating flow gas desulphurisation devices, ash handling, wastewater treatment and wash water. The most water is, however, used for cooling the thermos-electric power plants and this has, together with the choice of fuel technology, by far the biggest impact on the overall water supply needed as well as the ecological health of surface water bodies where it is subtracted from.

Of Eskom's ten base load plants, eight use wet recirculation cooling technologies, which applies cooling water through condenser tubes with steam on the outside. The temperature variations between the water and steam cause condensation. The warm water in the condenser is collected in the cooling tower where an upward draft of air removes the heat. The cooled water is then recirculated to the condenser. A major drawback of this technique is that the water lost through evaporation when the warm cooling water comes in contact directly with air.

Two of the base load plants (Kendal and Majuba) use dry cooling approaches. The dry cooling technology uses air instead of water in the heat exchange mechanism to cool down high temperature steam.

The RTS plants use wet recirculation techniques while Grootvlei also incorporate dry cooling technologies. These plants are water guzzlers, but their impact is exacerbated by their locations in the severely constrained water management areas of the Olifants and the Inkomati. While they satisfy energy requirements they adversely affect water needs.

The yet-to-be-completed Medupi and Kusile power plants will use direct-dry technology, drastically reducing water use.

Yet, all technologies have both advantages and disadvantages. For example, while dry cooling systems are more water-efficient, they are more expensive to build and the plant is less efficient. In the case of Medupi and Kusile however, they will be made more efficient from a system thermal efficiency perspective, because of the use of super-critical boilers.

Study findings

The researchers found that Eskom's total water requirements are expected to increase from roughly 360 gigalitres on current levels to just above 370 gigalitres in 2020. Furthermore, the water use consumption of the RTS fleet is the most significant, and is set to increase

Table: Cooling technologies in Eskom coal power stations (current and future)

Category	Name	Cooling technique	Location	Year of completion
Base load	Arnot	Wet recirculating	Mpumalanga	1975
	Duvha	Wet recirculating	Mpumalanga	1984
	Hendrina	Wet recirculating	Mpumalanga	1970
	Kendal	Indirect dry	Mpumalanga	1993
	Kriel	Wet recirculating	Mpumalanga	1979
	Lethabo	Wet recirculating	Limpopo	1991
	Majuba	Wet recirculating and dry	Mpumalanga	2000
	Matimba	Direct dry	Mpumalanga	1991
	Matla	Wet recirculating	Mpumalanga	1983
	Tutuka	Wet recirculating	Mpumalanga	1990
Return-to-service	Camden	Wet recirculating	Mpumalanga	1967
	Grootvlei	Wet recirculating and dry	Mpumalanga	1973
	Komati	Wet recirculating	Mpumalanga	1966
New build	Medupi	Direct dry	Limpopo	On-going
	Kusile	Direct dry	Mpumalanga	On-going

to unsustainable levels by 2020. As such, it is integral that this fleet be decommissioned on a unit by unit basis as soon as Medupi and Kusile can support the national grid, which will make up the power shortfall.

According to the report, "though the RTS fleet has been important in reducing the constraints placed on electricity supply due to increased demand and maintenance, lower performance parameters lead to an increased need of water while supplying electricity during peak hours. The water consumption factor for the RTS fleet is expected to reach 3 ℓ/kwh by the year 2020. It is vital to note that the RTS fleet has to be decommissioned on a unit by unit basis as soon as Medupi and Kusile can support the national grid."

It was found that water requirements could be reduced to 320 gigalitres depending on the retirement of the RTS fleet. This would bring about a reduction of approximately 40 gigalitres of water per annum, which is roughly the amount of water used by one of the larger power stations such as Kriel, Tutuka, Matla or Lethabo. Medupi and Kusile are expected to consume four to five gigalitres thereby creating a net saving of 35 gigalitres, when the RTS fleet is decommissioned.

This saving could account for almost 15% of the forecasted deficit of 234 gigalitres by 2025.

It is hoped that the two new stations will be completed earlier than that, resulting in larger water savings, notes Prof Pouris. It is expected that as the newer coal plants are built and older plants are retired, the new build fleet will be entirely integrated into the base load fleet, thereby relying more on dry cooling technology.

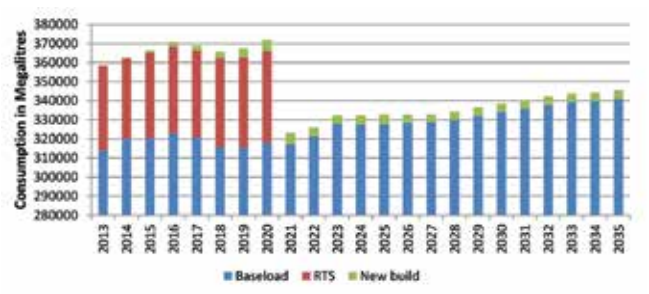
According to Prof Pouris, Should the RTS fleet be decommissioned and Medupi and Kusile brought online, the fleet would have five (four full and one partial) power plants out of 12 using wet cooling. Currently only three (two full and one partial) out of 13 uses dry cooling technologies.

Regards the forecast of total electricity generated, the researchers found that the expected output from the coal power plant fleet could reach 260 TWh by the year 2035. These forecasts are in accordance with the expected installed capacity of 36 900 MW being operated at a capacity factor of 80%.

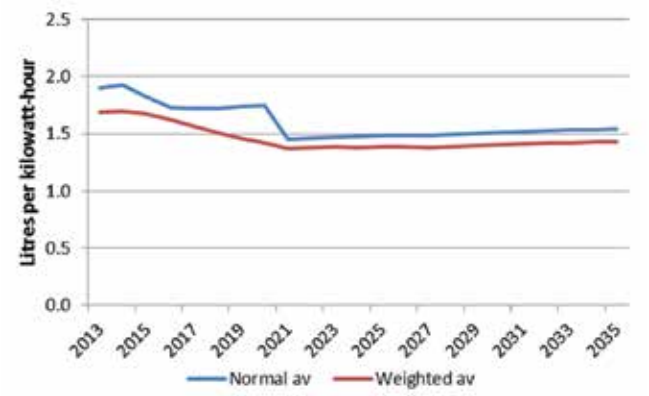
More questions

"With our findings we have created additional questions regards the best technologies to use," notes Prof Pouris. While the decommissioning of the RTS plant looks like the most appropriate solution to Eskom's projected water-shortfall, new technologies could create more opportunities to use current power plants more efficiently. However, due to a lack of actual operational figures it is not possible to conclusively forecast their water usage.

Combined coal power plant water consumption projection



Coal fleet average consumption forecast (weighted vs average)



Combined coal fleet generation forecast. Source: Eskom (2014) data to 2012

Grootvlei is one of the previously mothballed power stations that have been returned to service.

Looking for answers

The WRC is supporting a project to assess and map opportunities for water desalination as well as water-use optimisation of concentrated solar power generation in South Africa. While South Africa has a high resource potential for the use of CSPs, it has limited water resources. An integrated CSP cost efficiency and water usage model will be developed for the three major CSP technologies incorporating air cooling, hybrid cooling and evaporative cooling.

The latter will be used as benchmark and will consider freshwater and saline water options. Results will be used to identify areas most suitable for CSP development from a cost and water usage point of view. This model will then give an accurate indication of the cost per MWh produced on an hourly basis for locations within South Africa with suitable solar resources. Distance from existing and planned transmission infrastructure and from transport infrastructure will be included, to give an indication of infrastructure-related costs for each location.

In considering water availability, fresh water, brackish water, and produced water from other industries will be included. In this way the optimal locations can be chosen for future CSPs so that electricity can be produced by CSPs as cost- and water-efficiently as possible.

"There are a large number of technologies of interest," says Prof Pouris, "but they are stuck at the issue of water, and there needs to be research on this."

He is referring to technologies that are also mentioned in the South African Coal Roadmap, a multi-scenario analysis of the future possibilities and interventions in the local coal industry.

New coal technologies include Underground Coal Gasification (UCG), where deep coal seems are burnt underground, and Fluidised Bed Technology (FBC). While there are some expectations of lower water usage and emissions, there are also risks. These include the risk of contaminating underground water reserves during UCG.

Though is has not been receiving much public attention, Eskom has put out feelers in this direction. Their Majuba UCG pilot plant is a pioneering project in this technology, and FCB technologies are proposed to be viable for the Waterberg coal field which has large reserves of high ash and low-calorific value coal. While, emission reduction mechanisms such as retrofitting existing power plants with Flue Gas Desulphirisation (FGD) are also being investigated, these are again expected to increase the water footprint of power plants.

Matimba power station is one of many power stations in South Africa located in a water scarce area.

Eskom has conducted a number of feasibility studies into the water consumption factors of some of these technologies, but these cannot be used for conclusive forecasting due to a lack of actual operational figures. According to Prof Pouris, the issue of what the other available technologies are is potentially useful, but we also need to ask what their capabilities to limit water consumption are going to be. "The technologies are being investigated, but not their impact on water use. So the issues that are being investigated are not always that relevant."

Other inhibiting factors are money and technology, he notes. "We can develop desalination plants and take water from the sea and pump it wherever we want. The issue is not the water, but the cost."

"The reviewers of the report article asked why we are not talking about the other possibilities to limit water use further," says Prof Pouris. But, he adds, internationally there is a limitation of data.

"So it's not just local research that is lacking, but also the monitoring of international research to see if it will be profitable to go there." While the location of the RTS plants is critical, shutting them down is only a temporary solution, and Prof Pouris is making a call that more research is critical to find the long term solution. Not only that, but research that looks at the long-term needs of the country.

"I think that the most critical finding from this study is for the government to recognise that if they are not going to support research we will be in trouble again, in the same way that we are in trouble with Eskom now." He adds that they hope that this study might be the first step towards realising this. "Our report aims to highlight this issue, not only so that policy makers can understand it, but also so the layman can understand."

"In summary, the need for water use forecasting in the topic of energy-water nexus, is essential in South Africa."

The final report based on this study will be published later this year.

Water reclamation

Water – precious resource to be used again, and again and again…

What do Beaufort West residents, Bill Gates and the International Space Station's astronauts have in common? It sounds like the setup of a corny joke, but in all seriousness the answer is … they have all drunk 'reclaimed' water that has been produced by removing all the impurities in treated wastewater to ensure it meets drinking water quality standards. Article by Sue Matthews

The Omni Processor is being piloted in Senegal, where it will convert solid waste from pit latrines into drinking water.

In the International Space Station, a water-recycling system with approximately 85% recovery treats urine, kitchen wastewater and condensate to supply the astronauts with water for drinking and food preparation. The system, which uses distillation technology, an absorption bed and a catalytic oxidation reactor, cost US$250 million and has been in operation since May 2009.

Last November, Bill Gates demonstrated his support of the Omni Processor – a sewage and water treatment machine developed by Janicki Bioenergy with funding from the Bill & Melinda Gates Foundation – by drinking a glass of its reclaimed water. The container-sized machine was designed to provide a drinking water supply for communities without access to safe water and sanitation, and is being piloted in Senegal this year. Sludge from pit latrines is boiled to kill pathogens and generate water vapour, which passes through several filters before being condensed back to water for further treatment. The pilot model, which costs about $1.5 million, can process 12.3 cubic metres of sewage sludge and produce 10 800 litres of drinking water per day.

"The water tasted as good as any I've had out of a bottle," wrote Gates in his blog. "And having studied the engineering behind it, I would happily drink it every day. It's that safe."

Beaufort West bears the distinction of having South Africa's first direct potable reuse (DPR) plant, where treated wastewater effluent is conveyed directly to a water treatment facility for further treatment to drinking water standard.

It was built in 2010 when the town's main water supply, the Gamka Dam, dried up during a drought. Emergency relief funding from National Treasury covered the construction costs of about R24 million, and the plant became operational in January 2011. In June of that year, the drought was broken by a cut-off low that caused widespread flooding in the central Karoo and Garden Route. The Gamka Dam began refilling and reached 100% capacity by September, but the DPR plant continued operating nevertheless.

"From the outset the intention was always to blend no more than 30% reclaimed water with either surface water or borehole water, or a mix of the two," says Chris Swartz, a consulting engineer who chairs the Water Iinsitute of Southern Africa's water reuse division. "Even when the dam filled, they kept the reclaimed water component at about the same level. The area has a very low annual rainfall, and in March of this year the dam was only 9% full, so the reclaimed water is still needed."

The towns of George and Mossel Bay also built water reclamation plants during the drought, but each took a different approach. The George plant is an indirect potable reuse (IPR) plant, where the treated wastewater effluent is discharged to the Garden Route Dam for dilution and storage before it is piped to the water treatment plant for further treatment. In this case the reclaimed water replenishes the surface water supply, but in some schemes – for example in El Paso, Texas and Orange County, California – it is used to recharge groundwater that is subsequently extracted and treated to drinking water standard. Of course, the discharge of treated effluent from wastewater works into rivers, followed by diversion of river water to water treatment plants downstream, represents 'unplanned' indirect potable reuse, which happens the world over.

The Mossel Bay plant involves water reclamation for industrial purposes only. Final effluent from the regional wastewater works is treated further to provide the high-quality water needed for the PetroSA refining process. A similar scheme had already proved successful for the eThekwini Municipality, where the Durban Water Recycling Project was undertaken as a public-private partnership. The treatment plant was commissioned in May 2001, and to date the two largest customers for its high-quality but lower-cost water are the Mondi Paper Mill in Merebank and the Sapref Refinery owned by Shell and BP.

Many other towns and cities recycle the final effluent from wastewater treatment works by making it available for industrial purposes or for irrigation of agricultural crops, golf courses, sports fields and public open spaces. This water is generally not treated further to bring it to a higher standard, but many of the advantages of water reclamation still apply. It conserves the available water supply, which reduces the need to abstract more water from surface or groundwater sources, or build new dams or interbasin transfer schemes, all of which have environmental and financial costs. It also reduces the volume of treated effluent discharged back into aquatic systems, where it may degrade natural water quality and cause the ripple-effect of ecological changes associated with nutrient enrichment.

But while recycling of wastewater effluent and advanced treatment for industrial purposes are often cheaper alternatives than using the normal potable water supply, water reclamation for drinking purposes is considerably more expensive. Australia's much

Bill Gates chats with Omni Processor's developer, Peter Janicki, after tasting its water.

lauded Western Corridor Recycled Water Scheme, which collected effluent from six wastewater treatment plants in Brisbane and processed it at three advanced water treatment plants to augment the city's main drinking water reservoir, was mothballed in August 2013 because it was costing so much to operate. Authorised by the previous state government during a drought, the scheme was labelled an 'unmitigated disaster' by the then Water Minister. It is costing Queensland Aus$150 million per year in interest repayments.

The cost of installing new pipelines and pumps is just one of the many factors to take into account when considering the implementation of direct or indirect potable reuse systems. Another is the quality of the feed water, because this will determine whether the more advanced treatment technologies are required, resulting in higher capital and operating costs.

In a recently completed WRC-funded project (K5/2119), a decision-support model aimed at assisting municipalities and water boards to evaluate, compare and select appropriate reuse systems was developed. Since cost is inevitably one of the most important selection criteria, a costing model called REUSECOST was developed in addition to the main REUSEDSM.

Potable reuse plants employing reverse osmosis as a treatment method have high energy costs, because the process relies on high-pressure pumping to overcome osmotic pressure. The Beaufort West DPR plant uses reverse osmosis as part of a multiple-barrier approach that also incorporates rapid sand filtration, ultrafiltration, UV-hydrogen peroxide and final chlorination.

Reverse osmosis also pushes up costs because the highly concentrated brine produced as a by-product is difficult to dispose of.

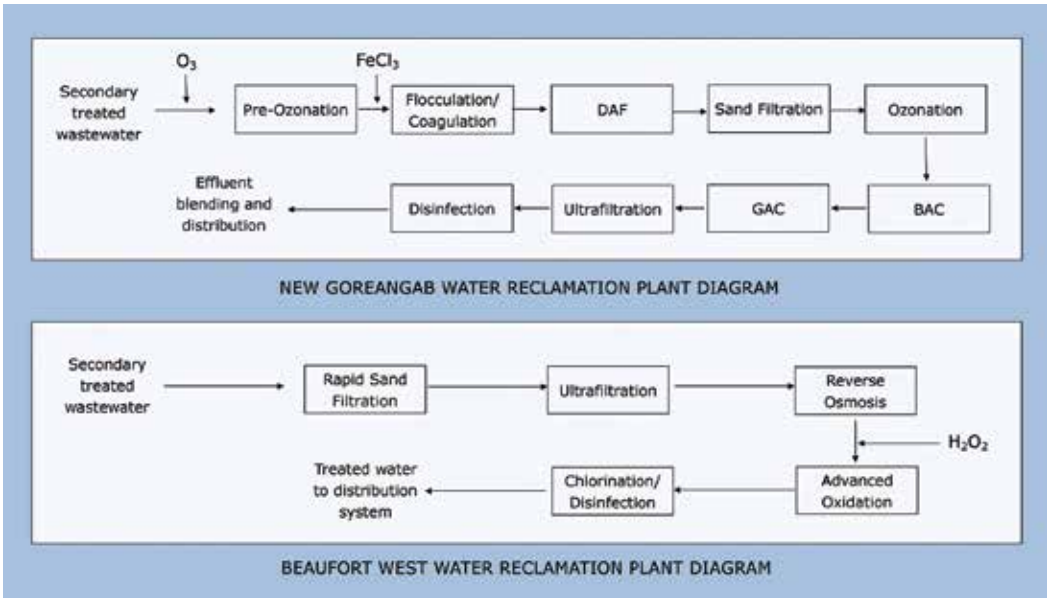
"If the plant is near the coast it can be discharged into the sea, but there are environmental impacts associated with that," says Swartz, who headed up the project. "If it's inland the options are very limited – it needs to be contained in evaporation ponds that are lined and have a large surface area. It's quite expensive, so that has a big impact on the capital cost of the plant."

"At Beaufort West there were some extra ponds available at the wastewater treatment works, and fortunately the volumes are reasonably low, but for a bigger plant the cost can be a problem."

The membranes needed for reverse osmosis are also expensive, although prices are coming down all the time as the technology is more widely used. The Beaufort West DPR plant includes a pre-treatment stage to reduce the loading on the membranes and hence limit the fouling rate, which helps ensure that the membranes last longer before needing costly cleaning or replacement.

But if there are so many negatives associated with reverse osmosis, why use it? The New Goreangab Reclamation Plant in Windhoek – commissioned in 2002 to replace the world's first, but less sophisticated, DPR plant that began operating in 1968 – certainly manages without it, and its capacity is ten times that of the Beaufort West plant. It just employs more 'treatment barriers' to bring the water to potable quality, including a number of ozonation and chemical dosing steps, dissolved air flotation, biological and granulated activated carbon filters, ultrafiltration and chlorination.

The advantages of using reverse osmosis in potable reuse plants are that pathogens, dissolved salts and some dissolved organics can be removed using less chemicals and labour (since the process is fully automated) on a smaller footprint of land. Reverse osmosis is also believed to be more effective in removing so-called contaminants of emerging concern (CECs). These include chemical compounds from pesticides, flame retardants, plasticisers, pharmaceuticals and personal care



The treatment processes used at the New Goreangab Water Reclamation Plant and the Beaufort West Reclamation Plant.

products, amongst others, which may be carcinogens, endocrine disruptors, or toxins that cause neuro-developmental defects.

Some CECs are still detected in the final water of both reverse osmosis and granulated activated carbon based treatment works, albeit at extremely low concentrations. In a WRC project (K5/2369) undertaken by Chris Swartz Water Utilisation Engineers in collaboration with the CSIR and the University of the Western Cape, a priority list of CECs in reclaimed potable water in South Africa is being developed, and guidelines for appropriate treatment barriers and monitoring programmes recommended.

It would be impossible to measure the concentrations of all possible CECs, because there are hundreds of them and detailed chemical analysis of water is expensive. Bioassays, which measure biological activity, and surrogate compounds, which suggest the presence of related CECs, are used instead. For example, the Enzyme Linked Immuno Sorbent Assay (ELISA) is widely used to measure the human hormone 17-beta estradiol, the most potent estrogen and a surrogate for other endocrine disruptors. Carbamazepine, an anticonvulsant and mood-stabilizing drug used primarily in the treatment of epilepsy and bipolar disorder, is one of the surrogates that could be used to indicate the presence of other pharmaceutical drugs.

Of course, some of the CECs in reclaimed water can be limited by keeping industrial effluents out of the wastewater treatment works, which is the approach taken in both Beaufort West and Windhoek. Last year, Windhoek opened its new Ujams industrial wastewater treatment plant, replacing an older plant that could no longer cope with peak effluent flows from the industrial zone. Although the plant cost R125 million, it ensures that industrial pollutants that may be difficult to remove or require costly treatment processes are largely absent from wastewater destined for the New Goreangab Reclamation Plant.

The project on CECs builds upon another WRC project (K5/2212), which developed guidelines for a holistic monitoring programme in potable reuse systems. This would involve not only compliance monitoring of the final water, aimed at protecting human health, but raw water monitoring of the incoming wastewater effluent and operational control monitoring of each treatment unit's performance too. The latter requires the selection of appropriate indicative parameters that will be measured either by regular sampling or by automatic instrumentation with built-in alarms or shutdowns if results are outside the acceptable range.

There can be no 'one size fits all' monitoring programme because water reclamation plants have different process configurations, feed water and possibly even different standards for final water quality. But the recommendations emanating from the project will no doubt assist the Department of Water and Sanitation in developing guidelines and standards for water reuse, and in incorporating the necessary monitoring into the Blue Drop and Green Drop programmes.

"Water reclamation is well recognised as an alternative to conventional water supply strategies," says Dr Nonhlanhla Kalebaila, WRC Research Manager, who oversees the water reuse projects. "However, its wide implementation in South Africa needs to be fast-tracked by building the required technical capacity in the water sector, and providing clear institutional leadership and financial incentives towards water recycling, reclamation and reuse. In addition to these specific factors, there is a need to educate, raise awareness and involve the public in water reuse decision-making, in order to change their perceptions and circumvent challenges with recycled water acceptance."

Indeed, the 'yuck factor' – consumer resistance to drinking what was once domestic wastewater – is the major challenge to overcome. But implementing a comprehensive monitoring programme, effectively communicating the results, and raising awareness about the benefits of water reclamation can go a long way towards building the public's trust in water service providers and allaying fears about health risks.

Chris Swartz with students on a visit to the Beaufort West water reclamation plant.

The Beaufort West reclamation plant.

The low level of the Gamka Dam illustrates the importance of reclaimed water in Beaufort West.

Treated effluent from Beaufort West's wastewater treatment works passes through maturation ponds before entering the reclamation plant.

Alternative water supply

The demand-side risks of large-scale desalination

There is a saying in Australia: "The easiest way to break a drought is to build a desalination plant…" They should know; they have been there, and have just done that. This article explores how a drought led to a vast investment in desalination capacity in several Australian cities, and what the various responses were in the different regions, when the drought was finally broken. It then reflects on the demand-side risk of the investments, and how different cities responded to it.

Article by Dawid Bosman, TCTA Senior Manager: Advisory Services.

"Nothing is more important to Western Australians than the security of our water supply. As we experience an increasingly dry climate, evidenced by dwindling inflow to our dams, we must re-think the way we source water."

The worst drought in Australian history lasted from 1997 to 2009, and left a lasting scar on the national psyche. Their densely-populated coastal belt was hit the hardest, and the Murray-Darling basin, sustaining their primary agricultural zone, was devastated. In response to this crippling drought, Australia built six large desalination plants which, as a cluster, were the most expensive of their kind, to date, anywhere in the world. And then the rains came… Capital investment in a disruptive environment can be cruel.

The drought

It is important to know how the drought played out. Australia is not a stranger to droughts; since 1860, when records began, there has been a major drought somewhere on the Australian continent in 82 out of the 150-odd years, and droughts are now regarded as common and often-repeated events of Australian climate. The Millennium Drought, as the 1997 to 2009 episode is now known, was the most severe of all. Whereas the previous droughts affected only specific regions, this one affected large parts of the continent over several years, including Australia's five most populous cities, Sydney, Perth, Melbourne, Adelaide and Brisbane, as well as the major food-producing regions in the Murray-Darling basin.

The build programme

It was therefore no surprise that Australia launched a massive build programme of large-scale desalination plants, which yielded six plants in the five most populous cities, coming on-line from 2006 through to 2012. Perth built two plants of 144 and 290 Ml/d capacity, Adelaide a plant of 300 Ml/d, Sydney a plant of 250 Ml/d, and Melbourne a massive plant of 450 Ml/d. The total EPC expenditure amounted to AUD12-billion.

It should be noted that the Australian projects, with the exception of the first Perth plant (Kwinana), set new industry records on a cost-per-design-capacity basis; these costs are certainly not the norm. The high cost was caused by a few contributing factors:

- All the projects except Kwinana required very expensive tunnelling during the construction of the marine works;
- This was Australia's first foray into the large-scale desalination market; bidders are known to add a risk premium in such circumstances;
- Australia's high labour cost;
- Very high environmental standards, which required expensive impact mitigation measures;
- The high cost of borrowing; the projects were financed during the global financial crisis.

The drought broken

Then came the rain, and in no small measures either. Frequent and heavy rain events during 2010 and 2011 brought about the wettest two-year period in the history of Australia. Large parts of the continent had record-breaking rainfall throughout 2010 and 2011, and certainly the densely-populated coastal belt saw welcome relief. Notably though, the drought persisted around Perth in Western Australia.

Brisbane, situated on the Eastern edge of the continent, was struck by extreme flood events in January 2011 and again in 2013. Ironically, the newly-built Brisbane desalination plant had been handed over to the Queensland government just two months earlier, in October 2010.

Demand-side risk

This brings us to the demand-side risk of water infrastructure; the risk that the assumed demand projections made during planning may not endure through to the operational phase or, in fact, last for the duration of the facility's life span. Circumstances may change, which erode the need for a given size of facility. This has significant implications for loan redemption, and for the technology partner who is contracted to run the facility. However the contract may be structured, the risk that an investment may be standing idle, lodges somewhere.

Before we explore the validity of this risk, it is interesting to observe how the six Australian plants are utilised today. For apparent reasons we will explore later, the demand-side risk did not unfold in the same way for all of them.

Here follows a summary of their operational status:

Desalination Project[1]	EPC Cost (AUD)	Capacity	Off-taker	Date On-Line	Current status (March 2015)
Perth 1 / Kwinana	$387m	144 ML/d	Water Corporation	2/2007	Both **on-line**, and **producing at 100%** of capacity.
Perth 2 / Southern / Binningup	$955m	290 ML/d		Phase 1: 9/2011 Phase 2: 9/2013	
Adelaide Desalination Project	$1842m	300 ML/d	SA Water	Phase 1: 3/2012 Phase 2: 12/2012	**On-line**, and produced at 100% capacity through to December 2014. Now **scaled back to 10%** while optimal operation mode is being assessed.
Brisbane / Gold Coast / Tugun	$1200m	133 ML/d	Seqwater	1/2009	**On-line**, but on 'hot standby' since December 2010.
Sydney / Kurnell	$1900m	250 ML/d	Sydney Water	4/2010	**Off-line, mothballed** since December 2012.
Melbourne / Victorian / Wonthaggi	$5700m	444 Ml/d	Melbourne Water	12/2012	**Off-line, mothballed** since December 2012. The Government has placed a third consecutive zero water order for the supply period ending June 2015.

1. Depending on the literature referenced, the projects are called by various names, which could include the closest major city (e.g. Melbourne), the State (e.g. Victoria), or the suburb (e.g. Wonthaggi).

In Perth, Western Australia, the desalination plants are fully utilised, and they are supplying nearly half of Perth's water requirement. Rainfall has generally been below average since the Millennium Drought, and the dams within Water Corporation's service area are only 30% full. The general sentiment towards desalination is very positive, as it has been from the outset.

The view of the current leadership is that the two desalination plants were key investments in building water resilience. In the words of the Western Australian Water Minister, Bill Marmion: "Nothing is more important to Western Australians than the security of our water supply. As we experience an increasingly dry climate, evidenced by dwindling inflow to our dams, we must re-think the way we source water." In line with this thinking, Water Corporation has embarked on a ten-year plan to "drought-proof Perth by 2022 so that sufficient water supplies are maintained, whatever the weather."

In Adelaide, South Australia, the plant operated at full capacity from commissioning in December 2012 through to December 2014, during which time it produced one third of the city's water supply. However, due to good rainfall, the dams in the area are now 58% full, and the desalination plant has been scaled back to 10% of capacity.

The current Water Minister, Leon Bignell says of the desalination plant: "It's there for when we don't have a rainy day. … when it is in full production, and we are in the grips of a terrible drought, it will be seen as one of the best pieces of infrastructure ever built in South Australia." Despite this view, the regional political discourse on this matter seems to focus very much on the vast capital outlay for the plant, and the cost of desalinated water. An opposition water spokeswoman called the plant "an expensive experiment", and claims that the plant, which has the capacity to meet half of Adelaide's demand, "should have been built at half its size."

In Brisbane, Queensland, the Tugun desalination plant has been on hot standby since December 2010. This requires frequent start-ups for the plant, which it was not designed for, and it introduces additional asset risks. It does however save around AUD10-million per annum over running the plant at one third capacity, which would have cost around AUD24-million.

Dam levels in the South East Queensland region are now at 96% and plant will only be restarted when levels fall below 60%.

The current leadership view is that the plant capacity was designed "beyond its needed functional optimum", and the Queensland State Government has commenced with a study to explore alternatives for the future of the Tugun plant.

In Sydney, New South Wales, the Kurnell plant operated for a two-year proving period through to December 2012, when it was taken off-line and mothballed. The operating regime was adopted that it will be restarted whenever dams are at 70%, and again be mothballed at 80%. Dam levels are now nearly 100% full, and the prognosis is that a restart within the next two years is unlikely. In the interim, the plant's contracted operator (Veolia) has taken measures to protect the plant and its equipment during the extended shutdown.

During 2012, the State sold the Kurnell plant to a pension scheme for AUD2.3-billion under a 50-year lease-back agreement, which released net proceeds of AUD300-million back to the State for financing other infrastructure. This allowed the State to disinvest from an asset it no longer viewed as strategic, and so reduce much of the pressure on municipal water rates. It is interesting to note that capital recycling (selling public assets to provide capital for new

Perth also constructed desalination plans to assist the city against drought.

investment) has now become a regular practice in Australia.

In Melbourne, Victoria, the Wonthaggi plant will remain mothballed for a third year running, and probably remain so for the foreseeable future, since the dams in the region are currently 75% full. The current labour government sees the plant as an "important insurance policy" – it was, after all, a labour government who committed to the plant back in 2007.

But incredibly, the AUD5.7-billion plant has produced no water since the performance tests and commissioning were completed. Even prior to completion, the project became a significant liability to the Labour government who launched it; a political hot potato, synonymous with waste, mismanagement and spin.

In December 2010 a Liberal-National coalition came to power in Victoria, and early in 2013 the new Water Minister, Peter Walsh announced that it was "a personal ambition to never order water from the Wonthaggi Plant". The desalination plant had become politically "toxic", to the extent that the *Sydney Morning Herald* speculated that the coalition government "is so determined to use the plant as a political weapon against Labour, it is deliberately planning to keep it mothballed for as long as possible, stressing the idea that the whole thing has been a giant waste of taxpayers' money."

Numerous project challenges and setbacks were encountered during construction: Cyclonic weather, labour unrest and low productivity of the workforce caused construction delays of nine months. This resulted in legal claims and counter-claims between Aquasure, the consortium that built, owns and operates the plant, and the State of Victoria, during 2012 and 2013.

By October 2013, claims amounting to AUD1.3-billion, mainly from Aquasure against the State, were finally resolved, which paved the way for Aquasure to refinance AUD3.7-billion of project debt at less than half of its original cost.

"Agreeing to early refinancing now and resolving claims will allow AquaSure to obtain a better risk profile for the desalination plant project, and in turn, this means significantly lower financing charges," said Walsh at the time. "The amount of savings to be realised by water customers is expected to be significant."

In December 2014, the Labour party returned to power in Victoria. The desalination plant is still a sensitive matter, but now less of a political embarrassment.

Reflection

The events described in this article, the drought, the desalination build programme, and the two wettest years that followed, created a pretext for suggesting how water may be valued in the different parts of Australia. In Western Australia, and to some degree also in South Australia, the value of water security, and its fragility in the light of climate change, seems pervasive and deeply ingrained into the consciousness of nearly all who live there. Of course, the same is true of those who live in other parts of the country, but it seems to a lesser degree, and less pervasive. The relative ease with which the desalination investments became politicised in Victoria, and the decision in New South Wales to sell the desalination plant, suggest that the price of water may be perceived as more important than climate-independent water security.

Neil Palmer, the CEO of the National Centre of Excellence in Desalination Australia (NCEDA), observes: "Internationally, other countries are looking at Western Australia's use of desalination as a stand-out example of best practice, and using its plants as environmentally sustainable benchmarks as their energy requirements are offset by purchasing renewable energy. Yet sadly on the east coast the focus around desalination is short term, on current pricing rather than the long-term benefits - avoiding the fact that without desalination, east coast cities will face water deficits in years to come."

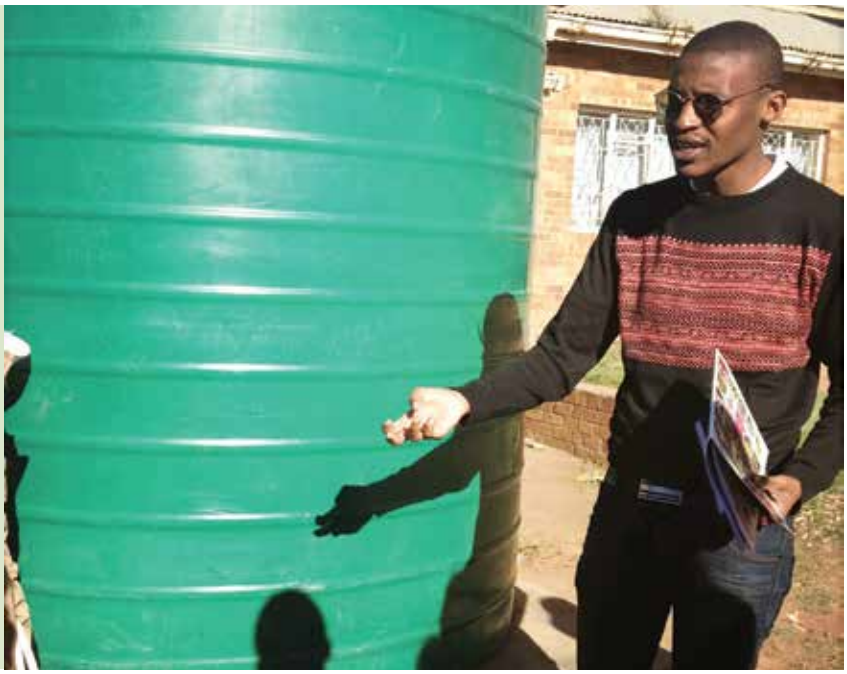
Which brings one to the demand-side risk of the desalination investment; drawing on the Australian examples, it is clear that an expectation of substantial and sustained demand on a desalination plant will often be unrealistic, unless the region is naturally water scarce, and the yield of the plant is destined purely for base-load supply. In areas where the dam inflows have been slowly decreasing over a number of decades, suggesting a long-term decline in rainfall and increased evaporation, desalination can certainly be a solution, but with the caveat that the demand-side risk be assessed over an extended period.

Finally, as the *Sydney Morning Herald* observed in 2013: "… Australia experiences a drought on average every 18 years, although the time between severe droughts can vary from four to 38 years. Victoria's desalination plant has been built to last 100 years. In the absence of new dams, it is almost inevitable Victoria's desalination plant will be needed at some point, particularly with Melbourne's population swelling by around 80 000 people a year. At this point, instead of seeing it as a white elephant, it might be viewed as a necessary insurance policy – albeit a fairly expensive one."

Water and society

Learning about learning in water resource management

Sharing water knowledge with stakeholder communities in an adequate and appropriate way is a challenge faced by many water-related institutions. Jane Burt and Robert Berold shed some light on what they've learned about engagement.



In recent years, water management practice has shifted away from a 'technicist' approach, with its focus on building dams and laying pipes, to a broader approach which includes people as well other natural resources like land. This change has come about through understanding that it is not possible to manage water without knowing what people need, how they understand their water resource, and what role they have in managing it.

Knowledge mediation

Learning is always mediated. In the water sector a mediator may be someone who is formally employed to impart knowledge (e.g. an extension officer or development fieldworker), or he/she may be informal and unpaid but still in the mediator role. Here are some definitions of a mediator:

- A mediator is an individual who re-interprets knowledge in a way that is relevant to a particular water practice and to those involved. Most people feel that the best learning is direct human-to-human interaction as opposed to learning from instructions taken from a book or from the Internet.
- A facilitator (another term for mediator) is one who contributes structure and process to interactions so groups are able to function effectively and make high-quality decisions, a helper and enabler whose goal is to support others as they achieve exceptional performance.
- A mediator/facilitator is someone who encourages full participation, promotes mutual understanding and cultivates shared responsibility.

Why we need mediators

Even when a community audience is literate, a written learning resource is not very useful unless mediated. A skilled mediator will re-interpret written knowledge in a way that is relevant to those involved.

A good example of effective mediation was reported by researchers at the University of Cape Town who had been trying to work with communities on problems of contaminated water (grey water and black water). Working with three informal settlements outside Cape Town, they provided the communities with the materials they needed to filter contaminated water that was running into stormwater drains, providing a written learning resource which showed how to build the filters.

However, only one of the three communities took up the challenge and actually built the drainage system. The researchers found out that this community had been working closely with a local non-governmental organisation (NGO) as a knowledge mediator. The NGO had held workshops, using the written learning resource to explain the benefits of building the drainage system, and how to build it, and this had made the difference.

Designing a learning resource

The whole sequence of the production of a learning resource has to be thought through from beginning to end: assessing the target audience, writing the resource, editing and design appropriate to the audience, the question of whether translation is necessary, deciding who should receive the resource and thinking about how they will be able to get hold of it, whether a series of workshops is required to do this, and the funding for all these processes.

Our research found that while there was no shortage of water research knowledge, this knowledge was rarely presented in a way that was understandable and accessible to non-specialists and that took into consideration context and how context mediates learning.

How learning is socially embedded

Although there has been greater awareness in recent years among researchers about target audiences and their needs, we still tend to see learning resources as stand-alone instruments of transferring knowledge, independent of context. However research has shown that learning happens most effectively when it is socially embedded. It is important therefore to look at resources as mediation tools and think of the mediation practices that go with them.

Researchers in two case studies from the Netherlands observed that knowledge emerges out of practices situated in their specific contexts. Simply put, *how* people know something comes from *what they do*. Therefore how people know about water management comes from how they actually engage with water management. In the same way, learning resources are more effective when they engage learners with water issues as they experience them, in their local context.

The researchers in these case studies observed that people who reflected on knowledge together developed a deeper understanding of their practice than those who reflected alone. If shared reflection leads to deeper understanding, it is important that we create spaces which bring people together to reflect on what they do and how they do it.

Most learning resources are not designed to encourage people to question what they do or consider how to adapt it. There is an assumption that correct factual information will logically be adopted, and will change people's behaviour. What we and many others have found, is that factual information is not persuasive enough. Learning resources work more effectively when they ask learners to think about their local water issues, to enquire about what they are doing and why they are doing it.

Knowing how we know

Whether or not we consider it our field, if we want to communicate with people, it will help if we have some understanding of theories of learning. In particular, we should ask ourselves: Will the resource we want to develop only inform (offer facts) to people about a practice, or will it go further and engage people in thinking and reflecting on what they do? Underneath this question is the deeper question of how we know and how we learn.

Facts alone do not lead to changes in practice. After all, most smokers know that smoking is bad for them, but this does not make them stop. Likewise most of us know that the way human beings treat the environment is damaging us in the long run, but we can't stop because we depend on so many structures that harm the environment.

We choose rather to ignore the effects of our actions, or we believe it is too difficult to change, or we try to change but meet overwhelming obstacles. If I am environmentally conscious in my private life, but work for a mining company that is a known water polluter, will I give up my job?

We need technical expertise to solve technical problems, such as a leaking dam wall. But in order to diagnose such a problem (why was did the dam wall start leaking), and to resolve it in its context (who is responsible for fixing the dam? For maintaining the dam? Do they have the knowledge and resources to do so?) we need social learning theories that consider how people learn from each other. These theories show us not only how to provide information, but how to collectively transform practice.

Generating a learning resource from practice

In our research we wanted to see what would happen if we developed a written learning resource starting from questions arising out of a current practice. The learning resource would be constructed via a dialogue between what people were doing already and what research knowledge was saying should be done.

We also wanted to see if learning resources could be developed by on-the-ground mediators themselves. Such resources would be different depending on the specific water practice being carried out, the context in which it is carried out, and the individual mediator who is developing the resource.

In order to do this, we identified and brought together a number of water mediators working in different areas of the Eastern Cape, each with different water problems ranging from watering of school gardens to pollution of rivers. The resources that they developed documented both the learning that had taken place around their particular water practice and the questions that had arisen out of that learning. The objective was not only to produce the resource but to experience the process of developing it.

After piloting this approach we developed a course for water activists (including NGO and NPO staff) which is accredited through the Environmental Learning Research Centre at Rhodes University.

We are now in the process of running this course in collaboration with the Environmental Monitoring Group as part of a Water Research Commission project that looks at the monitoring of the National Water Resource Strategy 2 (NWRS2). The course is being run for members of the South African Water Caucus to strengthen their ability, as civil society activists, to ensure and monitor the implementation of the NWRS2.

Organisations and collaborations

An effective irrigation knowledge network in Africa

Improving the effectiveness of irrigation schemes is not only a South African objective, but something that many countries on the continent are striving for. Arguably one of the most active networks of its kind in Africa, the Southern African Regional Irrigation Association (SARIA) has created an effective knowledge sharing mechanism for its members.

Article by Dr Sylvester Mpandeli and Soneni Nyamaranga.

Loskop Dam

SARIA was created under the auspices of the International Commission on Irrigation and Drainage (ICID). At present, the organisation comprises members from 15 SADC countries, with the Water Research Commission (WRC) in South Africa acting as the Secretariat. SARIA's vision is to strengthen research, communication, training and development of appropriate science and technologies in irrigation and drainage for gender balanced poverty eradication and economic development. This must be done to improve the livelihoods of the inhabitants of southern Africa.

Says SARIA member, Lisema Lekhooana, from Lesotho: "Water plays a vital role in the production of food. In Africa, food security is an escalating challenge, made more difficult by the often unfavourable climate conditions experienced on the continent, including floods and drought. The SARIA initiative has contributed positively to the SADC region, especially towards the efficient management of water resources for food."

Earlier this year, SARIA organised a workshop and steering committee meeting in Pretoria. This event was well attended, with attendees representing 13 of the 15 member countries. The workshop was jointly funded by ICID and the Department of Agriculture, Forestry and Fisheries. The main objective of the workshop was to facilitate the exchange of ideas and practices between researchers, advisors and government officials from southern Africa.

On the first day, participants attended a training workshop on rainwater harvesting and conservation of crop lands. The tone was set by ICID Vice President Honoraire, Dr Gerhard Backeberg, whereafter Jonathan Denison and Heidi Smulders from Umhlaba

Consulting presented their work on the topic, which was undertaken as part of a WRC project.

The Umhlaba Consulting Group has developed a comprehensive water harvesting and conservation learning materials package targeting learners and facilitators at training organisations and resource-poor gardeners and farmers (**WRC Report No TT 492/11 to TT 496/11**). As rainwater harvesting is a major challenge for all SARIA members, it was agreed that the training resource material will be used as a basis for organising further courses in the respective member countries.

"The training materials on water harvesting will definitely be used by myself and colleagues here at the Botswana College of Agriculture," noted SARIA member, Anne Clift-Hill. "I was not aware that there were several traditional methods in use in South Africa, including spate irrigation, which I was already familiar with from Sudan. Given that Botswana is currently in the grips of one of its worst ever droughts, the subject for this year's capacity building was very relevant."

Added SARIA member, Winston Sataya from Malawi: "The SARIA workshop was really an eye opener which imparted practical knowledge on how to design and implement environmentally responsible water harvesting and conservation systems on farms. Most countries in the region are experiencing unreliable rainfall for crop production… It is therefore vital that our farmers should be knowledgeable on how they can make use of available water resources through water harvesting and conservation."

On the second day, members visited South Africa's second largest irrigations scheme at Loskop. Loskop irrigation scheme is managed by a water user association. Each section of the scheme has a section manager that monitors and manages the water distribution. The current scheme comprises 667 properties with an average scheduling of 25.7 ha each. The main products being cultivated are wheat, vegetables, tobacco, peanuts, cotton and citrus.

Loskop Irrigation Operations Manager, Nico Jurdo, explained to SARIA members how the scheme is being managed. The main water resource of the scheme is the Loskop Dam (originally constructed in the 1938 and raised in 1979). The mass concrete dam has a wall height of 54 m and a net storage capacity of 348 million m^3, making it one of the largest dams in South Africa.

Among others, SARIA delegates learnt how water deliveries are timed, the mechanisms to adjust schedules to each member of the irrigation scheme and procedures for paying operations and maintenance of the canal system. Loskop Dam also supplies water to other stakeholders, including the Olifants River Irrigation Board, Hereford Irrigation Board and two local municipalities, namely Groblersdal and Marble Hall.

SARIA member, Dr Musa Dlamini, shared his experience: "The field visit to Loskop Dam has added value to our knowledge and experience. We learned that water as a vital resource needs to be managed with great care and sharing it with other community members improves its diversification and use."

On the third day, a steering committee meeting was held. All countries present were given opportunities to report on activities of national committees and irrigation issues. ICID Vice President Honoraire, Felix Reinders, also gave an excellent presentation on the activities of SARIA since its founding 15 years ago. Members also used this opportunity to map the way forward for SARIA for the next three years. Some of the issues which received attention included how to keep the organisation viable, and the inclusion of aquaculture and fisheries in SARIA activities.

SARIA's next training workshop and steering committee meeting will be held in Malawi in 2016. The theme for this event will be rural freshwater aquaculture.

The Members of SARIA during the workshop in Pretoria.

SARIA members viewing the main canals at Loskop Irrigation Scheme.

Minister turns the valve on SA's largest conduit hydropower installation

Bloemwater electrical technician, Jacques van Delft, assists Minister of Water and Sanitation, Nomvula Mokonyane, to open the valve at the conduit hydropower facility at Brandkop reservoir.

The largest conduit hydropower installation in South Africa has been officially launched at Bloemwater's Brandkop reservoir, in the Free State.

The collaborative partnership between the Water Research Commission, University of Pretoria, and sector partners such as City of Tshwane, Bloemwater and eThekwini, has led to the successful development and demonstration of conduit hydropower in South Africa. Conduit hydropower is the extraction of available energy from existing water supply and distribution systems. The technology involves tapping into an unutilised source of hydropower by using excess energy in pressurised conduits to produce hydroelectric power.

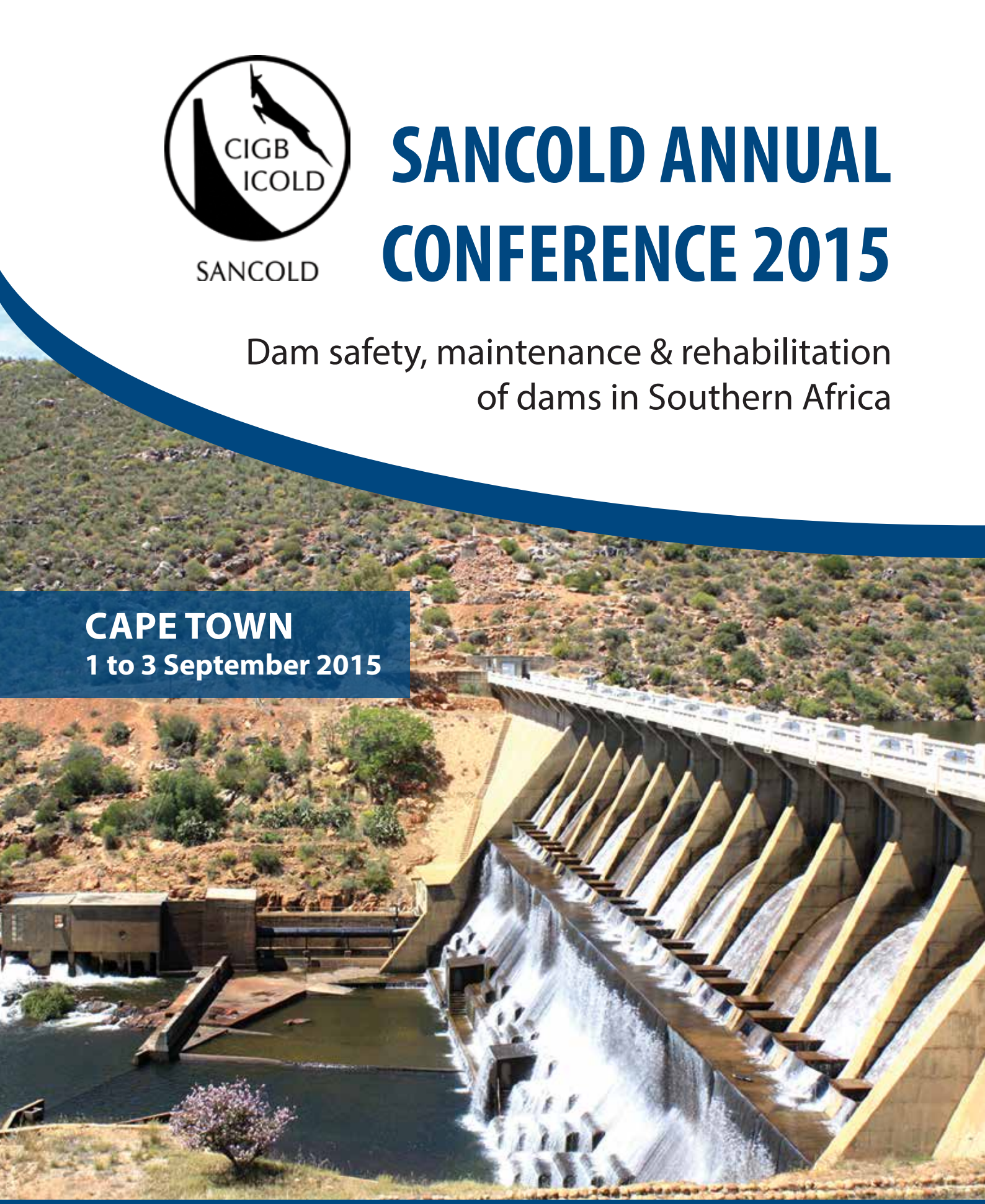
The Bloemwater installation involves the Caledon-Bloemfontein potable water supply system, which supplies the majority of the water demand in Bloemfontein. The water is supplied to the Brandkop reservoir, where the water utility's head office is located. The conduit hydropower technology involves tapping excess energy through pressure control valves before the water is discharged into the reservoir. In this manner, 96 kW/h of energy is generated – enough to power Bloemwater's headoffice.

"This is indeed an extraordinary collaborative effort and one that all South Africans should celebrate," noted Minister of Water and Sanitation, Nomvula Mokonyane at the launch. "For water supply utilities introducing enhanced in-house energy generation will alleviate, to some extent, dependency on the already stressed national grid and keep their energy costs down. It requires a small capital investment and has a short return on investment period. As long as people use water, renewable electricity can be generated."

SANCOLD

SANCOLD ANNUAL CONFERENCE 2015

Dam safety, maintenance & rehabilitation of dams in Southern Africa



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