

amanzi

Newsletter of the Water Research Commission

In This Edition

Knowing the Drill p 1

A Credit to the WRC p 2

Ex-WRC Board Chairperson Appointed to Global Water

Leadership Position p 2

WRC's Knowledge Forum p 3

Accolade for WRC Researcher p 3

WRC @ Langebaan Site Visit p 4

SANCID 2006 Biennial Symposium p 4

What's New p 5

Knowing the Drill

She has progressed from the novice stages of learning how to lock diffs in a 4x4 bakkie to a renowned authority on groundwater in South Africa. Christine Colvin commenced her career as a volunteer from the UK who was involved in a Namibian drought relief programme. Armed with a resistivity meter and a naïve understanding of 4x4 driving and bush dynamics, this budding volunteer geologist commenced what eventually has become a very rewarding career in groundwater-related research. It was out there that Christine completed valuable and insightful ground work – no pun intended! “– I learnt a huge amount about geophysics, drilling, borehole construction and rural community water supply. All the basics for groundwater supply schemes,” says Colvin. The young geologist knew that groundwater ran in her veins when she drilled her first borehole in 1992 and was rewarded with water – this was not a question of beginner's luck!

Christine returned to the UK to complete her M.Sc in Hydrogeology at University College, London and worked on groundwater contamination for a year in Europe. The call to the African continent was great, especially South Africa where Christine has firmly established roots. She moved to Stellenbosch in 1995 where she commenced work with the Groundwater Group at the CSIR.

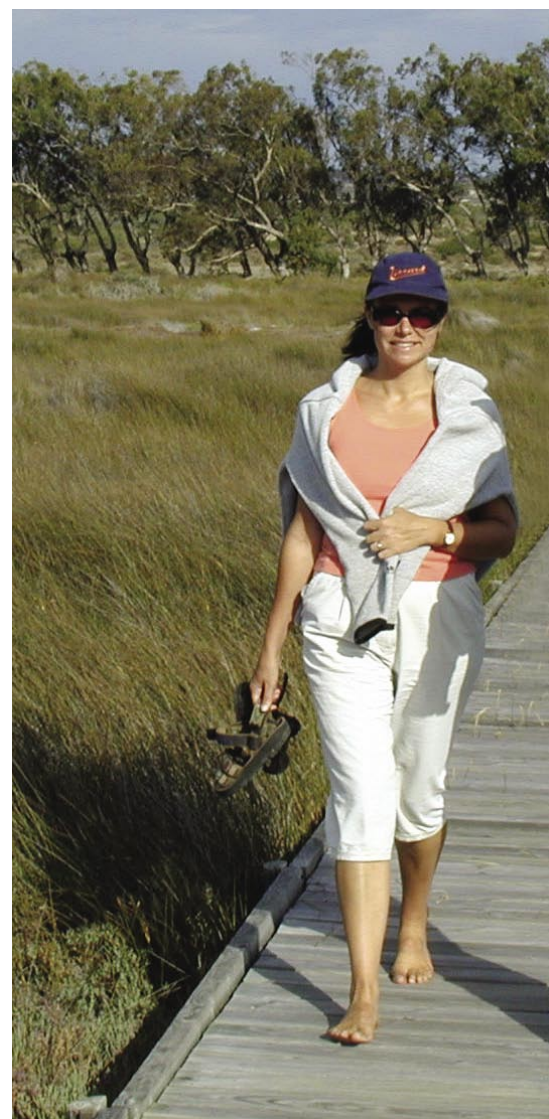
How does this talented lady view the WRC? “I first worked on WRC-funded research in 1996 with my colleagues from the CSIR, John Weaver, Gideon Tredoux, Roger Parsons, Pannie Engelbrecht and Julian Conrad, assessing contamination of groundwater by agriculture. My late inclusion on the team was ‘rewarded’ by my having to assess the impact of the use of sewage sludge as a soil conditioner! I was terribly nervous facing my first grilling at the hands of the Steering Committee, but it was a great project and I remember putting the finishing touches to our *Handbook on Groundwater Quality Protection for Farmers* a taxing exercise that was exacerbated by the fact that it preceded the birth of my first son, Timothy. The WRC plays a crucial role in the South African water sector, particularly in promoting the results of water research to the broader public and decision makers. It is wonderful that the wealth of water knowledge published by the WRC is freely available to all South Africans, and a particularly important resource for students.”

Christine shares the WRC's vision of networking and forming partnerships so that knowledge generation and dissemination is meaningful. She credits her success to supportive colleagues – a formidable list of individuals! She also attributes her success to a loving and supportive family as well as sincere friends. Christine's latest WRC project involves partner, Prof Roychoudhury at UCT, and is titled *Biogeochemical Controls on the Plant Biodiversity Within a Saltmarsh Ecosystem in The West Coast National Park: Impact of Saltwater-Groundwater Interaction on Pore Water Chemistry and Vegetation*. This is also a subject of discussion in this issue of *Amanzi*. Colvin intends completing her Ph.D which has advanced to the “write-up” stage. However, this passionate hydrogeologist hopes to “enable the next generation of young hydrogeologists to reach their potential, to be involved in researching a deeper understanding of water in the South African landscape and the limits on its sustainable use.” Her head may be on the ground, but her ideas and dreams are lofty indeed!

Christine has certainly made South Africa her home and this is reflected in her intimacy with matters that are South African – one being the scarcity of water and the increasing role that groundwater plays in improving the quality of the lives of South Africans. “I believe that groundwater has a critical role to play in improving the lives of South Africans and the last decade has given lots of opportunity to raise the profile of groundwater within the philosophy of Integrated Water Resource Management (IWRM). The South African groundwater fraternity has made significant progress in putting aquifers on the map and raising awareness of our ‘hidden treasure’.” A further priority is the development of strategic capacity in the vibrant South African water sector – another matter that is close to Christine's heart. “The water sector has a vital role to play in supporting development in South Africa, but I believe we are a sector in crisis. We are struggling to implement the principles of our National Water Act, and the principal constraint is a dire lack of people power to do the job. This means that everyone who is involved in the water sector can make a difference. My advice to young people starting in the sector is to invest your time in quality education and experience, and find good mentors to guide you through your career. We desperately need a solid foundation to build capacity for the future.”

Dr Kevin Pietersen, Director: Research Coordination & Partnerships at the WRC, who has worked closely with Christine says, “Christine has the unique ability to communicate scientific concepts to various stakeholders. This ability has stood the groundwater community in good stead and has raised the profile of groundwater resources at a political level.”

Christine, the WRC is supportive of your initiatives and the vast strides that you have made thus far. We share your philosophy and are proud to have another competent researcher in our ranks.



A credit to the WRC

The WRC financial machinery has been greatly enhanced by the appointment of Mr Nareshkumar (Naresh) Patel as Chief Financial Officer (CFO).

Mr Patel completed his B.Comm (Accounting) at Rhodes University (1986) and worked as a graduate trainee at VW-SA. He completed B.Comm (Hons) at UNISA in 1993. Naresh has worked in a number of different job environments which has given him diverse experience: SA Post Office, Port Elizabeth (1995-1997); Murray & Roberts Foundries (1997-2002); Pikitup (2002-2004) and Mintech (2004-2006). Hopefully, his last port of call will be the WRC!

Naresh is impressed with the WRC as an organization and believes that it has vast potential, owing to its strong leadership capacity. "It looks like a world-class knowledge hub," says Patel.

Naresh plans on building on the current systems at the WRC, especially in terms of "refining financial discipline and accelerating the accrual basis of accounting practice." Mr Patel is also a firm believer in team work and team spirit, tenets which he intends fostering at the WRC. With such an ethos in place, Naresh hopes to also "develop a fully integrated ERP system and to promote a professional work ethic".

Naresh's attitude at work is also reflected in his family life, which is also dominated by a strong sense of commitment. When he is not juggling figures and balancing books, he enjoys spending quality time with his wife, Bharti and his two children, Tarika and Nikhil. This energetic forty-something man also enjoys keeping fit by visiting the gym regularly and taking to the road: he has completed three Comrades Marathons and two Two Oceans Marathons.



Naresh, the WRC welcomes you to its ever-growing family and we hope that you enjoy your stay at South Africa's water knowledge hub.

Ex-WRC Board Chairperson Appointed to Global Water Leadership Position

The former Chairperson of the Water Research Commission, Prof Hamanth Kasan was recently appointed to the International Water Association's (IWA) Board of Directors

Prof Kasan is a well-known leader in both the national and international water sector, and was nominated to serve on the Board of IWA. Nominees were given the opportunity to present themselves, by means of a three-minute presentation, to the governing Board during the Biennial IWA World Water Congress held recently in Beijing, China. The governing body of IWA, represented by some 130 countries, resolved to appoint Prof Kasan to the Board of directors.

Kasan is very excited by the challenges which this appointment affords him. He is of the opinion that South Africa can and will play a leading role in the global water industry. He is also the current Chairperson of the Eastern and Southern African region (ESAR) committee of IWA, which is comprised of fourteen member countries: South Africa, Botswana, Zambia, Mozambique, Lesotho, Swaziland, Ghana, Malawi, Kenya, Mauritius, Madagascar, Seychelles, Zimbabwe and Namibia.

Prof Kasan sees his chairmanship as a key opportunity to contribute towards capacity development among water utilities in South Africa and Africa through the IWA global network of expertise and resources. He emphasised that the IWA is an organisation which is made up of leading water professionals in science, research, technology and practice. There are 10 000 individuals and 400 corporate members from as many as 130 countries. This global network spans the continuum between research and practice, covering all possible facets of the water cycle. IWA members collaborate to pro-



mote the development and implementation of innovative and effective approaches to water infrastructure management and water services provision in general.

Some of the key challenges facing the water sector are capacity building, awareness and performance management. Therefore, one of his first projects as Chairperson of ESAR will be to spearhead the establishment of the first IWA regional office in Africa. Once established, the office will coordinate all initiatives toward

capacity development and improvement of water service delivery in the fourteen member countries. Contributing to the urgency to establish a regional office is the sad fact that one child dies of a water-borne disease every 12 seconds. Most of these children are below the age of five years and are from Africa and South East Africa. Prof Kasan's multi-disciplinary education (ranging from science, engineering, management, leadership, corporate governance, coaching, etc) equips him well for this challenge. Furthermore, the professional and geographical diversity of IWA membership – a global mosaic of member communities – including academic researchers, research centers, utilities, consultants, and water equipment manufacturers will afford Prof Kasan access to global expertise and valuable experience to address the key water-related challenges in Africa. Prof Kasan is also an active member of the IWA Strategic Council and the IWA Utilities Forum.

As General Manager: Scientific Services at Rand Water, Prof Kasan manages a division comprised of some 130 multi-disciplinary staff, the majority of whom are scientists and engineers. One of his team's main objectives is to ensure that Rand Water continuously produces water within the World Health Organisation (WHO) quality guidelines. Prof Kasan is a firm believer in leaving a legacy to the future generations and, under his leadership, Rand Water is the first utility on the continent to implement a water safety plan. This plan is consistent with WHO guidelines and is based on a risk-based approach to ensure water quality to customers and consumers. A training programme has been formulated in order to build capacity in South Africa and Africa.

WRC's Knowledge Forum

The WRC's Knowledge Forum took place at The CSIR Convention Centre on 10 October. The event commenced with a presentation by the WRC CEO, Dr Rivka Kfir, outlining the WRC *Annual Report and Knowledge Review*. These documents were then officially handed over to Ms Barbara Schreiner, who accepted the documents on behalf of Mr J Sindane, the Director-General of the Department of Water Affairs and Forestry.

This was followed by a comprehensive panel discussion on: *Current realities and challenges in sanitation improvement – Future perspectives and needs*. The panelists were:

Prof TE Cloete

Sanitation Options – Which way to go

Mr Sandile Mbanjwa – Acting Director: Water Services-Mogale City

Suggestions towards a Sanitation Policy Formulation – taking into account lessons learnt to-date.

Ms Kathy Eales – Programme Manager: Water and Sanitation Infrastructure and Services Department, City of Johannesburg

Eradicating Joburg's sanitation backlogs: Unpacking some of the challenges

Ms Linda Tyers – Sanitation Sector Engineering Specialist, Development Systems Engineering

Ensuring an enabling environment for sustainable sanitation service delivery

Dr Nozi Mjoli – Director: Hlathi Development Services

Lessons Learned From 5 Case Studies of Sanitation Projects

Mr David Gadd – National Programme Manager: IDT

Sanitation – it's all in the approach

The facilitator was Mr Craig Bishop, a journalist from *The Witness*, a newspaper based in Pietermaritzburg. The final sum-up was conducted by Ms Connie September: Chairperson: Portfolio Committee on Water Affairs & Forestry.

This event also included a demonstration by the national winners of the SA Youth Water Prize: Nompilo Mahlobo and twin sisters Thobile and Thokozani Mbanjwa from Imbali, Pietermaritzburg.



Top left: Dr Kfir being interviewed by Gilian de Gouveia, a journalist from the SABC

Top right: Ms Connie September being interviewed

Top right, bottom: Guests at the knowledge forum

Left: Panelists at the Knowledge Forum

Accolade for WRC Researcher

The developer of a unique South African water administration system, which has increased the productivity of water use in irrigation agriculture, has won a prestigious international accolade. Dr Nico Benadé was recently awarded the International Commission on Irrigation and Drainage's (ICID's) Innovative Water Management Award for the Water Administration System (WAS) at a ceremony held in Kuala Lumpur, Malaysia in September 2006. This is the first time that a professional represented by the South African

National Committee on Irrigation and Drainage (SANCID) has received an award in this category. The WAS was developed with funding from the WRC to provide irrigation schemes with decision support for efficient water management. The WAS is a decision-support program designed for use by water user associations (WUAs) on irrigation schemes to enable them to manage their water accounts and their water supply to clients through rivers, canal networks and pipelines.

"This system is a prime example of taking the innovation process through the full cycle – from research to practical application to exploitation of its commercial potential," says Dr Gerhard Backeberg in his dual capacity of Director: Water Utilisation in Agriculture at the WRC and Chairperson: SANCID, who nominated Dr Benadé for the award. "The gratification associated with the ICID Award is the international recognition of an innovation which is truly South African."

WRC @ Langebaan Site Visit

The WRC was part of the site visit and Steering Committee at Langebaan on the West Coast. The new research project (K5/1591) is titled:

Biogeochemical Controls on the Plant Biodiversity Within a Saltmarsh Ecosystem in The West Coast National Park: Impact of Saltwater-Groundwater Interaction on Pore Water Chemistry and Vegetation

Project leaders, Prof Roychoudhury and Ms Christine Colvin, outlined highlights of the project to group members on 17 October. This was followed by a Steering Committee meeting on 18 October.

some of the colourful grasses of the ecosystem under study

The group at the Langebaan site visit

Christine Colvin explaining groundwater concepts to group members

South African National Committee on Irrigation and Drainage (SANCID)

2006 Biennial Symposium

The Changing Face of Irrigation in Southern Africa

The South African National Committee on Irrigation and Drainage (SANCID) represents South Africa at the International Commission on Irrigation and Drainage (ICID) and became a member in 1992.

ICID was established in 1950 as a Scientific, Technical, Professional, Voluntary, Not-for-Profit, Non-Governmental International Organization (NGO), dedicated, inter alia, to enhance the worldwide supply of food and fibre for all people by improving water and land management, and the productivity of irrigated and drained lands through the appropriate management of water, environment and the application of irrigation, drainage and flood control tech-

niques. More information on ICID is available on the internet at <http://www.icid.org>.

The objectives of SANCID are, *inter alia*, to serve as the South African National Committee of ICID, and to further the aims and objectives of ICID in South Africa, as well as to actively contribute to the stimulation and promotion



of research and the development of technology in the fields of irrigation, drainage and flood control in South Africa. This is done by liaising with local organisations and bodies; initiating and organising specialised and regional ICID conferences; encouraging the submission of papers for presentation at the ICID congresses and workshops; keeping members informed on international activities; and exchanging technical information with ICID and its member countries. Please refer to the website of SANCID at <http://www.sancid.org> for more information.



any group of professionals who are active in irrigation, drainage and flood control in South Africa. The first SANCID symposium was held in November 2004 in the Eastern Cape, and attended by delegates from government departments, universities, research organisations, private consulting firms and the irrigation industry.

SANCID does not have individuals as members, but consists of representatives of governmental, parastatal and private organisations, as well as learned societies involved in various fields of irrigation, drainage and flood control, in this way reaching the irrigation and drainage community of South Africa.

In order to address the objectives mentioned above, four main activities have been identified namely (1) participating in ICID congresses; (2) contributing to ICID working groups and establishing local networks; (3) organising local symposia; and (4) encouraging publication of scientific articles in the ICID Journal Irrigation and Drainage. Accordingly a decision was taken by SANCID to introduce a biennial symposium aimed at creating a platform for a multi-disciplin-

The SANCID Symposium took place in Aventura Swadini, Mpumalanga from 15-17 November. The Chairperson of SANCID, Dr Gerhard Backeberg, is also the Director: Water Utilization in Agriculture at the WRC. For more information on the conference visit the SANCID website www.sancid.org.za.

Visit the WRC website (www.wrc.org.za) to read Opening Address by Dr Backeberg and the Key-note Address by Prof Wim van Averbeke.



Prof Van Averbeke delivering the keynote address

What's New

Report No 1446/1/06 (Contractor: Rhodes University)

On-line real-time enzyme diagnostic system for the detection and monitoring of faecal contamination of water intended for drinking purposes.

The aim of this work was to develop an on-line real-time enzymediagnostic system for the detection and monitoring of faecal contamination in water intended for drinking purposes, using suitable marker enzymes. One of the most promising alternative approaches to microbiological detection of faecal indicator micro-organisms was selected. Detection via marker enzymes was successfully achieved within 24 hours. Cell permeabilisation was not required for the *in situ* assays, thus saving on the costs involved and time required for analyses. Real-time monitoring of faecal pollution proved promising through direct electrochemical detection and development of a sequential flow injection analysis (SFIA) system. This design constitutes a high priority for future research and is based on the proof of concept that was established during the course of this study.

Report No 1334/1/06 (Contractor: South African Weather Service)

Skill comparison of some dynamical and empirical downscaling methods for southern Africa from a seasonal climate modelling perspective

The main emphasis of the project was to assess the ability of an advanced state-of-the-art method of downscaling large-scale climate

predictions to regional and local scale as a seasonal rainfall forecasting tool for southern Africa in order to improve seasonal outlook information for hydrological purposes. Downscaling the large scale to more localised seasonal rainfall over southern Africa had previously been shown to be feasible, but further research in downscaling was required. Various downscaling techniques and raw general circulation model (GCM) output were compared to one another over the 10-year period from 1991/92 to 2000/01 and also to a baseline prediction technique that uses only global sea-surface temperature (SST) anomalies as predictors. The various downscaling techniques described in this study include both an empirical technique called model output statistics (MOS) and a dynamical technique where a finer resolution regional climate model (RCM) was nested into the large-scale fields of a coarser GCM. The study concluded by investigating the internal variability of the RCM. The study addressed the performance of a number of simulation systems (no forecast lead-time) of varying complexity. These systems' performance was tested for the December-January-February (DJF) rainfall for both homogeneous regions and for 963 stations over South Africa, and compared with each other over a 10-year test period from 1991/92 to 2000/01. The simulation methods outscored the baseline method that used sea-surface temperature (SST) anomalies to simulate rainfall, thereby providing evidence that current approaches in seasonal forecasting are outscoring earlier ones. The potential for using dynamical and statistical downscaling methods and their combination for modelling South

African seasonal regional rainfall variability has thus been demonstrated. In addition to expanding on the number of ensemble members, the test period of 10 years should be increased in order to test the robustness of the results presented here since this test period may be too short to demonstrate which simulation method is the best.

Report No 1426/1/06 (Contractor: South African Weather Service)

Daily rainfall mapping over South Africa (DARAM): Infrastructure and capacity building

Owing to the need for more rigorous quality assessments and improvements this project was undertaken to further refine products, with the main focus being on correcting shortcomings attributable to infra-structural and capacity-building weaknesses. Each of the platforms used for rainfall measurement, namely surface raingauge networks, radar networks as well as satellite data, came under the spotlight. New quality check procedures for the processing of the real-time raingauge data were developed and implemented. Measures to improve the calibration and maintenance of radars were implemented, resulting in a system that constantly monitors the performance of the radars in the network. A new scheme to remove ground clutter from the radar precipitation fields was also developed and implemented. Errors introduced into radar rainfall fields through deficient sampling at longer ranges were reduced through the dynamic determination of usable radar ranges under such conditions. Plans were developed to

expand the radar network within South Africa and also within the region, with SAWS collaborating with Mozambique and Botswana Meteorological Services in this regard. A new satellite rainfall scheme was developed using the MSG-channels corresponding to those of the Meteosat 7 satellite on which the majority of the products generated during SIMAR, the earlier phases of DARAM, had been based. The new scheme showed marked improvements related to resolution. The development of human capacity to utilise the products generated in DARAM was a major outcome of the project. The DARAM project highlighted the lack of rainfall observation infrastructure. As a solution, the SA Weather Service Recapitalisation Plan was conceived and will be a crucial part of the modernisation and revitalisation of the South African meteorological and climatological infrastructure. It will support improved rainfall estimations and related application.

Report No 1266/1/06 (Contractor: University of the Free State)

Generalised whole-farm stochastic dynamic programming model to optimize agricultural water use

The main objective of this research was to develop a generalised whole farm stochastic dynamic linear programming model to assist farmers and water user associations (WUA) with optimal water use within the framework of integrated catchment management. The research was done on the Vaalharts irrigation scheme which comprises a total of 35 000 ha of irrigation plots of some 680 land owners. Canals supply the water to the irrigation plots. Flood irrigation is the dominant irrigation type followed by pivot irrigation. The most important cash crops in the area are maize, groundnuts, wheat, lucerne and cotton and the most important long-term crop is pecan nuts. GAMS (General Algebraic Modelling System) was chosen as the preferred modelling environment to develop the generalised stochastic dynamic optimisation model. The dynamic optimisation model is theoretically sound and is based on standard capital budgeting procedures. All the necessary cash inflows and outflows are dynamically accounted for and the model is therefore able to model cashflows better when compared to any of the existing models. Thus, the model is able to evaluate the cash flow implications of alternative investments decision more accurately, thereby enhancing the quality of advice that farmers can get. Procedures were developed in this project to separate data manipulation and calculation of input parameters from the matrix generating equations used to construct the model. Through the adoption of such a procedure, the accounting equations that determine the underlying structure of the programming matrix are more transparent.

Report No 1074/1/06 (Contractor: PRG, University of KwaZulu-Natal)

Co-digestion of high strength/toxic organic effluents in anaerobic digesters at wastewater treatment works

The aims of this project were to illustrate that high-strength or toxic organic liquid effluents can be disposed in conventional sewage works and to provide a protocol for the

evaluation of liquid effluents for an alternative treatment system and for high-strength liquid effluents that are currently being disposed to landfill. Industrial effluents fed to an anaerobic digester could cause an *organic overload* or display a *toxic effect* and possibly lead to the failure of the digester. A need was identified for a method to assess whether an industrial effluent can be safely treated in an anaerobic digester; or if it requires to be mixed with another readily biodegradable effluent in order to be simultaneously digested (co-digestion); or else if it is not amenable to be anaerobically digested at all. A screening protocol has been established, investigating two quick simple reliable analytical and technical methods that are relatively inexpensive so that it is affordable to small companies: Firstly, the serum bottle method is based on the determination of the volume of gas produced in a sealed vial, as a measure of the activity of the anaerobic sludge. Secondly, the pH-stat titrimetric method consists of compensating the change in pH caused by a physico-chemical or biological process within a suspension, by the controlled addition of an appropriate solution which neutralises the excess acidity or alkalinity produced or consumed. The anaerobic digestion process seems ideally suited for the latter measuring principle. A completely stirred laboratory-scale digester was set-up to measure the biogas production. The digester was run for almost 150 days and the operating conditions had been repeatedly changed in order to verify hypotheses or counteract potentially dangerous situations that could lead to a complete failure of the digester. A few semi-quantitative results on the distillery effluent are also discussed.

Report No 1252/1/06 (Contractor: PRG, University of KwaZulu-Natal)

Life cycle assessment of a secondary water supply

The overall objective of this study was to determine the environmental burdens in an urban context, as measured by an environmental life cycle assessment (LCA), for a terrestrial pathway of the water cycle, i.e. from the abstraction of water from rivers, through treatment, distribution, collection (after use), treatment, recycling and disposal, all of which are aspects of the human-modified water pathway which do not occur in the natural water pathway. The LCA results were applied to a number of different scenarios as test cases. Two scenarios were the provision of potable water to 200 000 new customers in an urban environment with waterborne sewage and in a peri-urban environment with on-site sanitation. The options analysed were maximising the use of existing assets, recycling water and building new infrastructure. A further option analysed was to provide bottled water for drinking. The LC impact scores calculated for both the urban and peri-urban scenarios showed that the most environmentally-friendly option was water recycling, followed by maximising the use of existing assets, then constructing new infrastructure. The use of bottled water for drinking carried the highest environmental burden. Overall, the use of LCA as a tool for defining environmental impacts and developing appropriate solutions has been demonstrated. The results of this study can be used to evaluate any South African water and sanitation systems that are

based on similar processes to those investigated.

Report No 1380/1/06 (Contractor: Mvula Trust)

A methodical approach to health and sanitation integration

The study explored the hypothesis that a methodical approach to health and hygiene implementation on rural sanitation projects can potentially address current gaps in methods of health and hygiene delivery by sanitation service providers. It also began a preliminary exploration of the hypothesis that a livelihoods approach to water and sanitation delivery can potentially enhance the direct and indirect impact of water and sanitation on livelihoods and the recipient communities' ability to pay, thus ultimately increasing the pace of services delivery. The study developed a Community-Based Health and Hygiene Model (CBHHM) with an attendant implementation kit and evaluated methods used by service providers on rural sanitation projects in the Eastern Cape and Limpopo provinces in relation to the developed model. The study findings indicate that there are significant impact reducing gaps at all stages of the health and hygiene programmes as currently carried out by service providers. The study results indicate that health and hygiene budgets are only 2% of sanitation project budgets and the house-to-house method of health and hygiene promotion is only used in 33.9% of cases. An analysis of the results of the CBHHM indicates that a community-based approach to health and hygiene promotion on sanitation projects is integral to achieving maximal impact. Recommendations are made to policy makers for the use of livelihood approaches in community water and sanitation delivery to ensure that projects are better able to identify, target and impact maximally on the livelihoods of the poor and vulnerable, thus ultimately increasing their ability to pay for services and enhancing the sustainability of such projects.

Report No 1264/1/06 (Contractor: University of the Free State)

Quantitative evaluation of the modal distribution of minerals in coal deposits in the Highveld area and the associated impact on the generation of acid and neutral mine drainage

Mineralogy plays a controlling role in the formation of acid mine drainage (AMD). Mineralogy describes, inter alia, whether and in which quantities the acid producing sulphide and acid neutralising minerals are present, how reactive they are, their spatial distribution and ease of weathering. This project focused on the identification of minerals occurring in coal, the understanding of the distribution of these minerals among the various coal seams and the lateral distribution patterns of minerals within coal seams. There was also an attempt to establish the relationship between the mineralogy of the coal and the associated water quality. Good correlations were obtained between Neutralising Potential and CaO% and Acid producing Potential and S%. It is thus possible to use mineralogy to predict these factors. It should also be remembered that since these predictions do not take time and weathering rates into account, the predictions hold only for ideal situations. A significant amount of useful mineralogical information has been compiled during the course of this study.



Report No 1453/1/06 (Contractor: ERWAT)

Premise for the development of Volume 1 and 2 of the South African sludge guidelines

The first edition of the Guideline on the *Permissible Utilisation and Disposal of Sewage Sludge* was published in 1997. An Addendum to the 1997 Guideline document to clarify the interpretation and use of the Guidelines, was published in 2001. Simultaneous with this initiative, the WRC initiated a research programme to characterise South African wastewater sludge and to better understand sludge disposal practices, with a view to develop a local knowledge base and a better appreciation of the issues that could form the basis for a comprehensive revision of the 1997 Guidelines. At the completion of these investigations it was agreed that the second edition of the South African Sludge Guidelines would consist of a series of documents focusing on specific sludge management options. This project developed Guideline Volumes 1 and 2. Guideline Volumes 3, 4 and 5 are currently being developed as part of a solicited project. The development of the guidelines consisted of an assessment and review of the current legislation and international and local literature, which culminated in a technical background document that records the rationale and limits put forward in the guidelines (WRC Report No 1453/1/06). This was followed by consultation with the regulating authorities and key stakeholders about the acceptability of the proposed rationale and the limitations proposed for the guidelines and the drafting of the user-friendly Guideline Volumes 1 and 2 documents (WRC TT 261/06 and TT 262/06). It is anticipated that these Guidelines will usher in a new era of cooperation between Government and sludge producers to dispose of sludge in an environmentally acceptable and sustainable manner.

Report No 1350/1/06 (Contractor: Golder Associates Africa (Pty) Ltd)

An evaluation of the performance and effectiveness of improved soil cover designs to limit through-flow of water and ingress of air

Most of the rehabilitated coal discard dumps assessed during the study were found to exhibit erosion, indicating that the covers are becoming progressively thinner with time. Salinisation of the soil covers was also found, although confined to localised zones on most dumps. This indicates the need to design future covers with erosion prevention in mind, probably by means other than vegetation. Surface armouring is considered to provide an effective means of improving erosion resistance and enhancing the sustainability of slopes. Slope length was also an important determinant of erosion and should be considered in future designs. The importance of selecting soils with the appropriate characteristics in terms of moisture retention and volumetric stability has been illustrated by the research. Compaction has been shown to play an important role. The simulation of a range of cover configurations based on laboratory-derived parameters shows that a cover thickness of between 0.5 m and 1.0 m will be optimal for soils typically available in the region. The laboratory tests indicated that cracking of soil increases the amount of water that infiltrates into the soil cover. This conclusion is supported by intuition and by the experience of other researchers in the field of geotechnical engineering. It confirms the importance of selecting soils that are volumetrically stable and the role that compaction plays. The research supports the proposition that soils available in Mpumalanga may be used for store and release covers and that the results of the experimental work conducted at Kilbarchan in KwaZulu-Natal can be used to calibrate designs conducted for other soils types and climatic regions.

Report No 1057/1/04 (Contractor: CSIR)
Neutralisation of Acid Mine Water and Sludge Disposal

This project addressed several of the needs associated with active neutralisation of acid mine water. The research was primarily conducted through laboratory scale beaker and pilot studies, but full scale application of the findings are discussed as part of the report. The presence of iron in the reduced state is problematic during neutralisation of acid mine drainage (AMD) since iron precipitates can armour limestone particles and render them useless for neutralisation when iron is oxidised during the neutralisation process. Secondary acidity is produced upon oxidation of iron(II). This may happen even after the release of neutralised AMD into the environment. The project investigated the biological oxidation of iron in a plate reactor and a continuously operated submerged packed-column reactor. An integrated neutralisation process comprising a fluidised bed reactor for reacting limestone with AMD was used in various process configurations to determine reaction rates. The study showed that acid content, sulphate concentrations and aluminium content could be reduced while pH increased from 2.2 to 7. The conventional and High Density Sludge (HDS) processes are the most commonly used methods to treat AMD. The sludge generated by the HDS process contains high metal concentrations and are consequently classified as hazardous waste that need to be disposed of under special conditions. In short-term experiments the co-disposal of HDS-sludge and coal discard was found to be beneficial. This project contributed significantly to advance the introduction of limestone as a considerably cheaper replacement of lime for the neutralisation of AMD. It addressed the more pertinent issues in this regard and contributed to the fact that the limestone process is increasingly used in full-scale treatment facilities.

Reports can be ordered at orders@wrc.org.za