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## Newsletter of the Water Research Commission

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## A Researcher by Nature

When Sayomi Tasaki ditched her dolls and tea sets for studying ants by enticing them with sugar, her mother realized that transformation of her eight-year old daughter was virtually impossible. Sayomi was born in Brazil and practised as a marine biologist in her mother country. Her Brazilian mother and her Japanese father (of Samouri descent) have generated an interesting mix in the likes of Sayomi.

She arrived in South Africa as a backpacker and has fallen in love with this beautiful land and its diverse nature: people, cultures, languages and religions. But when she was exposed to South Africa's wildlife, she knew that this was the place she wanted to live in. As Portuguese was her mother tongue, Sayomi is learning English and has become fairly competent in the language. I enjoyed having a conversation with this lady whose interests are as diverse as the country that she has chosen as her own. She has been living in South Africa for the past 13 years and she now enjoys permanent residency status, something she cherishes because she says, "I have fallen in love with South Africa and find the natural beauty and wildlife like magic."

Sayomi's work experience in Brazil was varied and ranged from aqua culturist, biology lecturer, fisheries quality control officer and marine ichthyoplancologist assistant. Sayomi also worked in various environments in South Africa: PA, public relations, receptionist, ecotourism, interpreter, sales representative and marine ecologist. In 1991 she was offered a job as a cave limnologist in South Africa which she accepted. Sayomi's work involves a vast amount of field work, a facet of her research that she enjoys tremendously. Her work involves the monitoring of headwater streams, boreholes and abseiling into caves to investigate groundwater fauna. "This requires a high level of fitness. I am able to achieve this by practising martial arts." Sayomi is a keen practitioner of martial arts, which happens to be one of her ways of relaxing. She also divides her limited leisure time and indulges in swimming, hiking, reading, natural photography, scuba diving, bird watching, flower arranging, dog training and nature conservation. This energetic lady is determined to "work until the day (I) she die(s)" because she loves what she is doing.

Sayomi, a freshwater invertebrate zoologist-research scientist based at the Rand Afrikaans University (RAU), focuses on groundwater ecology and works closely with the Water Research Commission (WRC) and the Department

of Water Affairs & Forestry (DWAF). Although Sayomi has been involved in WRC-funded projects from 2002, her contribution has been significant and her contribution in the future is certain to be boundless. She has found various groundwater-related invertebrates in the area around the Cradle of Humankind. Tasaki says, "Studies of groundwater fauna can reveal the composition of aquifers and provide valuable information that can guide efforts to protect aquifers from pollution and over-utilization." She is studying groundwater-related invertebrates in order to provide a better understanding of catchments, thereby making a valuable contribution to water management in South Africa. Sayomi is on the verge of completing her PhD and her research is multi-faceted: Identifying links and pathways for ecological processes between surface water and groundwater systems; refining the understanding of these systems in order to support conservation and protection of groundwater-dependent ecosystems; providing a water-quality assessment model using groundwater invertebrates; assessing the quality of groundwater discharge and detecting the occurrence and transmission of organic pollution in aquifers.

About three years ago, with the cooperation of Mr Eddie van Wyk and Mr Barry Venter of DWAF, and supported by Dr F Durand and Prof G. Steyn, Sayomi and her team became aware that blind amphipods were present in streams, cave systems as well as in boreholes. During discussions among Sayomi, Dr Kevin Pietersen and Dr Steve Mitchell, it was decided that such an area could not be neglected. "The WRC decided to support this research as a contribution for investigations concerning the integrity of South African aquifers as ecosystems. The WRC demonstrated innovation and foresight in supporting this avenue of research and the knowledge generated was enormous. They are smart people who are professional and supportive," says Sayomi.

Kevin Pietersen, one of the directors at the WRC says, "Sayomi is one of the rare people who has tremendous energy and a natural flair for research and the pursuit of academic excellence. Sayomi can certainly add value to water research in South Africa."

Sayomi, we at the WRC respect your work and ideologies.

Your inclusion in the mosaic of South Africa adds energetic bursts of colour to this already growing master-piece.





## WRC Open Day and Launch of Career Guide

On 22 July 2004 the Minister of Water Affairs & Forestry, Honourable Minister Buyelwa Sonjica launched the WRC career guide *Water @ Work*. This guide focuses on potential careers in the water sector and is aimed at high school learners.

The function also served as a WRC Open Day. Guests included The Minister of Water Affairs & Forestry, The WRC Board, representatives from Provincial and Local Government, academics, learners and educators and university students. Learners came from as far as Fort Beaufort and King William's Town.

The Open Day component of the event showcased research projects from the Eastern Cape. Project leaders were on hand to discuss aspects of their projects with guests and to also complement the career guide: learners were enlightened about potential careers in the vibrant water sector. The career guide is also available as a download from the WRC website ([www.wrc.org.za](http://www.wrc.org.za)). On Friday 20 August 2004, Dr Steve Mitchell was interviewed on Morninglive (SABC 2) about the WRC career guide. For more information e-mail: [yuveng@wrc.org.za](mailto:yuveng@wrc.org.za)



*Top right: Prof Kasan welcoming guests  
Middle right: Dr Kfir delivering her address  
Bottom right: Minister Sonjica at the Open Day function  
Left: Dr Msibi chatting to guests*

## The WRC & the SA Youth Water Prize

The winner of this year's SA Youth Water Prize was Jacques Deacon of Kathu High School in the Northern Cape. The function honoured Jacques as well as the runners-up: Dean Butler (Oorsterland Hoerskool) and Kirsty van der Berg & Niveshni Maistry (Rand Park High School). The Minister of Water Affairs & Forestry, Ms Buyelwa Sonjica, delivered the keynote address.

Mr Jan du Plessis of the WRC was one of the judges at this prestigious event. The WRC sponsored computers to the winner and the runners-up.

*A joyous moment: the winner of the South African Youth Water Prize for 2004, Jacques Deacon, from Kathu High School in the Northern Cape, accepts one of his prizes from the Minister of Water Affairs and Forestry, Ms Buyelwa Sonjica. Pictured (from left) are: Nokuthula Dubazane, runner-up from KwaZulu-Natal, Jacques Deacon, the Minister and Dean Butler, runner-up from Mpumalanga, with his parents. Jacques won the competition with his invention, Alien Buster 1,2,3 – a device used for eradicating alien invasive plants - and represented South Africa at the international Stockholm Junior Water Prize competition in Sweden.*



## What's New

### Report No 1217/2/04 A flood Nowcasting system for the eThekweni Metro. Vol 2: Modelling flood inundation in the Mlazi River under uncertainty

This project aimed, firstly, to pull together the outcome of previous research funded by the WRC in the areas of radar estimation of rainfall, space-time modelling and forecasting of rainfall, linear catchment modelling and river-flow modelling, and, secondly, to provide decision makers in Umgeni Water and Durban Metro (and eventually the Umgeni Catchment Management Authority) with the tools to be proactive rather than reactive in the context of flood warning. The components of the project are meteorological, hydrological and hydraulic. As a result of the project, people living near rivers now have both the potential for receiving warnings about impending floods and the knowledge that the Disaster Management Group is working towards mitigating floods in their area. Furthermore, with the new flood forecasting capability, 6 to 12 hour warning of an impending flood will enable industries to evacuate staff and perform controlled shut downs or take steps to reduce the damage to sensitive plants.

### Report No 998/1/04 Modelling of rectangular sedimentation tanks

This project sought to evaluate the suitability of computational fluid dynamics (CFD) as a technique for design and research of rectangular sedimentation tanks; design CFD models for simulation of sedimentation tanks; validate the models with experimental data; use CFD to investigate the effects of design parameters and operational parameters and to make recommendations for improved design and operation of sedimentation tanks. It was found that CFD does provide a useful tool for modelling of sedimentation tanks. It can be used to calculate flow patterns of the water in the tanks, as well as the effect of various parameters on it. It cannot, however, be used as a routine tool by simply any operator. At present CFD is still a qualitative rather than quantitative tool for this specific application. It is necessary to develop better mathematical descriptions or measurements of these parameters and incorporate them in the CFD models in order to obtain better quantitative results.

### Report No 1274/1/04 Least Cost Planning (LCP) for the water services sector in South Africa

This project aimed at exploring LCP in general and its application in the water sector; comparing LCP with other planning approaches and exploring an algorithm for LCP in the water services sector through a hypothetical example. The aims of the study were achieved through tracing the history of LCP and the adoption of a definition which was applicable to the water services sector of South Africa. Lessons were drawn from the various sections. Although some experience from the energy sector is transferable to the water sector, certain aspects of water supply are dramatically different from energy supply. Unlike electricity, natural gas and transportation utilities, which have regional transmission networks, regional water systems are constrained by the limited application of economies of scale. The study developed an algorithm that demonstrates the effectiveness of LCP and recommends that the algorithm be tested through a "real life" case study with various stakeholders. The linkage with further research should be encouraged and the LCP approach should be communicated to as many interested parties as possible.

### Report No 1155/1/04 Development and evaluation of an installed hydrological modelling system (IHMS)

The IHMS developed in this study was set to be generic for South African catchments and to involve the building up of national, regional and local hydrological data sets. The national quaternary catchments database was refined and linked to the ACRU model to develop the framework of the IHMS. The developed IHMS was then applied to case study catchments: Mkomazi and Thukela. The case study simulations involved detailed model simulations which looked at a number of catchment characteristics, some of which had never received attention before. The project produced a detailed national hydrological data and information system coupled to the first Windows-based ACRU model. The ACRUView: A model output visualisation and statistical package for model post-processing, was one important development that took place in this study. This project also generated a reasonably supported electronic model user support system which is likely to improve model use and the quality of outputs to be generated.

### Report No 1238/1/04 Hydrogeology of fractured-rock aquifers and related ecosystems within the Qoqodala dolerite ring and still complex, Great Kei catchment, Eastern Cape

Research has shown that the dolerite ring structures, which are prominent features in the landscape of the Karoo and Eastern Cape, are potentially fruitful drilling targets for groundwater exploitation. Continuation of this research in the Eastern Cape has thrown light on the dependency of ecosystems, springs and seepages on fractured-rock aquifers related to these dolerite rings, and their vulnerability to groundwater abstraction. A large part of the population of the Eastern Cape is dependent on springs and seeps for their water supplies. The research required a multidisciplinary approach involving structural geology, hydrostratigraphy, spring census, geomorphology, wetland and biosystems mapping, and extensive use of spatial analysis and remote sensing. In addition, a total of 12 exploration boreholes, drilled by DWAF across the SW rim of the Qoqodala dolerite ring, were needed to fine-tune a conceptual model of the ring system. The saucer-shaped intrusion contains three aquifers: shallow, unconfined; medium-depth, semi-confined; and, deep, confined. Because of the shape of the intrusion, the upper unconfined aquifer is very vulnerable to deep drilling, which would create artificial connections between aquifers. The location of wetlands or seeps at low elevation, the direction and density of fracturing, the slope of the inclined sheet, and the shape of the intrusion are factors that must be taken into account when developing groundwater from dolerite rings.

### Report No 1230/1/04 Evaluation of nanofiltration for the treatment of rural groundwater for potable water use

Many groundwater sources in the North-West Province cannot be used for potable purposes because of the saline quality of these sources – especially regarding nitrates, fluorides, sulphates, calcium and chloride in the water. The project aimed to evaluate different nanofiltration membranes at a laboratory scale in the removal of these compounds. The studies showed that divalent compounds could be removed with varying success by the use of these membranes, but that the monovalent ions, such as fluoride and nitrate, could not be adequately removed. These results are significant in that they point the way forward to the niche areas where nanofiltration could be implemented with success – and which applications to avoid.

### Report No 1080/1/04 The mechanisms and kinetics of biological treatment of metal-containing effluent

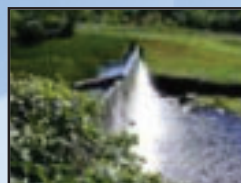
Bioprocesses for the treatment of acid mine drainage (AMD) and other such acidic high-sulphate wastewaters offer various technical, cost and operating advantages over physicochemical treatment systems. This project aimed at obtaining fundamental information for developing and optimising bioprocesses for treatment of these wastewaters, both to produce clean water and to recover metals. Specific objectives were to define the state-of-the-art literature on the mechanism and kinetics of microbial sulphate reduction; provide rate equations for critical sub-processes; develop a mathematical model describing the biological treatment of AMD and other high-sulphate, metal-containing effluents; and investigate metal precipitation theoretically and experimentally, to maximise clean water recovery. The final report contains a number of recommendations on the technical application of the results as well as further work required. These aspects are being addressed in a follow-up WRC Project No. 1251. The body of work will advance the prospects of implementing biological sulphate reduction processes on full scale.

### Report No 1136/1/03 Optimization of irrigation management in mango trees by determination of water and carbon demands to improve water use efficiency and fruit quality

The research was carried out in a commercial five to eight year mango orchard of the Westfalia Moriah Estate in Hoedspruit, Limpopo Province. Five irrigation treatments of regulated deficit irrigation (RDI) were applied and seasonal crop yields and fruit quality were determined. The study revealed that deficit irrigation represents a suitable irrigation method to save water and simultaneously achieve optimum yield, particularly under water scarce conditions. RDI requires regular monitoring of soil water status, preferably on a daily basis. Water savings, up to 24 %, were achieved with RDI, compared to the control treatment. The period of water reduction before flowering in the RDI treatment could be further optimised by scheduling the practice earlier. In this approach, negative effects of reduced irrigation will be avoided while additional savings on irrigation water are achieved. Over irrigation leads to water and nutrient losses, mainly on coarse sandy soils that are used. RDI will, if adopted, lead to

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savings in the amount of water used for irrigation, as well as savings in pumping and other costs. It is also possible that this treatment will improve fruit quality, and therefore, income.

#### Report No 1089/1/03 The contribution of root accessible water tables towards the Irrigation requirements of crops

Experiments conducted over a period of three years have shown that water tables between 1 m and 1.8 m in depth, far from being a liability, can be a valuable resource for the irrigation farmer. Depending on crop, soil texture and depth of water table within the abovementioned range, the water table was able to contribute between 21% and 63% of the crop's seasonal water use. During the period of peak water uptake, a constant water table at 1 m contributed up to 90% of daily evapotranspiration in all crops considered. Considering that approximately 260 000 ha of irrigated arable land in South Africa has shallow water tables, understanding the capillary contribution from a water table towards a crop's water requirements could be the foundation for the development of an important management tool to conserve irrigation water. Without such a tool, this contribution could easily be overlooked and the crop wastefully over-irrigated. Clearly, irrigation scheduling methods must be modified, where necessary, to account for contributions from water tables. The fact that certain simulation models were shown to simulate the uptake from shallow water tables satisfactorily, shows this to be feasible.



*The WRC Annual Report is now available. You can download a copy from the WRC website ([www.wrc.org.za](http://www.wrc.org.za)) or e-mail [yuveng@wrc.org.za](mailto:yuveng@wrc.org.za) to order your copy.*

## The WRC @ Sasol Techno X

The annual Sasol Techno X was held in Sasolburg from 23-28 August 2004. The theme this year was "Xplore your Future". The WRC participated at this event and promoted the career guide *Water @ Work*. The guide was distributed to learners and they expressed great interest in a career in the water sector. Learners were also given copies of *The Water Wheel* and publications such as the popular *Some for All, Forever*. It was a great outreach initiative for the WRC and educators and learners are more aware of the WRC as a knowledge base.



*Ms Agnes Molubi (WRC) at the sasol Techno X with learners who visited the WRC exhibition*

## Kerkplaas Handover

On 16 September 2004 the WRC handed over the Kerkplaas solar still research project, which has been implementing the technology successfully over the past two years, to the Kannaland Municipality.

The small communities of Kerkplaas and Algernyskraal, in the arid Klein Karoo region of the Western Cape, are the first in the country to benefit from solar desalination technology on an operational scale.

Project leader, Ian Goldie, anticipates that a decision on general acceptance of the technology for municipal use will be taken as soon as the demonstration period at the Algernyskraal plant has been completed next year.

During summer, when solar radiation levels are at their highest, the Kerkplaas plant can produce up to 200 ℓ/day and the Algernyskraal plant can deliver up to 400 ℓ/day. As plant output is dependent on radiation levels, less water is desalinated during winter.

The WRC funded the research that resulted in the development of solar stills as a small-scale potable water provision technology for use in single households or small communities. The research was carried out mainly at the Polymer Institute of the University of Stellenbosch, in collaboration with the Department of Chemical Engineering at the Cape Town Technikon.



*The solar still plant at Kerkplaas*



*Mr Jay Bhagwan (WRC) handing over the solar still project to a representative of the Kannaland Municipality*