

# S4 waterbulletin

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## AGRICULTURAL WATER MANAGEMENT

Food plot production at irrigation schemes investigated

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## RIVERS RESEARCH

Researchers model abiotic-biotic links in the Sabie River

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## WATER & SANITATION

Researcher studies personal hygiene in Ivory Park

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# UNIVERSITY OF DURBAN-WESTVILLE

## Department of Civil Engineering

# MSc in Water and Environmental Management

The department has successfully been running an MSc degree course in *Water and Environmental Management* since 1995. The course content takes into account the multi-disciplinary nature of water and environmental management and has attracted **Civil and Chemical Engineering** graduates as well as **Honours graduates from Microbiology, Geography, Chemistry** and other related streams in the past.

### Course Contents

This programme consists of two segments. In the first six months of study, each candidate is required to undertake six courses, three of which must be core courses and other three electives.

- The core courses are: Environmental Impact Assessment; Environmental Pollution and Control; Economics, Environment and Sustainable Development; Unit Operations and Processes, and Water Resources Planning and Management.
- The elective courses are: Earth and the Environment, Ecological and Biological Principles and Processes, Advanced Transport Phenomena, Convective Dispersion Modelling, Advanced Hydrology, Industrial Water and Wastewater Management, Land Drainage and Coastal Defence, Project Management, Rural Sanitation and Epidemiology, Applied Statistics and Operation Research, Water Chemistry and Microbiology, Water Distribution and Wastewater Collection Systems, and Principles of Water Quality and Legislation.

The remaining six months is devoted to an individual research project, which must be written up as a dissertation and submitted for examination. **Please note:** Classes usually commence in **February**.

The research work undertaken in this programme have been well-received and yielded publications in referred journals and conference proceedings. Graduates from this programme have a high marketability. Almost all of them have been absorbed into various governmental, semi-governmental agencies and the private sector.

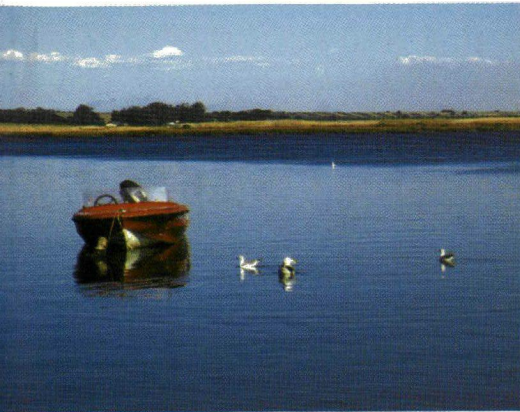
This programme has special provision for serving engineers/scientists/consultants who wish to join. After completing the course work, they may undertake individual research project at their own work-place/organisation under the joint supervision of an academic staff member from the department and another person from their organisation (if available).

Most of the candidates admitted to this programme were supported through bursaries awarded by National Research Foundation (formerly Foundation for Research Development). A limited number of tutorship/laboratory assistantships may also be awarded depending upon the need and merit of the individual candidates.

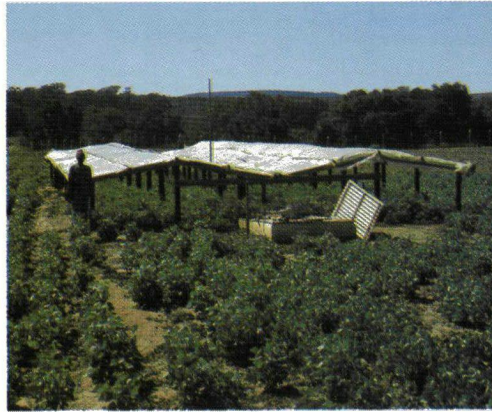
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Cover: *The Great Berg River estuary (see page 12). (Photo: Helene Joubert)*

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# IWA HONOURS TO SOUTH AFRICANS

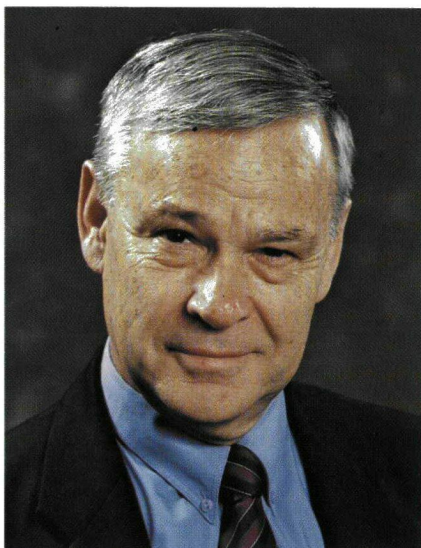
Two eminent South Africans on the waterfront, Messrs Piet Odendaal and Vincent Bath have been elected as co-presidents of the newly formed International Water Association (IWA). The Association resulting from a merger between the International Association on Water Quality (IAWQ) and the International Water Services Association (IWSA), was recently launched in Buenos Aires, Argentina. The IAWQ had been active in the field of wastewater management and water pollution control for some 35 years, while IWSA served the field of drinking water supply for more than 50 years.

However, the IWA as a major international professional association now represents stakeholders that are directly involved in all of the various facets of urban water management. Many internationally recognised authorities and leaders of the water and wastewater sectors in most countries of the world are counted amongst the members of the IWA. The Association has some 9000 members, including national, organisational and individual members in 130 countries.

Piet Odendaal, as president of the IAWQ, and Vincent Bath, as the incoming president of IWSA, have for the past three years played leading roles in effecting the merger of IAWQ and IWSA.

"The fact that both presidents are from South Africa, is an indication of the value the international water community places on the sterling research South African scientists have been doing over decades, as well as the status of our water services industry" says Mr Odendaal, also Executive Director for the Water Research Commission.

According to Mr Bath, Chief Executive Officer of Rand Water, the idea of man-



**Mr Piet Odendaal**



**Mr Vincent Bath**

aging the entire urban water cycle as a whole, is not a new one. Over the years there has been a gradual realisation of the need for a more integrated approach

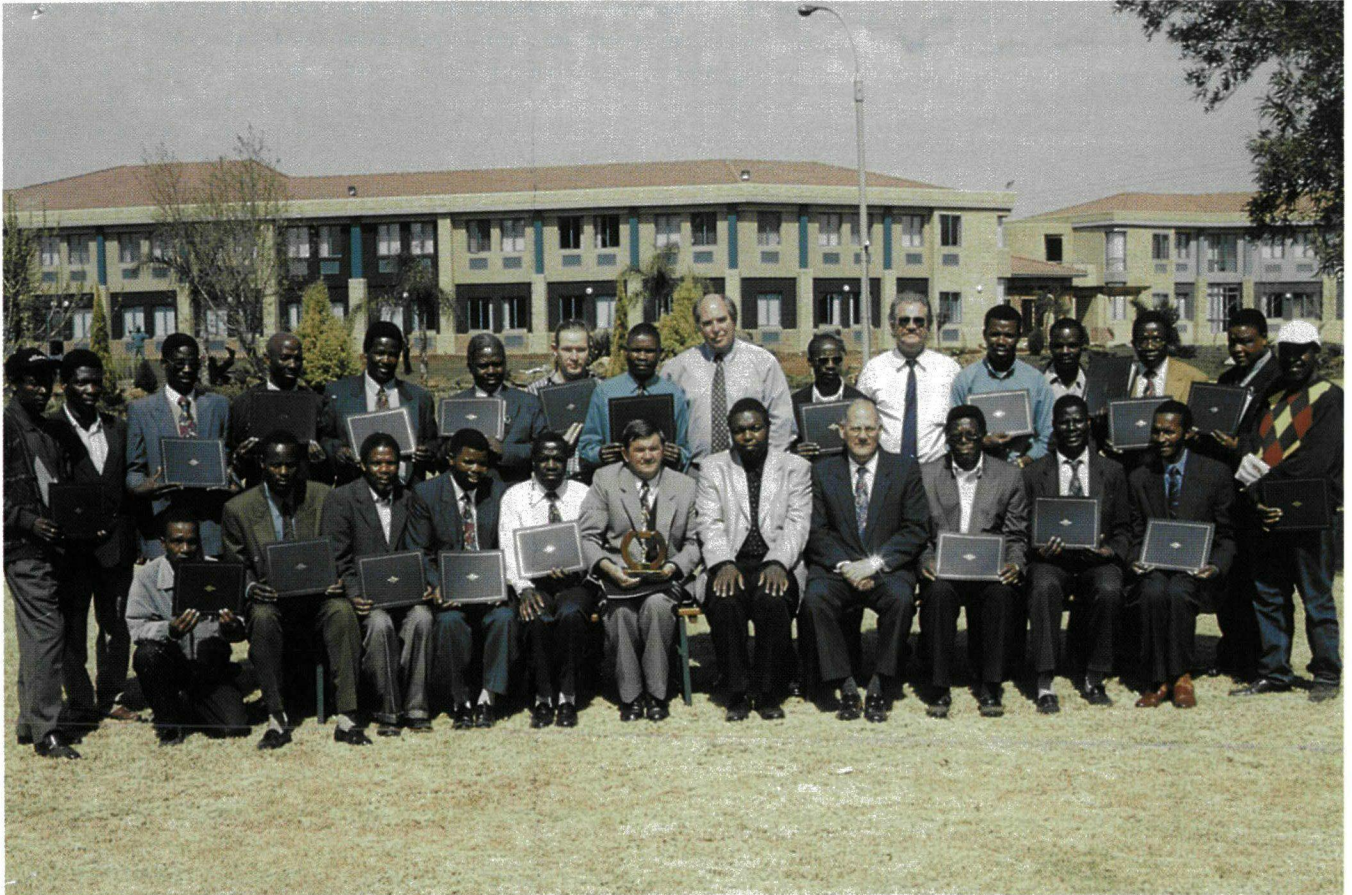
to urban water management. This realisation prompted the merger discussions.

As separate associations, both IAWQ and IWSA were at a disadvantage as they could only present either potable water or pollution and wastewater perspectives. The IWA is now able to credibly address issues in an integrated manner, and effectively contribute to debates concerning the international water scene.

The new association also has a declared policy of drawing on the collective expertise of its membership to assist developing countries. Mr Bath indicated that the association will be striving to work closely with water utilities in developing countries. "We want to be able to take leave, after a period of five to ten years, with the assurance that we are leaving behind viable utilities." Mr Bath added that a lot of money has been poured into projects in the developing world during the past 50 years. However, little attention has been paid to the long term management and maintenance of these projects in ensuing years.

Mr Odendaal said that the IWA will assist developing countries with regard to transfer expertise and technology transfer, by negotiating partnerships with bodies such as the World Health Organisation, the World Bank and various agencies of the United Nations. While these international agencies have political clout and financial resources, the IWA is able to draw on a formidable pool of knowledge and expertise through its members.

A special public fountain has been constructed in Buenos Aires to commemorate the launch of the International Water Association.



*ERWAT's Trainers with ERWAT's Water Care Operators proudly displaying their course certificates.*

# USA training course for water care operators

**T**he East Rand Water Care Company (ERWAT) has become the first company in South Africa to present an Operators Training Course of the USA Water Environment Federation's Technical Division (WEFTEC).

According to Mr Willie Rossouw, ERWAT's District Manager: Special Projects, who co-ordinated the training, the course covers every aspect of waste water treatment - from waste water sources to chlorination of the final effluent, as well as sludge treatment and safety aspects.

This prestigious course has specifically been developed for the training of water

care operators to ensure the efficient operation of waste water treatment plants. Altogether 27 ERWAT operators attended the eight-week course presented last year.

A practical examination was held during May 1999 to give the operators the opportunity to apply the theoretical knowledge acquired during the training course. These examination results were then submitted to WEFTEC for its approval.

At the award ceremony held on 20 August 1999, 26 proud students who passed their examinations and the practical side of the course, received certificates from ERWAT and WEFTEC. On

this occasion, ERWAT conveyed condolences to the family of Mr Jonathan Makwana who passed away during July 1999. Mr Makwana was posthumously congratulated on being the best student while Mr Andries Venter received the trophy as second best student.

WEFTEC's training course has attracted a great deal of interest locally, as there is a possibility that the course can be accredited. ERWAT, in conjunction with various technicians, is liaising with the South African Qualifications Authority to gain accreditation approval. In future, ERWAT will also train plant operators on behalf of other companies. Such a training course is currently being presented at Phalaborwa.

# New Minister and Board for WRC

**M**r Ronnie Kasrils is the new captain at the helm of the ship since being appointed as Minister of Water Affairs and Forestry by President Thabo Mbeki. The Water Research Commission (WRC), a statutory body, reports directly to the Minister, and it functions completely separate from the Department of Water Affairs. The mission of the WRC is to:

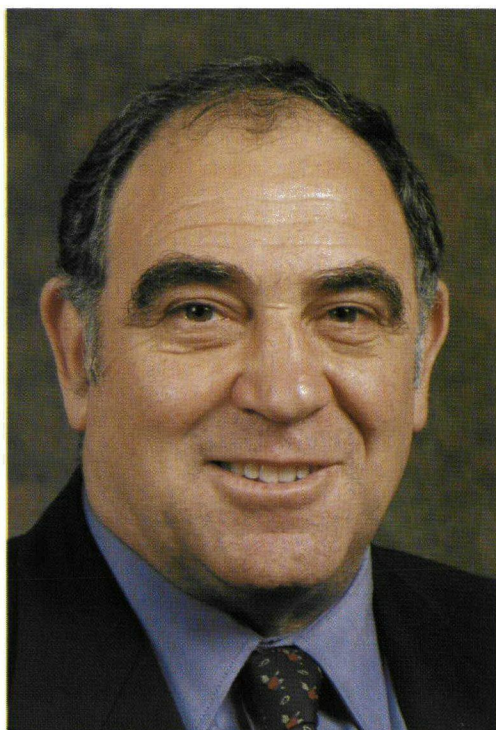
- promote co-ordination, communication and co-operation in the field of water research
- establish water research needs and priorities
- fund water research on a priority basis, and
- promote effective transfer of information and technology.

The new Board of the WRC has also been appointed, after the term of office of the previous Board had expired earlier this year. The Minister addressed the newly appointed Board of the WRC on the occasion of their first WRC Board meeting. Mr Kasrils pointed out that Science and technology are critical for transforming the South African society, as well as the region and the African continent as a whole and that South Africa with its high level of technology and proven management capacity must play a leadership role.

"In this the potential of the Water Research Commission is obvious. We are extremely fortunate in the water sector to have a stable and continuous source of research funding. This offers a mechanism for developing new knowledge and understanding, and has the potential to be a key factor in building the technical capacity we need in this sector."

"I believe that the WRC will continue to be a flagship of science and technology

in South Africa. I want water to continue to be a leading sector in the country within which the WRC can take a proud lead."



*Mr Ronnie Kasrils, the Minister of Water Affairs and Forestry.*

## NEW BOARD

The members of the new WRC Board as appointed by the Minister are as follows:

**Prof Kingston Nyamapfene** was appointed Chairman of the Board, he has been a member of the WRC Board during the past five years. Presently he is Deputy Vice-Chancellor (Academic) of the Vista University based in Pretoria. Prof Nyamapfene was Dean of Agriculture at Fort Hare University before joining Vista University. Prior to lecturing at Fort Hare, he had been lecturing in Zimbabwe for a number of years.

Presently he is also Professor Extraordinaire at the Post-graduate School of Agriculture and Rural Development at the University of Pretoria.

Professor Nyamapfene holds an MSc (Agronomy) from the Cornell University, USA, and received his PhD in Soil Science from the University of Aberdeen in the UK. In 1988 he was the recipient of the Senior Fulbright Research Fellowship at Purdue University, Indiana, USA. Apart from research work and lecturing he has served on a number of Boards and Committees, mostly related to education and agriculture. He has either studied or work in a number of countries, in Botswana, Lesotho, South Africa, Swaziland, Zimbabwe, Zambia and Tanzania, as well as Spain, the Netherlands and the USA. - and his linguistic ability has grown accordingly! In his free time professor Namapfene enjoys reading and walking in nature. He is an ardent jazz music lover.

**Dr Nombasa Tsengwa** was appointed as a Vice-Chairperson of the WRC Board. Presently she is mainly involved in the National Research and Foresight Project as a Co-ordinator, and she also lectures at the University of Pretoria. She holds a PhD in Agronomy from the University of Maryland, USA. She is a member of a number advisory groups as well as of professional associations. Currently she is also President of the Black Agricultural Association of South Africa (BAASA). In her free time she enjoys reading "especially inspirational writings", spending time with close friends and family, and also listening to good speakers.

**Prof Peter Tyson** was appointed Vice-Chairperson and has been a member of the WRC Board for a number of years.

Professor Tyson is well-known academic and an accomplished researcher in the field of climatology. Presently he is Director of the Climatology Research Group at the University of the Witwatersrand (Wits). He has held a number of positions at Wits since 1967, amongst others he has been Dean of the Faculty of Science, Deputy Vice-Chancellor, and also Vice-Principal (1988-1992).

Professor Tyson's particular teaching and research interests are meteorology and climatology. He is also often invited overseas as Guest Lecturer or Visiting Professor. He is a member of a number of scientific bodies (both national and international) and is actively involved in international research collaboration and joint research projects. He is the author of a number of books and scientific papers. In his spare time he enjoys a game of tennis and "do-it-yourself".

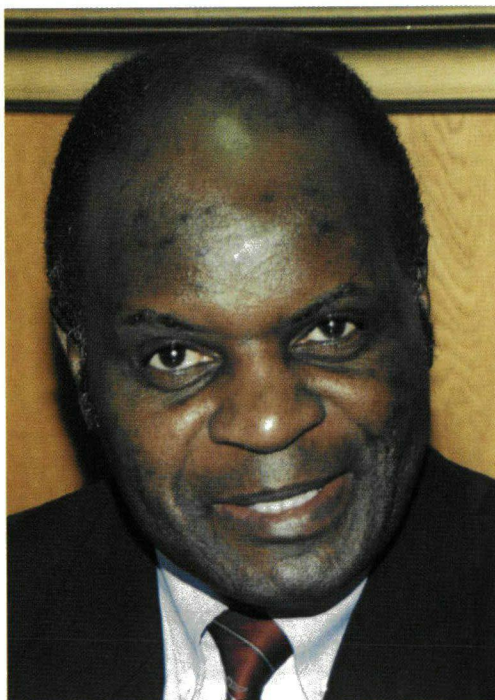
**Prof Colin Johnson**, has been a WRC Board member for several years and is the immediate past Chairman of the WRC Board. Presently he is Chief Executive Officer of the Agricultural Research Council (ARC). He is a keen botanist and thoroughly involved in science and education. Prof Johnson has held a number of academic posts at the Universities of Transkei and of the Western Cape.

**Ms Rowena Hay** is a well experienced hydrogeologist and sedimentologist, having worked on a number of varied projects in the course of her career. Presently she is with Umvoto Africa Water Resource Consultants. She is presently undertaking an investigation for a domestic waste disposal site at Plettenberg Bay, as well as investigating rural water supplies in the South West Cape amongst others. By her own admittance she is all work and very little play, but she does enjoy hiking, camping, gardening, fine literature and shopping!

**Dr Hamanth Kasan** has also been re-appointed as a member of the WRC Board. Currently he is General Manager: Scientific Services at Rand Water. His previous position was as Dean of the Faculty of Science and Director of the Center for Water and Wastewater Research at the Technikon of Natal. He holds a PhD in Environmental Microbiology as well as a Graduate Diploma of

Water and Environmental Engineering.

**Ms Meriam Molala**, a newly appointed WRC Board member, is qualified in social work and holds a diploma in personnel management as well. Presently she is a consultant (Matshipsana Consultants) and she concentrates on social research, community facilitation, capacity building, organisational development and gender issues. She is passionate about helping other people and making a difference.



*Prof Kingston Nyamapfene, Chairman of the Water Research Commission.*

**Dr Mishack Molohe** holds a BSc (Hons) in Geology, and a PhD in Soil Science (University of Stirling, Scotland). He has experience as a geologist, and also as a soil science researcher within an agricultural context. He has lectured for a number of years and became the Principal of the Taung Agricultural College before being appointed to his present position as Chief Director: Resource Conservation and Quality Control, at the Department of Agriculture.

**Mr Mike Muller** is the present Director-General of the Department of Water Affairs and Forestry. He has been involved with water supply and sanitation for many years, first in Mozambique and later in South Africa. He was a co-founder of Mvula Trust which was estab-

lished to promote new approaches to water supply and sanitation. He played a major role in preparing the White Paper on Water and Sanitation, and the National Water Policy for South Africa, as well as a new legislative framework for both water services and water resources.

**Mr Rodney Nay** is one of the newly appointed Board members. He qualified as a Professional Technologist (Engineering) and gained 20 years' extensive experience in a wide variety of civil engineering projects while working for a firm of Consulting Engineers. Presently he is Executive Officer: Wastewater at the Eastern Metropolitan Local Council (EMLC) of Greater Johannesburg. His philosophy is that a kite will rise against the wind, not with it.

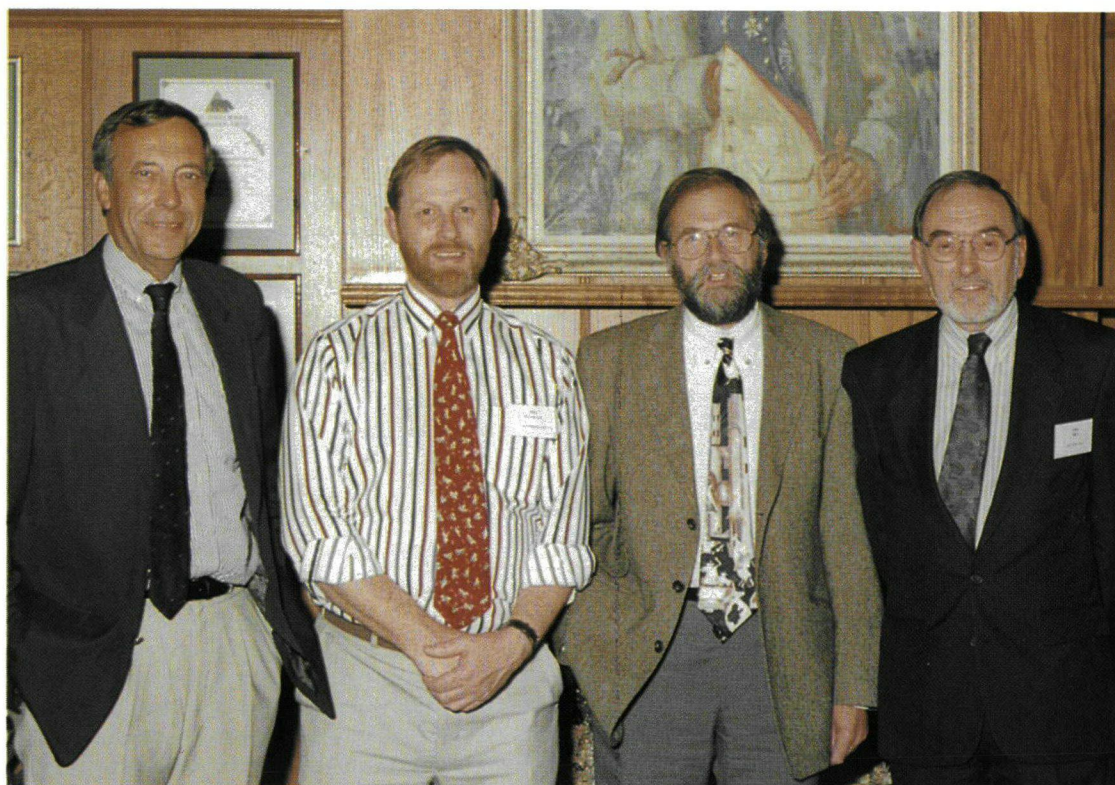
**Mr Moses Nene** is a new Board member with a wealth of experience as a health inspector and environmental health officer and is well versed in community water supply and sanitation. He has, amongst others, a Postgraduate Diploma in Public Health Engineering, and is currently doing an MBA part-time. He is the Chief Executive Officer of Nceduluntu Appropriate Technology Systems. He is an avid long-distance runner, and have completed the Comrades marathon five times.

**Mr Piet Odendaal**, the Chief Executive Officer of the Water Research Commission, is also the present president of the newly merged International Water Association.

**Dr Caroline Palmer**, is a Senior Research Officer at the Institute for Water Research (Rhodes University) specialising in aquatic toxicology, water quality management, water-related policy development and the ecology of riverine macro-invertebrates. She has recently been awarded the Silver Medal of the Southern African Society for Aquatic Scientists for "the exceptionally high standard of a particular contribution to the management and conservation of aquatic ecosystems and resources: in respect of the inclusion in South Africa's National Water Policy and National Water Act, of requirements for the protection of South Africa's water resources".

# AiEPS '99 SYMPOSIUM

## highlights clean technologies



The invited speakers from overseas attending AiEPS '99 were (from left to right): Professor Edward Schroeder (USA), and Professors Phil Crowcroft, Julian Wimpenny and Alan Bull, all from the UK.

The African International Environmental Protection Symposium (AiEPS '99) was held in Pietermaritzburg from 4 to 8 July 1999, to facilitate the transfer of knowledge and techniques for restoring the balance in the soil, water and air environments. The AiEPS '99 also incorporated the fourth Southern African Anaerobic Digestion Symposium.

Following the success of the first three Southern Africa Anaerobic Digestion Symposia (held at the University of the Orange Free State in 1986 and 1989 and the University of Natal in 1992) this fourth symposium was planned and expanded to cover the full spectrum of environmental protection. The symposium

attracted over 90 delegates, of which, 17 international delegates came from the USA, UK, Denmark, Portugal, Germany, Netherlands and India. Formal papers and discussions ranged from environmental legislation and guidelines to water treatment (aerobic and anaerobic) as well as other areas such as biological treatment of gasses and the possible impacts of landfilling operations and possible remediation and revegetation strategies. The bioremediation of contaminated soils was also, extensively covered.

The four invited speakers, Prof Alan Bull and Prof Julian Wimpenny and Phil Crowcroft all from the UK and Prof Edward Schroeder from the USA provid-

ed both informative and challenging addresses. For example, Prof Bull who chaired the Organisation for Economic Co-operation and Development (OECD) task force on Biotechnology and Industrial development, which culminated in the OECD report *Biotechnology for Clean Industrial Products and Processes: Towards Industrial Sustainability* pointed out that a paradigm shift has occurred in the last 10 years which is driving attention and action away from environmental remediation and towards the prevention of environmental degradation. Whereas waste production was seen as an inevitable outcome of industrial production and processing, and a problem that could be managed by end-of-pipe and *in situ* biotreatment, dispos-



al, or simply be ignored, the advent of clean, or cleaner technology options now focusses attention on the minimisation of materials and energy use, and waste generation, and upon recycle. Thus clean technology has emerged as a concept that is compatible with industrial sustainability, and whose environmental benefits and economic competitiveness have been demonstrated over a range of industrial sectors. Biotechnology is an enabling technology and it offers one important route to clean products and processes; it provides powerful and versatile tools which can compete with chemical and physical means of reducing both material and energy consumption, and the generation of wastes and emissions.

Many new and exciting industrial applications of this technology were demonstrated by a series of case studies. For

example, the Kaneka Corporation has developed an all-enzymatic process for amoxicillin production as an alternative to a part-chemical process; the new process alleviated the formation of by-products and colouring of the product, and led to improved energy efficiency.

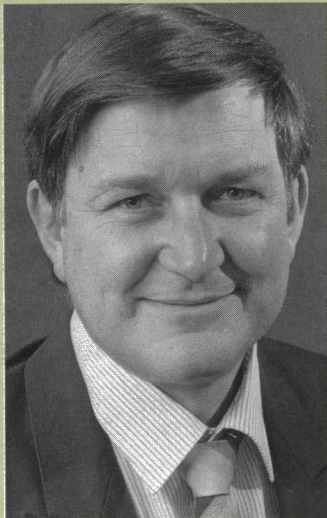
Prof Schroeder showed the phenomenal capabilities of biological remediation of contaminated industrial airstreams by biofilters. Biofilters are packed bed microbial reactors where the microbial cultures grow as biofilms on the packing surface. Because of the large air flow rates used in most biofilter applications, the systems are open and maintaining pure or designed cultures is impossible. Virtually any volatile compound amenable to liquid phase biological treatment can be removed from the vapour phase and biologically degraded in biofilters.

Examples include off-gas from paint spray booths, furniture manufacture and refinishing, baking, brewing, distilling and soil vapour extraction at remediation sites. The most impressive feature of biofiltration is the extent of treatment obtainable. Typical outlet contaminant concentrations of degradable contaminants are in the sub-50 ppbv range.

Following the completion of the formal papers and presentations the symposium was closed with a post-conference workshop on the production of anaerobic digester granules, chaired by the symposium chairman, Prof TJ Britz.

This fourth meeting is, hopefully, the first of a new series of symposia and the organising committee, look forward to seeing you at the next African International Environmental Protection symposium.

## Elected to ICWQ



Dr Peter Ashton

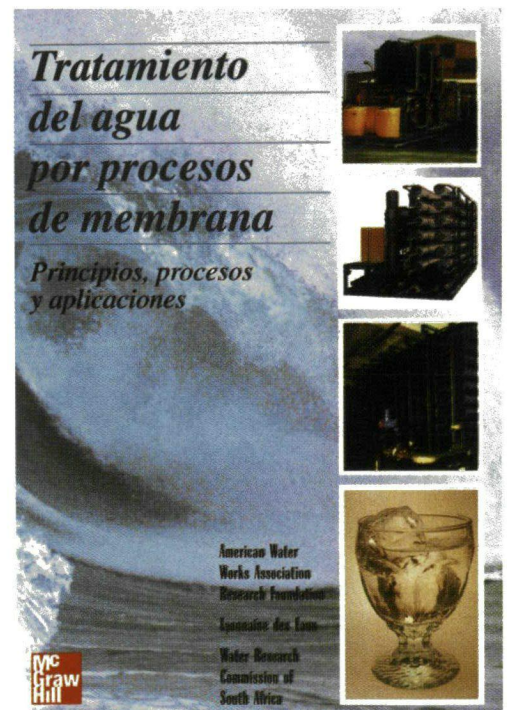
Dr Peter Ashton, of the Division of Water Technology at the CSIR, has been elected Vice-President of the International Commission of Water Quality (ICWQ) of the International Association of Hydrological Scientists (IAHS) during the ICWQ plenary session at the recent General Assembly of the International Union of Geodesy and Geophysics (IUGG).

# SA water researchers now speak in Spanish

An authoritative publication on water treatment membrane processes jointly sponsored by the American Water Works Association Research Foundation, the South African Water Research Commission and the French company Lyonnaise des Eaux has been translated into Spanish, making the information accessible to a larger international audience.

South African contributors to the book include Professor Chris Buckley, Mr Quentin Hurt and Susan Wadley from the University of Natal, Professor Ron Sanderson and Dr Ed Jacobs from the University of Stellenbosch and Mr Piet Odendaal, Executive Director of the Water Research Commission.

The publisher is McGraw-Hill Inc.



# Managing nonpoint source pollution in South Africa



The Water Research Commission (WRC) recently published a report reflecting the contributions made by researchers from Sigma Beta Consulting Engineers to ensure that mechanisms which can be used to manage nonpoint source pollution, are incorporated into the National Water Act. The researchers, GC Pegram, AHM Görgens and GE Quibell, with this report provides a scientific basis on which to base nonpoint source pollution control, and also proposes practical procedures to implement these in a cost-effective and legally sound basis.

Up to fairly recently the efforts to protect the quality of South Africa's water resources were concentrated mainly on the control of effluents from point sources. Despite these efforts an apparent deterioration in the water quality of the country's surface waters is being observed. It transpires that in many catchments there are zones where nonpoint (diffuse) source contributions are significant or even dominant. This changing perspective occurs against the background of international recognition of the inherent potential of nonpoint source pollution to become a severe management, political, institutional and fiscal problem.

An obstacle for rapid progress with current research in this field appears to be the lack of a conceptual framework which can link together factors such as process understanding, quantification approaches, management needs and options as well as decision support tools, such as simulation models. Consequently, despite employing state-of-the-art remote sensing and GIS technologies to quantify spatial data related to nonpoint source areas, certain projects might not fulfil their potential as a result of inappropriate linkages with decision-support procedures that are meaningful to the water resources management and planning environment.

Furthermore, consultants and researchers participating in water quality management studies make use of diverse analysis, predictive and simulation techniques. There is a distinct need to systematically document the preferred and more successful analysis and predictive methods, to integrate individual insights and findings, and to develop an updateable set of estimates of non-point loadings of selected water quality variables in heavily impacted basins.

## RESULTS

As part of the South African Water Law Review process, a number of task teams were established within the Department of Water Affairs and Forestry to address key policy issues. One of the teams was requested by the Department to provide nonpoint source input to the Source-Directed Management component of the Water Environmental Quality Policy Task Team. This WRC report represents the resulting recommendations, together with relevant background information and arguments.

Key recommendations of the report were incorporated into the National Water Act. In this process the relevant background information and arguments were not necessarily recorded and may easily be lost for future reference. The Steering Committee for the project deemed it advisable to have this background information and rationale behind the recommendations recorded for future students of water law and the practitioners who have to apply the Act.

### Policy Considerations for Nonpoint Source Management in South Africa

GC Pegram • AHM Görgens • GE Quibell

Report to the Water Research Commission  
by  
Sigma Beta Consulting Engineers

WRC Report No 696/1/98



The key recommendations which were made for the Water Law Review process and which are reflected in the report, are the following:

- Pollution is defined as the introduction of substances or energy to the water environment at levels which have an unacceptable impact on the water environment or its users.
- All potential sources of pollution are classified as infrequent incident, point or nonpoint sources.
- A source-directed approach is required for nonpoint source management, focussing on the production of waste water and the process of delivery, before it enters the receiving water environment.
- Classification of nonpoint sources should be based on source type (land use activity), with cutoff levels reflecting the potential impact on the receiving water environment. Nonpoint source regulations should be defined according to these classes.
- Nonpoint source regulation should require the implementation of Best Management Practices (BMPs) associated with listed (classified) nonpoint source types.
- The possibility for restricting critical activities in some catchments, possibly through an impact assessment process, should be explored.
- Application of discharge standards to collected washoff from listed nonpoint sources should be regulated through point source administration.
- The possibility for using charges, taxes, subsidies, incentives or tradeable permits for nonpoint source management should be investigated further, and the enabling legislative framework should be provided.
- Participatory approaches should be encouraged through information sharing and enabling the adoption of voluntary actions in less sensitive situations, but providing for appropriate administration for auditing.
- National regulations (eg. restrictions, BMPs and/or discharge standards) should be provided for different nonpoint source classes and possibly receiving environments reflecting acceptable risk, but with the option of catchment specific regulations as part of catchment management plans.
- Registration of all listed nonpoint sources should take place, with associated regulations.
- Permitting should only be required for nonpoint sources which cannot comply with the specific regulations.
- Prosecution should be based on violation of registration or permit requirements.
- Information disclosure should take place on nonpoint source registration, permitting and auditing.
- Nonpoint source assessment should play an important role in development and implementation of regulations for nonpoint source management.

Copies of the complete final report entitled **Policy Considerations for Nonpoint Source Management in South Africa** - as input to the water law review process (WRC report 696/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. E-mail: library@wrc.org.za. (Overseas price: US\$ 20, via surface mail).

# Modelling the water quality of South African estuaries

Modelling the effect of changes in the quantity and quality of freshwater inflows to estuaries is essential in the determination of their freshwater requirements and their ability to sustainably receive waste inputs.

At present only two estuarine water quality models are available for application in South Africa, viz. the Mike 11 Water Quality Model and the Water Quality Systems Model. Although the water quality model Mike 11 has been applied to many European estuaries, it has not been applied to, or tested on any South African estuaries, which may exhibit different behavioural responses and so require different parameter ranges or even different modelling approaches. The Water Research Commission therefore contracted researchers from the Division of Water, Environment and Forestry Technology at the CSIR to undertake a two-year research project on the modelling of estuarine water quality with the following objectives:

- To investigate the utility of the Mike 11 Water Quality Model in addressing defined problems by applying the model to three selected estuaries.
- To critically assess the performance of Mike 11 and establish whether other internationally available models are better suited, or could contribute, to resolving the defined water quality problems in South African estuaries.

- To recommend a strategy to develop water quality modelling of estuaries in South Africa.



## Water Quality Modelling of Estuaries

JH Slinger • S Taljaard • M Rossouw • P Huizinga

Report to the Water Research Commission  
by the  
Division of Water, Environment & Forestry Technology,  
CSIR

WRC Report No 664/1/98



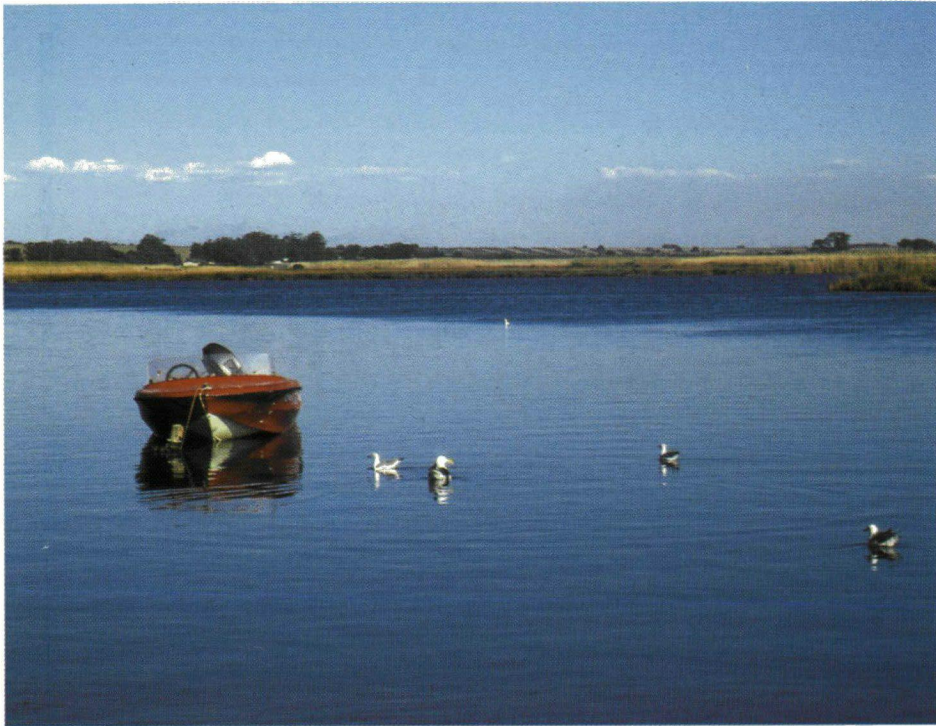
## RESULTS

A final report compiled by the researchers, JH Slinger, S Taljaard, M Rossouw and P Huizinga, states that the performance of the water quality model Mike 11 in addressing water quality issues was examined using the Great Berg and the Swartkops estuaries as case studies. Both systems are relatively long and narrow with permanently

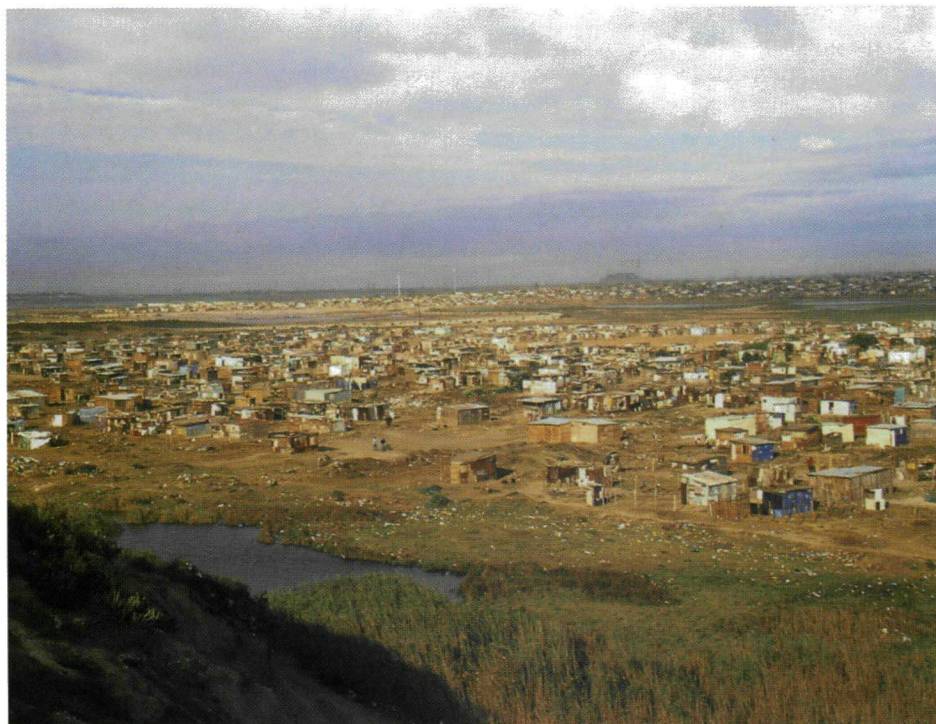
open mouths which suit the one-dimensional modelling approach. In addition, there are more data on these two than is the case for most South African estuaries. Mike 11 was tested against both high flow and low flow conditions for both rivers. By and large, the model showed good correlation between the measured and simulated values for temperature and dissolved oxygen, even to predicting the generally low dissolved oxygen levels in the Upper Berg Estuary in summer, although the high variability of the dissolved oxygen nearer the mouth was underestimated. The reason for this was that either the limited data on the seaward end of the estuary, or the fact that the transport-dispersion and water quality modules are decoupled in Mike 11. The researchers say more information is needed before this can be adequately resolved.

A factor identified as more important in South African estuaries than those of the Northern Hemisphere was the sediment oxygen demand. It is postulated that this results from the longer residence time of water in the estuary, due to the combination of a relatively long estuary and low freshwater inflow during summer. The model had to be calibrated for this.

Nutrients such as soluble reactive phosphorous and silicate-Si levels were strongly correlated to salinity, but this was not the case with total dissolved nitrogen. Total dissolved nitrogen did not



*Berg River Estuary: Estuaries are naturally prolific and diverse ecosystems with a rich fish and bird life, and are also in high demand for recreation purposes.*



*Rapid urbanisation of the floodplain adjacent to the Swartkops River Estuary: Urban runoff is a major concern in the water quality management of estuaries.*

correlate to any of the parameters measured or modelled.

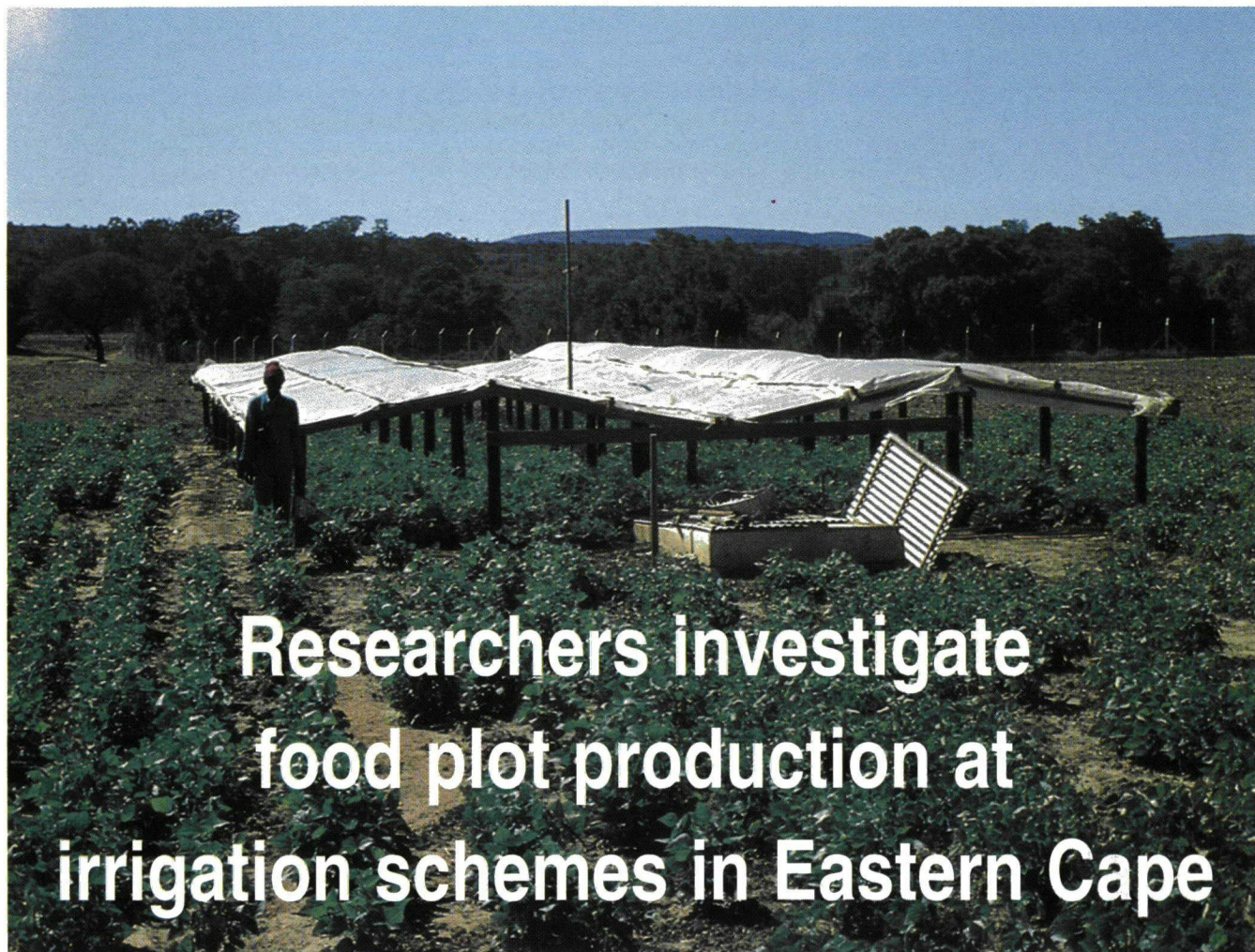
The cause of the low levels of dissolved oxygen in the upper estuary need further investigation. They may be a natural result of high temperature and low flow, but may just as easily be the result of the heavy infestations of water hyacinth in the lower reaches of both rivers.

The 'Black Tide' which occurred in St. Helena Bay during March 1994 was also modelled, and although the scientific information on the early stages of the tide was poor, the simulation indicated that low dissolved oxygen levels prevailed in the lower estuary for six to seven days, but did not extend as far as 10km up the estuary. This indicated that the higher salinity of the middle estuary would serve as a refuge to organisms mobile enough to get this far up the estuary. This use of the Mike 11 model is an application of linking water quality to the prediction of biological responses.

The application of Mike 11 to case studies showed the model's need for good data. This means that any monitoring programme needs to be designed with this in mind. The link between river and estuary monitoring also needs to be established so that any long term response noted in the estuary may be linked to events in the river and catchment.

Limitations are currently seen in the poor ability of Mike 11 to predict bacterial contamination and the inability of the model to simulate dissolved nutrient distributions under all conditions.

Copies of the report entitled **Water Quality Modelling of Estuaries** (WRC report 664/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 25, via surface mail).



## Researchers investigate food plot production at irrigation schemes in Eastern Cape

Internationally irrigated agriculture is today still recommended as an appropriate way of addressing rural poverty and unemployment in areas where sustained rainfed production of crops is limited by water deficits. Moreover, providing households of developing rural communities with access to small parcels of irrigated land (or food plots) is also a practical way of implementing a land reform policy. One of the main apparent advantages of the food plot scheme model is that relatively small areas of land can be of benefit to a large number of households. This enables the distribution of the capital expense incurred in the development of an irrigation scheme over a substantial group of beneficiaries.

In South Africa this is especially true for situations similar to that found in the Eastern Cape Province where climatological conditions are not ideal for rainfed cropping.

According to a report published by the Water Research Commission small

scale irrigation enterprises in Ciskei are generally favoured by relatively reliable and adequate irrigation water supply to meet crop water demands. Approximately 58 per cent of the potentially irrigable land in Ciskei is currently in production and of the remaining 42 per cent, half consists of unused land in existing schemes and the other half still needs to be developed from the start. The potential is therefore there to expand the area under irrigation, thereby addressing the problem of rural poverty through broader access to such land. Using the current 0.2 ha per household as a guideline, it is estimated that the existing six medium sized irrigation schemes in Ciskei can provide a livelihood for approximately an additional 17 000 households if the unused areas on these schemes are developed.

However, according to the report it is very important that the development of additional irrigated areas is planned appropriately, thereby ensuring their economic and social viability. Only if the

expansion of these schemes is such that they eventually become regional assets providing real and economically sustainable benefits, can additional financial investment and increased water use be justified.

Against this background the Water Research Commission sponsored researchers at the University of Fort Hare's Faculty of Agriculture and Rural Development Research Institute to carry out an investigation with the following objectives:

- To determine the physical, infrastructural, economical, institutional and social factors which contribute to successful food plot production on Ciskeian irrigation schemes.
- To analyse these factors in order to identify potential practical applications of these to irrigation scheme planning.
- To formulate guidelines for irrigated food plot policy.

## RESULTS

In their final report to the Water Research Commission the researchers, W van Averbek, CK M'Marete, CO Igodan and A Belete, say that during the 1970s and 1980s a number of irrigation schemes were developed in the central Eastern Cape. Most of these schemes involved fairly sophisticated technology and were designed to consist of two components, namely a social and an economic component. All of these schemes were meant to be managed centrally. The economic component, which was to be the locomotive of the scheme, was designed to be farmed as an estate by labour supervised by external managers. The social component consisted of an area of land - usually less than 25 per cent of total scheme area - under small food plots, which ranged between 0,16 ha and 0,25 ha in size, on which land right holders could produce crops mainly for subsistence purposes.

Food plot sections were introduced into irrigation scheme design primarily to compensate land right holders for making available their land for the development of the scheme. Yet, food plots have been one of the relatively successful aspects of irrigation scheme development in central Eastern Cape. Food plot developments offer a high degree of equity. This makes them attractive under conditions where land earmarked for irrigation is held under communal tenure or a modification thereof. However, there was a need to strengthen the security by which food plots are held. This could be achieved by addressing limitations in the breadth, duration and assurance of the rights plot holders have over their plots.

Incorporating six different schemes with plot sizes ranging between 0,16 ha and 2,0 ha, the results of the study suggested that an increase in the size of land holdings tended to be accompanied by a shift in the production objectives of farmers from subsistence to market oriented production, and a concomitant increase in the proportional contribution of agriculture to household income. This shift was found to expose farmers to a number of new challenges, of which production practices, marketing and financial management were the most important. The shift was also found to create new demands in terms of scheme organisation and supply of support services.

Factors such as ready access to inputs, good quality land preparation, a reliable water supply and expert extension co-determine successful small scale irrigated cropping. Well organised farmers' organisations were found to be able to handle many of these new challenges, and their development needs to be encouraged and supported.

By failing to allow for progression of farmers from subsistence to market oriented production, the design of food plot schemes caused farmers to be trapped at subsistence levels. For progression to occur at these schemes suitable institutional reforms with respect to land tenure would need to be developed and adopted by land right holders.



### An Investigation into Food Plot Production at Irrigation Schemes in Central Eastern Cape

W van Averbek • CK M'Marete  
CO Igodan • A Belete

Report to the Water Research Commission  
by the  
Faculty of Agriculture and  
Agricultural and Rural Development Research Institute  
(ARDRI)  
University of Fort Hare

WRC Report No 719/1/98



Whereas food plot schemes appeared to be a suitable model of introducing irrigation on land held under communal tenure, it is not recommended for settlement schemes. The size of standard food plots (0,25 ha or less) is just too small to make irrigated agriculture a viable livelihood option. From the study it appeared that a minimum plot size of 2 ha is required in order for agriculture to become the main source of income for farming households.

### FARMER SELECTION

The researchers say on settlement schemes farmer selection is of major importance. The experience at one of the irrigation schemes showed that a system of voluntary entry and exit,

whereby participation in the scheme demands farmers to make regular financial contributions towards the cost of water supply and its maintenance, had the desired results without causing undue social conflict. The success of this self-regulating system of farmer selection appeared to be heavily reliant on the presence of experienced farmer trainers and a good overall support system at the scheme.

Generally, timely access to good quality land preparation services and to a ready supply of irrigation water were the two most important factors determining success in food plot production. At present, water supply is subsidized at all six schemes. At the two schemes with large plots, farmers contributed meaningfully towards the cost of in-scheme water supply and its maintenance, but not to the cost of water itself. At the four schemes with standard food plots, farmers did not pay at all towards this service.

Considering the economics of irrigated crop production on schemes with standard food plots, and the prevalence of poverty amongst plot holding households, it is unlikely that farmers could contribute anything more than a token fee at this stage. The researchers, therefore, recommend that state subsidisation of water, its supply and its maintenance is continued and is considered as being a social welfare service. It may be desirable to introduce a system of payment for water. This might be in the form of water vouchers. It is important that farmers are introduced to the idea that water is a scarce resource and needs to be paid for. Plot holders could be required to purchase water vouchers annually for a small fee. Such a system would make water rights transferable. However, the cost of implementing the required administrative and monitoring system may prove prohibitive, adding further to the overall cost of providing irrigation water, without much hope for higher levels of recovery in future.

Copies of the report entitled **An Investigation into Food Plot Production at Irrigation Schemes in Central Eastern Cape** (WRC Report 719/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$25, via surface mail).

# Researchers model abiotic-biotic links in the Sabie River

The Water Research Commission has published the results of a project in which researchers drew the abiotic and biotic information and knowledge, generated by the Kruger National Park Rivers Research Programme, together into a suite of models which will enable resource managers and water scientists to predict the responses of riverine biota to geomorphological and hydrological changes in the Sabie River; and to use the synthesised information to launch an implementation phase of the Kruger Park Rivers Research Programme. The project was carried out by researchers from the Department of Civil Engineering at the University of Stellenbosch, the Centre for Water in the Environment at the University of the Witwatersrand, Johannesburg, the Institute for Water Research (IWR) at Rhodes University in Grahamstown and the Computing Centre for Water Research (CCWR) at the University of Natal in Pietermaritzburg. The project leaders were

J O'Keeffe, AHM Görgens and K Rogers.

During the course of the project several innovative methods and techniques were explored, including the use of qualitative models to simulate geomorphology, fish and riparian vegetation; development of new techniques for relating fish habitat to river channel morphology; develop-

ment of a geomorphology-based riparian vegetation model; the use of recent computing advances to aid the transfer of data and information and the visualisation of model results.

The final product of this project is a suite of models which consists of a hydrological model and three qualitative rule-based models to describe the geomorphic function, fish response and riparian vegetation response of

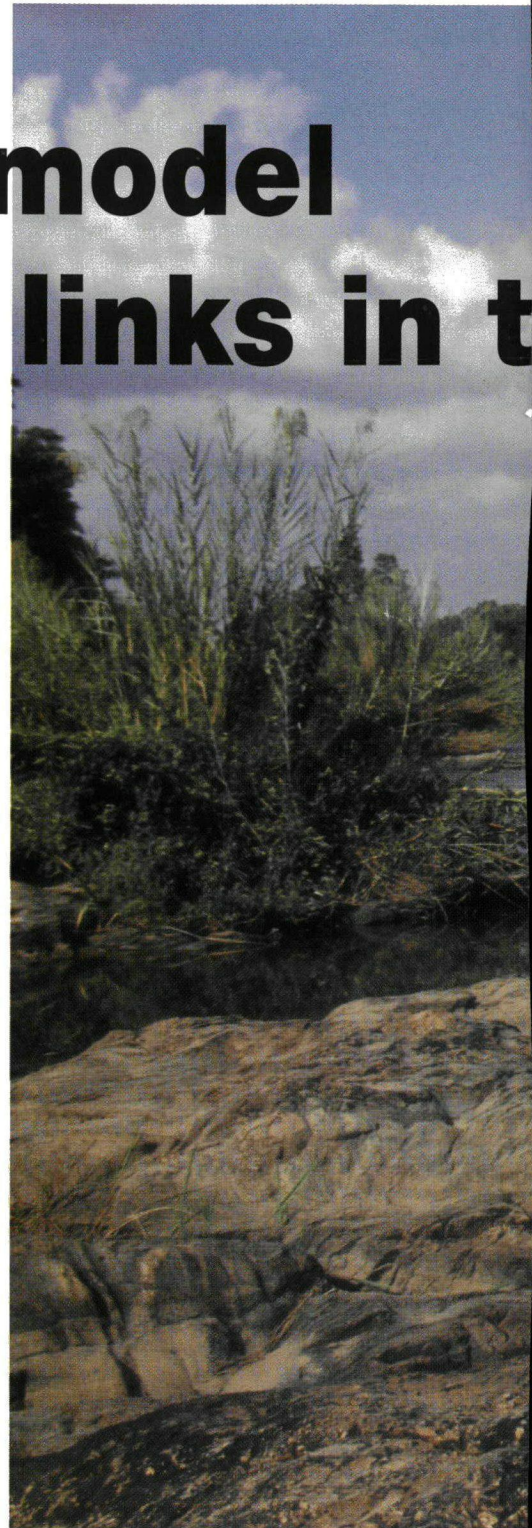
the Sabie River. The ACRU agrohydrological system is used to simulate catchment hydrological processes in order to provide daily streamflow and sediment yield information to the models.

## Modelling Abiotic-Biotic Links in the Sabie River

GPW Jewitt • GL Heritage • DC Weeks  
JA Mackenzie • A van Niekerk • AHM Görgens  
J O'Keeffe • K Rogers • M Horn

Report to the Water Research Commission  
by the  
Institute for Water Research  
Rhodes University

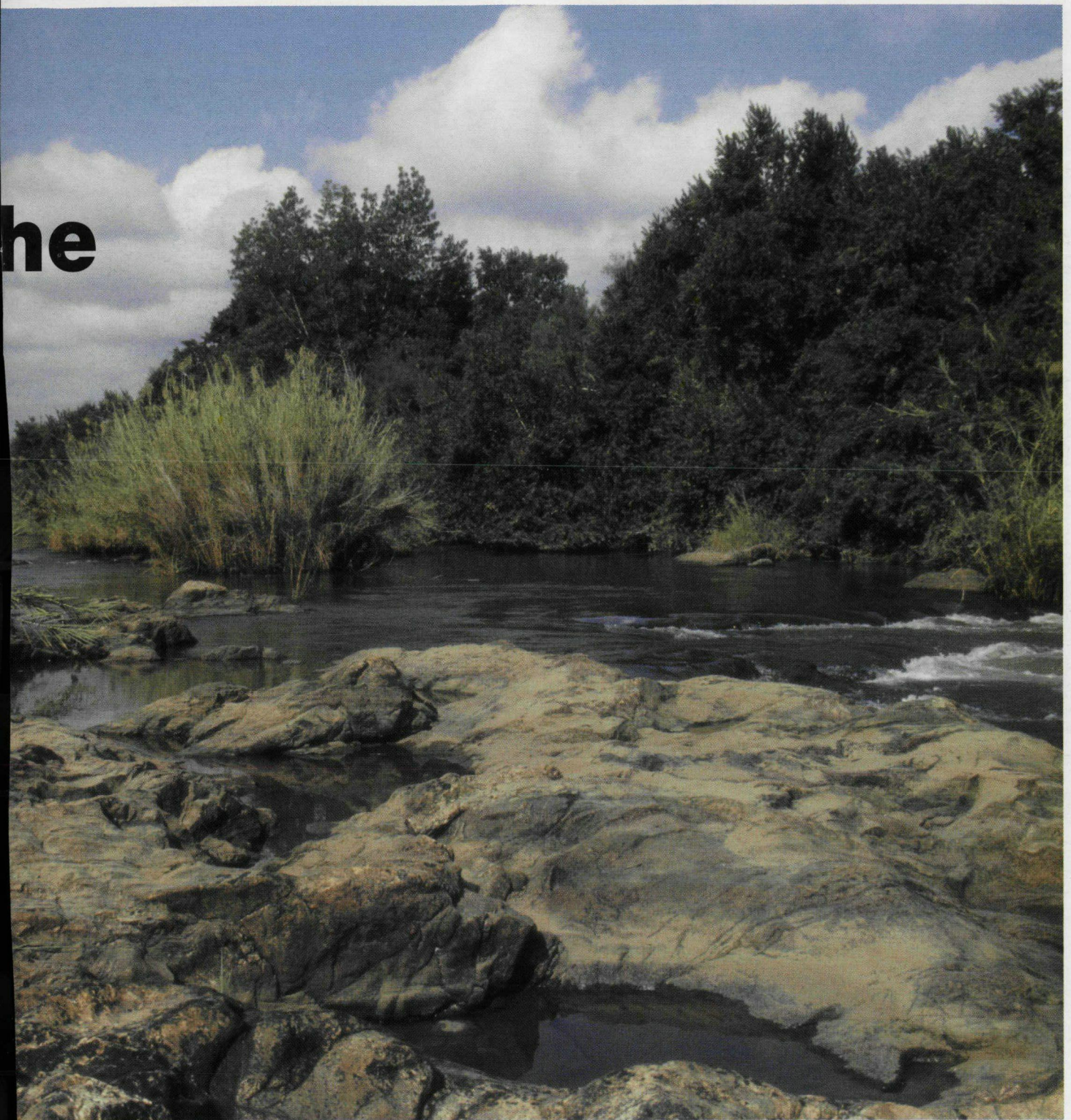
WRC Report No 777/1/98



## MODELS

- **Geomorphological model** - The geomorphological model has a baseline geomorphological template consisting of the distribution of channel types along the Sabie River, and these are used as the basis on which





to route sediment inputs from the subcatchments. Internally, the changing sediment balance within each channel type causes a change in the geomorphological composition at the scale of morphologic unit, and these are simulated with rules developed by geomorphologists with detailed

knowledge of the Sabie River.

- **Fish model** - As far as the fish model is concerned, a rule-based approach is used to predict the response of specific fish groups, characteristic of the shallow Lowveld sections of the Sabie-Sand River system, to varying

flow conditions in the catchment and potential changes in the channel type of the representative reach at which it operates. The changing patterns of abundance established for these species, both for normal and extreme seasonal conditions, form the basis of the predictive model. To facilitate



*An abundance of Phragmites reeds at a point along the Sabie River.*



*The dry river bed showing the increasing sedimentation. Note the riparian vegetation.*

interpretation, the eleven shallow-water fish species important in the Lowveld are, where possible, grouped according to shared lifestyles largely based on their taxonomic and life-history traits. A habitat-suitability index, to allow for the incorporation of information relating a change in fish habitat depending

upon geomorphic change, has been developed for inclusion in the model.

- **Vegetation model** - The riparian vegetation model is a qualitative rule-based model which predicts riparian vegetation response to geomorphic change, in response to an altered hydrological regime. Vegetation dis-

tribution patterns and the relationship of these patterns with fluvial geomorphology formed the background to the definition of rules that govern vegetation response in the model. Five functional groupings of geomorphological units, grouped according to their functionality in terms of their ability to support vegetation, are the model inputs. Model outputs are five geomorphic states which were defined for each functional grouping of geomorphological units. Six vegetation types were selected as response units for the model. Vegetation states, defined for each of the vegetation types, are predicted according to geomorphic states of each functional group of geomorphological units.

## **SIMULATION RESULTS**

The suite of models was used to simulate the effects of various flow scenarios in the Sabie River. The results from scenarios where the models were used to simulate the effects of the construction of a large dam on the Sabie, reflect the overriding response of the fish to seasonal hydrological conditions. The geomorphic response is one of increasing sedimentation. The riparian vegetation response is a slow increase in the abundance of the phragmites vegetation type. As expected, the riparian vegetation response is the least dynamic of all those simulated.

According to the report some of the rules developed and used may be applicable to areas outside of the Lowveld regions of the Kruger National Park, however, much testing would be necessary to establish this. Far more transferable than the rules and models developed, is the modelling methodology and expertise. The development of qualitative models using rules to represent the assumptions made by experts in their fields, seems to hold great promise in other areas where a link between biotic responses to abiotic components of a catchment is a requirement.

Copies of the final report titled **Modelling Abiotic-biotic Links in the Sabie River** (WRC Report 777/1/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 30, via surface mail).

## *Ninth South African National Hydrology Symposium*

# “Hydrology and Water Resources in Southern Africa”

29 - 30 November 1999

University of the Western Cape, Cape Town

Organised for SANCIAHS and SAICE Water Division by Department of Civil Engineering,  
University of Stellenbosch and Department of Earth Sciences, University of the Western Cape

### *Objectives*

The aim of this symposium is to support integrated water resource management (IWRM) in the Southern African region by providing a forum for hydrologists, water resources engineers, aquatic scientists, and catchment managers from the region to:

- report on findings from both fundamental and applied studies related to IWRM and catchment management;
- promote understanding of technical and scientific issues surrounding implementation of the new National Water Act of South Africa (Act 36 of 1998);
- share general research results, or work-in-progress, in the hydrological and aquatic sciences.

### *Symposium Format*

- The two-day Symposium will consist of oral presentations during plenary sessions each morning and during parallel sessions each afternoon. Parallel sessions will deal with defined topics. Adequate time will be allowed in all sessions for discussion. The emphasis will be on feed-back to the presenters. A key-note address related to the Symposium objectives will initiate each day's plenary session.

Some 45 papers have been provisionally approved for the Symposium, organised into sessions under the following topics: Integrated Water Resources Management (IWRM), Implementation of the National Water Act; Impact Studies Relevant to IWRM, Decision Support in IWRM; Environmental Water Requirements; Remote Sensing and Forecasting; Catchment Hydrology; Groundwater Management.

- So far, five poster presentations have been confirmed, but applications for more poster presentations are invited. Special arrangements for viewing and discussions surrounding posters will be included in the programme.
- Exhibitions of books, software and equipment will be present. Organisations still wishing to exhibit books, software or equipment, or to advertise, should contact the organisers without delay.
- Each delegate will be provided with a bound paper copy of the Proceedings. The Proceedings will also be lodged on a Web page.
- The Symposium will be preceded by a “meet, greet, eat and register” opportunity on the evening of 28 November 1999. The traditional SANCIAHS Dinner will take place on the evening of 29 November 1999. A special after-dinner speaker has been arranged for the occasion.

### *Fees & Accommodation*

The registration fee is R790. This fee includes the cost of teas/coffees, lunches, the “meet, greet, eat and register”, the Dinner and a bound volume of Proceedings, but excludes accommodation. Full-time students may register for R400, but will not receive the Proceedings, or participate in the Dinner.

Delegates must please make their own accommodation arrangements. University residence accommodation will not be available.

- For Hotel or Guesthouse accommodation, please contact:**  
Marina van Rensburg at Maties Travel, Bellville,  
Tel: (021) 99-6903  
Fax: (021) 99-7373, or  
E-mail: [marinavr.maties@galileosa.co.za](mailto:marinavr.maties@galileosa.co.za)

### *Registration & Payment details*

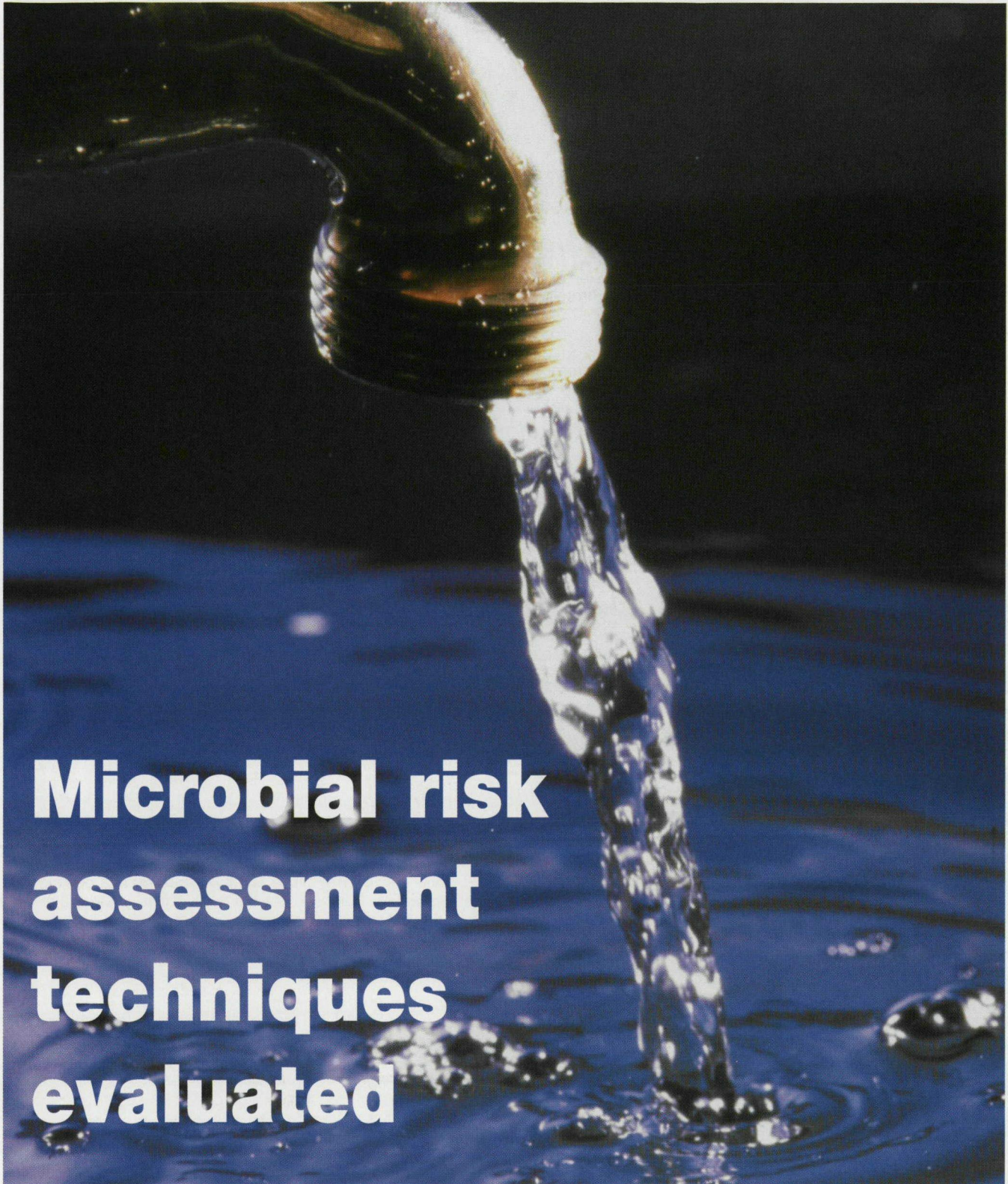
For registration please submit details by letter, fax or e-mail to:

- Ms Julie Haarhoff  
Department of Civil Engineering • University of Stellenbosch  
Private bag X1 • Matieland • 7602  
Tel: 021-8082100 (mornings only) • Fax: 021- 8084351  
E-Mail: [jhaarhof@ing.sun.ac.za](mailto:jhaarhof@ing.sun.ac.za)  
(Enquiries: Prof André Görgens: Tel: 021- 8084356)

Payment must be by crossed cheque, made out to SANCIAHS.

Payments made before 1 November 1999 will receive a discount of R40.





# Microbial risk assessment techniques evaluated

**A** study aimed at investigating the usefulness of microbial risk assessment techniques in the South African context has shown that these techniques could be very useful in the description of microbial water quality impacts as well as in the development of guidelines for the future.

Researchers from the Division of Water, Environment and Forestry Technology at the CSIR - B Genthe and N Rodda - say in their report to the Water Research Commission that the task of formulating water quality criteria and guidelines for the protection of public health has always been complicated by the difficul-

ties of relating levels of micro-organisms in water to health effects in the exposed population.

"Epidemiological studies are often not available, or are lacking in the necessary quantification. Risk assessment aims to provide a quantitative estimate

of the probability of illness associated with environmental exposure to hazardous substances, including infectious agents. It therefore holds potential as a useful tool for formulating water quality guidelines or standards for the protection of public health."

They say that a health risk assessment of an infectious agent describes the agent and the associated health hazards, characterises the nature and extent of exposure of humans to the agent, and assesses the response of humans exposed to the agent at various concentrations under controlled experimental conditions. The response is described by means of mathematical models, which are used to predict the response of the exposed human population to environmental concentrations of the same infectious agent.

The application of risk assessment concepts to microbial health hazards has been developed in the USA, and implemented on a limited basis. The Health Programme of the Division of Water Technology, CSIR has, during the last few years, established a capability for conducting health risk assessments, including the assessment of microbial risks. The Programme is now in a position to apply these techniques to contribute towards a more quantitative interpretation of microbial monitoring data.

Monitoring studies conducted by the Health Programme have frequently revealed the difficulties of relating measured levels of indicator and pathogenic micro-organisms to the incidence of disease. Such questions can be, and are being, addressed by means of epidemiological studies. However, these studies are extremely time-consuming and expensive. Results will not be available for some time, and resources are insufficient to couple all of the monitoring surveys with epidemiological studies. Furthermore, such studies are limited to overt health effects. Health risk assessment provides a means of estimating the probability of adverse effects associated with measured levels of pathogens, and hence also provides a tool for predicting the extent of potential or probable health effects. This information can be used by decision-makers and legislative authorities to define desirable water quality on a scientific basis and to protect public health.

## OBJECTIVES

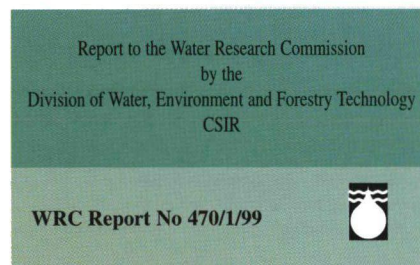
The objectives of the study funded by the Water Research Commission were as follows:

- to assess the usefulness of data collected by current microbial monitoring programmes for quantitative analysis of the associated health risks;
- to estimate the minimum levels of risk detectable using the volumes of water currently analysed;
- to evaluate the usefulness and implications of health risk assessment for the formulation of microbial water quantity guidelines.



### Applications of Health Risk Assessment Techniques to Microbial Monitoring Data

B Genthe • N Rodda



## METHODOLOGY

The assessment techniques were evaluated by means of a number of case studies based on microbial monitoring surveys conducted in South Africa in recent years. The case studies were used to assess the usefulness of data collected by representative microbial monitoring programmes for quantitative analyses of the associated health risks as well as to estimate the minimum levels of risk detectable using the volumes of water typically analysed. The studies were also used to evaluate the capability of risk assessment techniques to indicate desirable microbial water quality in the context of the monitoring methods used.

Case studies considered the following exposure scenarios: drinking water consumption, ingestion of water during swimming and ingestion of polluted shellfish. Organisms considered in the case studies were enteric viruses, since these are pathogenic microorganisms as opposed to indicator organisms, and can therefore be used in risk assessment models.

## MAIN RESULTS

- The monitoring requirements for risk assessment have been established, eg. large volumes of water need to be sampled and concentrated to be able to detect low risk levels.
- Current microbial risk assessment models are only applicable to exposure by ingestion. This drawback is self-explanatory and therefore future development of models should be addressed via other exposure routes for microbial risk assessment to be useful on a wider basis.
- The use of enteric viruses as a general group of micro-organisms for water quality monitoring and estimation of possible health risks adds to the uncertainty in risk calculation.
- Standardisation of methods used in estimations of longer term risks is needed to ensure that values can be compared across studies, both nationally and internationally.
- Microbial risk assessment techniques could not be used and applied in South Africa because of a lack of available and reliable data.
- Results obtained from this study further indicated that historical water quality monitoring aimed at protection of public health may have missed the mark due to insufficient protection against low levels of minor gastrointestinal complaints associated with waterborne pathogens.

Copies of the final report entitled **Application of Health Risk Assessment Techniques to Microbial Monitoring Data** (WRC report 470/1/99) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, via surface mail).



*Ivory Park, a peri-urban informal settlement at Midrand.*

## Researcher studies personal health and hygiene knowledge and behaviour

Increasing attention has been focussed upon the integration of water supply, sanitation and health promotion programmes to achieve community health benefits, says researcher MS Westaway from the National Urbanisation and Health research programme at the Medical Research Council in a report to the Water Research Commission (WRC) on the impact of health and hygiene behaviour on water.

The researcher says one of the terms of reference for the hygiene education and awareness task team is to establish a regional or context-based understanding of existing health and hygiene knowledge, beliefs and practices. Cognisance was taken of this term of reference in a WRC funded study in which the overall aim was to develop a methodology and measures to assess knowledge, attitudes and behaviour in relation to personal and domestic health and hygiene.

A household interview schedule and observation checklist was used to obtain

information on the background details of occupants (age, marital status, language preference, schooling, occupation, household head and the number of persons in the household); water supply storage and use; sanitation; sanitation supply and use; waste management; lighting and cooking; personal and domestic health and hygiene and aetiology, transmission and prevention of diarrhoea and eye and skin infections.

This information was used to develop and test a structured knowledge, attitudes and behaviour questionnaire. There were 45 knowledge items (signs/symptoms aetiology, transmission and prevention of diarrhoea); a ten item attitude scale and a ten item behavioural scale.

Ivory Park, a peri-urban informal site and service settlement in Midrand, Gauteng, and Tembisa were selected as the study sites because there are a mixture of different levels of water and sanitation provision. Interviews, observa-

tions and structured questionnaires were conducted and administered in randomly selected households.

In Ivory Park the Winnie Mandela squatter camp has limited access to water and sanitation. Extension six and eight and the Kanana suburb (Ivory Park) have individual (outside the house) or shared access to a tap and stand access to a septic tank (aqua privy). Tembisa township has inside or outside the house piped water and a waterborne sewerage system.

### MAJOR FINDINGS

□ **Socio-demographics.** There were no significant differences between the three groups of female interviewees on age, schooling, marital status, employment status, household head and household size in the first phase of the study. However, in the second phase of the study, women from Tembisa, in comparison with women from the squatter camp, were

older, less educated, married and employed. Women from the squatter camp were less likely to have their own dustbin, a television and a refrigerator than women from Ivory Park and Tembisa.

**Water.** Only 28 per cent of households used 20 litres or more of water per person per day, with the average being 18 litres in the squatter camp - higher than the 12 litres per person per day in Kanana. Most women said that they used the water for drinking, cooking and washing clothes. Water was collected in 20 or 25 litre plastic drums, originally used for cooking oil, chemicals or hair products.

**Sanitation.** Squatter camp residents had built their own pit latrines which were not used by small children. Therefore, adequate sanitation was a major need for these residents. The problems experienced with aqua privies (overflowing, desludging needed) suggested that this system was inadequate for sanitation. Toilet paper and newspaper were used for anal cleansing, with more women in the squatter camp using newspaper than in Kanana. Irrespective of area, disinfectants were used to clean aqua privies and pit latrines.

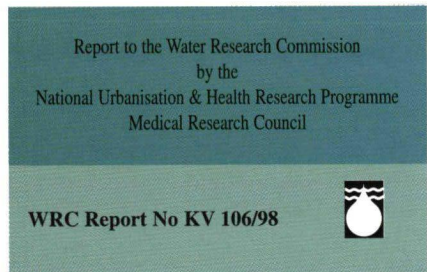
**Personal and domestic hygiene.** Less women (53 per cent) washed their hands before preparing food than before eating (82 per cent) or after going to the toilet (94 per cent). Just over half of the women used soap when they washed their hands.

Although women in the squatter camp were more likely to use water only when washing their hands, they were equally likely to have soap in their houses as women in the other two areas. Most women (86 per cent) with children bathed them daily. Food hygiene was of considerable importance - milk, meat and vegetables were either eaten immediately or refrigerated. Houses in the squatter camp were rated cleaner than those in Kanana.



**Determining Personal and Domestic Health and Hygiene Knowledge, Attitudes and Behaviour: A Pilot Study**

MS Westaway



**Diarrhoea.** Watery and bloody stools, sunken eyes and sunken fontanelle were recognised as the major signs of diarrhoea. Dirt, dirty food, dirty water, germs and dirty

dishes and utensils were perceived as the major causes of diarrhoea. Respondents were aware of the fact that diarrhoea was transmitted by rubbish and stools, insects and dirty hands, dishes and toilets. Women thought that diarrhoea was prevented by eating healthy food, drinking clean water, keeping dishes clean, cleaning toilets, keeping the house and the yard clean and covering garbage.

**Attitudes.** It was less important for Tembisa women to have clean dishes and utensils, covering and cleaning water containers, covering food and washing their hands with soap before preparing food, before eating and after going to the toilet than women in the squatter camp or Ivory Park.

**CONCLUSIONS**

An adequate water supply was not synonymous with usage.

Residents of the squatter camp needed more taps to reduce waiting time for collecting water.

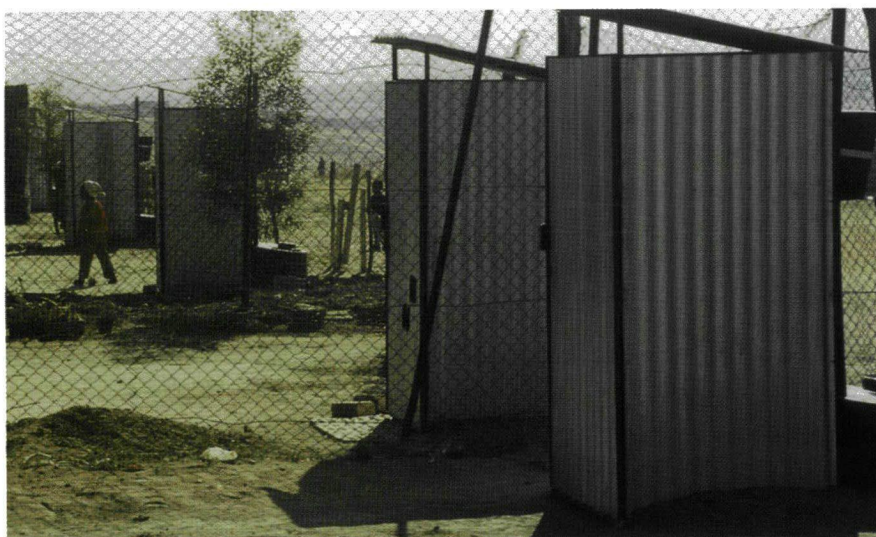
Pit latrines were considered unsuitable for children.

Adequate sanitation (not overflowing, no smells) was perceived as very important by all interviewees.

Ivory Park women were more knowledgeable about the signs, symptoms, aetiology, transmission and prevention of diarrhoea than women in Tembisa or the squatter camp. This high level of knowledge was probably due to the emphasis on hygiene health education at the five Ivory Park clinics.

Age, schooling, piped water inside the house, aqua privy/pit latrine, own dustbin and the possession of a refrigerator were important determinants of knowledge about diarrhoea, attitudes towards personal and domestic hygiene and personal hygiene behaviour.

Copies of the full report entitled **Determining Personal and Domestic Health and Hygiene Knowledge, Attitudes and Behaviour: A Pilot Study** (WRC report KV 106/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas orders: US\$ 20, via surface mail).



*Aqua privy sanitation provision at Kanana, Ivory Park.*

# The removal of disinfectant by-product precursors using enhanced coagulation processes

The discovery in the mid-seventies that disinfection of water can result in the formation of harmful disinfection by-products through the reaction of the disinfectant with natural organic matter in water resulted in the United States Environmental Protection Agency (USEPA) proposing the disinfectants/disinfection by-products rule in 1994. This rule sets maximum limits for residual disinfectant concentrations and maximum contaminant levels for disinfection by-products in drinking water.

Coagulants have traditionally been used for turbidity removal, but coagulation is also able to bring about some removal of natural organic matter, which generally acts as a disinfection by-products precursor. The removal of natural organic matter normally lowers the potential for disinfection by-products formation. USEPA's disinfectants/disinfection by-products rule requires that enhanced coagulation techniques be implemented - enhanced coagulation being defined as the addition of excess coagulant for improved removal of disinfectant by-products. When using enhanced coagulation techniques the coagulant dose that yields optimal natural organic matter or disinfection by-products precursor removal is the most important factor, but effective turbidity removal must still be provided. Enhanced coagulation also offers the possibility of significantly decreasing natural organic matter present in the water without the need for costly upgrading of current treatment processes or the implementation of new technologies.

Although no regulations regarding the removal of natural organic matter have been introduced in South Africa, the formation of disinfection by-products is still of great concern to those bodies which provide potable water. Conventional water treatment processes are not gen-

erally effective in removing disinfection by-products and their precursors and expensive treatment options, such as ozonation and granular activated carbon are required for these applications. These processes are not suitable for use at small treatment works which lack the financial resources and skilled personnel required to operate them and enhanced coagulation could offer a viable alternative in such circumstances.

To assess the effectiveness of enhanced coagulation the Water Research Commission contracted two researchers, MJ Pryor and SD Freese, at Umgeni Water in Natal to carry out a research project with the following specific objectives:

- To assess the reduction in disinfection by-product precursors, pesticides/herbicides and taste and odour compounds and natural organic matter achievable using enhanced coagulation on water typical to Southern Africa.
- To assess the effect of coagulant type and dose, method of coagulant addition, pH, alkalinity, hardness, temperature and the nature of organic matter on the effectiveness of enhanced coagulation.
- To compare the removal of disinfection by-product precursors, pesticides/herbicides and taste and odour compounds obtained with enhanced coagulation with that obtainable using ozonation and/or advanced oxidation and granular activated carbon or bacteriologically activated carbon.
- To produce a publication containing guidelines for enhanced coagulation for treatment of different waters typical to Southern Africa.

## RESULTS

According to the final report published by the Water Research Commission the inorganic coagulants such as ferric chloride and alum were generally better than the polymeric coagulants for the removal of natural organic matter using enhanced coagulation. It was possible to obtain removals of up to 40 per cent in trihalomethane formation potential (THMPFP), up to 60 per cent in total and dissolved organic carbon, between 70 and 90 per cent in biodegradable dissolved organic carbon (DOC) and between 70 and 90 per cent in UV absorbance using ferric chloride and alum for enhanced coagulation. Enhanced coagulation was also very effective for colour reduction and removal of algal cells.

Enhanced coagulation was not successful in removing micro-pollutants such as herbicides and taste and odour compounds.

Optimal removal of natural organic matter (NOM) was found to occur at between 1,5 and 7 times the optimal coagulant concentration for turbidity removal, this being dependent on the concentration and nature of organic matter in the water.

The pH was found to be important when using enhanced coagulation, with the optimal pH for removal of organic matter being around 5 when using ferric chloride and at between 5 and 5,5 when using alum. The pH was also found to affect the removal of organic matter when using a polymeric coagulant, as the optimum pH is around 5. DOC removals using a polymeric coagulant could be increased by 15 to 25 per cent by reducing the pH to around 5 using acid, without any adjustment to the coagulant dose.



Pre-oxidation of the water using ozone or permanganate prior to enhanced coagulation generally had little if any effect on the removal of organic matter, making it possible to use enhanced coagulation without pre-oxidation. It was, however, possible to increase TOC and DOC removal by between 10 and 15 per cent by pre-ozonating before enhanced coagulation treatment.

Magnetite does not appear to be a viable option for enhanced coagulation as it does not offer any significant benefits over other coagulants and would require very high concentrations.

Removals of natural organic matter using enhanced coagulation were comparable or even better than those achieved with the more advanced treatment processes involving ozonation and granular activated carbon (GAC). However, for removal of micro-pollutants, ozone and/or GAC would be required.

**GUIDELINES**

The researchers included the following guidelines in the report for the implementation of enhanced coagulation:

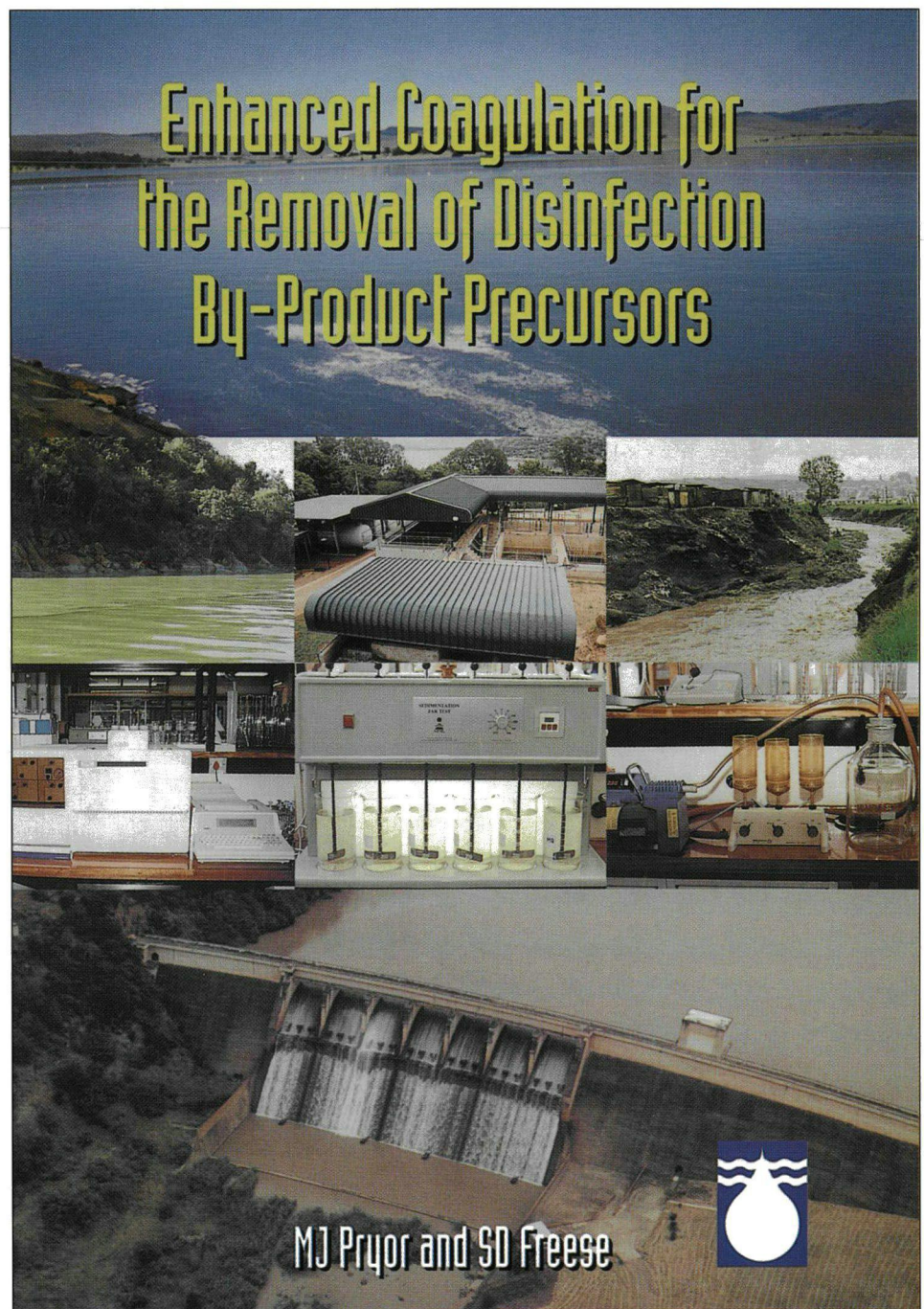
- Enhanced coagulation is effective for the removal of total organic carbon, dissolved organic carbon, biodegradable dissolved organic carbon, trihalomethane formation potential and colour, but not for the removal of micro-pollutants and taste and odour compounds. This needs to be considered when deciding on the most appropriate treatment options for a particular situation.
- The inorganic coagulants such as ferric chloride and alum are generally more effective than polymeric coagulants for enhanced coagulation applications.
- The optimal coagulant dose for enhanced coagu-

lation effects is generally between 1.5 and seven times the optimal coagulant dose for turbidity removal. These doses need to be assessed using laboratory, pilot-plant or full-scale tests.

- Alkalinity will adversely affect enhanced coagulation. Depressing the pH (using acid) to between 5 and 5.5 will increase the removal of natural organic matter.
- If determination of total organic car-

bon or dissolved organic carbon is not possible, turbidity or UV absorbance (254 nm) can be used to determine optimal organic carbon removal.

Copies of the full report entitled **Enhanced Coagulation for the Removal of Disinfection By-product Precursors** (WRC report TT 105/98) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20, via surface mail).



# Tips for effective Waterlit database searching

<http://www.wrc.org.za>

The number of users registered to access the *Waterlit* database via the Internet is now fast approaching the 1000 mark. A few useful tips are given below to help users in improving their search results.

When you plan to search the database, do keep the following in mind:

□ *Waterlit* currently contains more than 310 000 references - all on water-related topics. Avoid using the search term **water**, even when you plan to use a search phrase which has 'water' as one of the words, eg. water supply, water resources management, water treatment, etc.

□ A formal collection of terms, called the Thesaurus, is used by database builders to describe the contents of a publication. Please consult the Thesaurus (available on-line) to identify the best suitable terms to use when formulating a search strategy. The following example illustrates the importance of using the correct terminology:

When searching the database for references on "The formulation of a policy to determine water tariffs for local drinking water supply", you use the search terms "*water tariffs*" and "*drinking water*". This search retrieves only 5 records (Fig. 1). However, on consulting the Thesaurus you find that the terms used by the indexers building the database are: "*water rates*" and "*potable water*", and with this terminology your revised search now retrieves 109 records (Fig. 2).

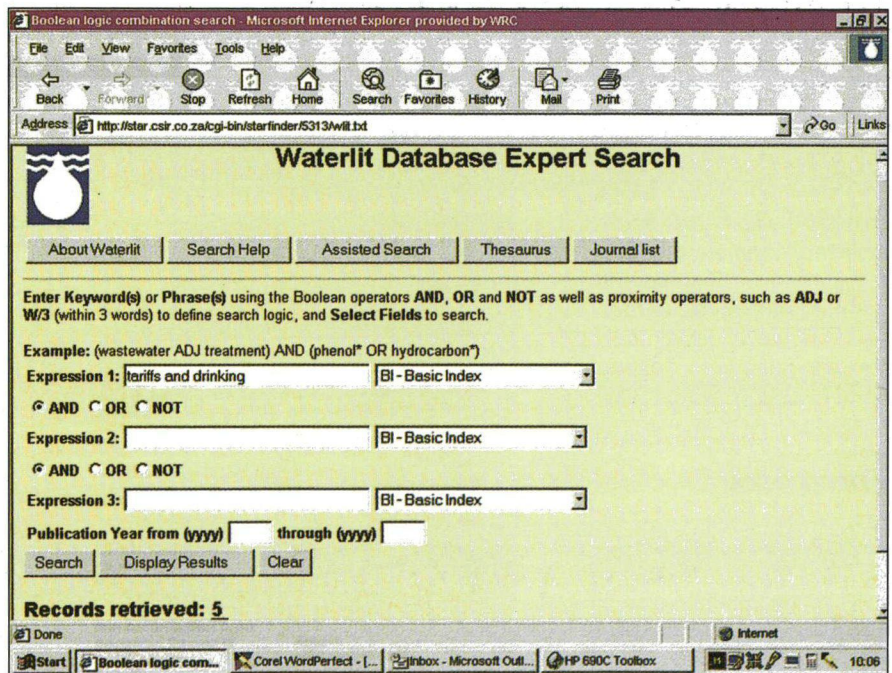


Fig 1: Database search results.

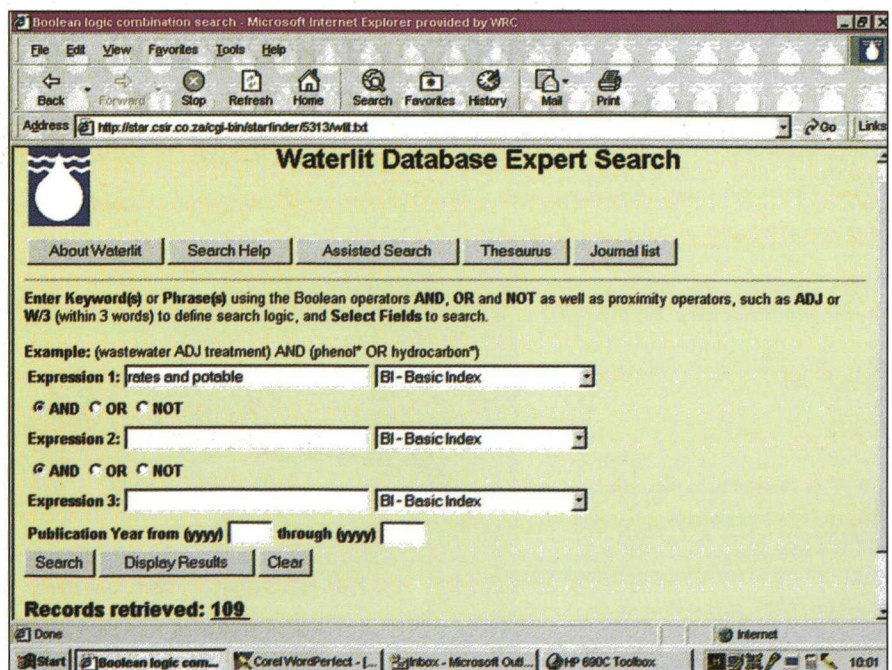


Fig 2: Revised search results.

- Avoid using broad terms describing an entire category of subjects, eg. wastewater treatment, hydrology, agriculture, ecosystems, etc. Please remember **before** you start searching to clearly
  - define your specific information requirements, and
  - formulate your search term(s). If you need information on eg. "wastewater treatment", determine whether you need information on:
    - a particular *type* of treatment (eg. chemical treatment, biological treatment)
    - a specific wastewater treatment *process* (eg. Bardenpho process, activated carbon treatment)
    - the *equipment* used during the treatment (eg. aerators)
    - the *effluent properties* (eg. effluent quality, effluent standards)
    - the final effluent *destination* (eg. land application, wastewater irrigation)
    - sludge* treatment - again be more specific (eg. sewage sludge, raw sludge, water treatment sludge, etc.)
- If your search retrieves a large number of references, repeat the search, but limit the numbers by requesting only records from the last few years.
- When searching for any flora and fauna references please use **both** the popular and the scientific names, eg. (water) hyacinths and *Eichhomia*.
- Always check your spelling, especially when using species names as search terms. Names of dams and rivers may also differ as used by individual authors, e.g. Hartbeespoort dam, Hartebeespoort dam, Bloukrans river, Blaauwkrantz river, etc.
- Always search for words in the singular form, adding an asterisk to indicate to the computer to broaden your search, e.g. the search term "filt\*" will retrieve: filter, filters, filtration, filtrates, and filterability.
- When searching for specific geographical references, add the name of the country to avoid confusion, eg. a search for "Buffalo river" will retrieve references to a river of that name in South Africa, Australia, USA and Canada. Also bear in mind that there is a "Buffels river" in South Africa!
- If your search results are not satisfactory, think of alternative or similar names or phrases to use instead of your initial search term. The following serves as an example of terms that are used to indicate waste treatment units, but with different applications:
  - home treatment units
  - small scale units
  - package plants
  - on-site treatment (used mainly for waste disposal) - sewerless waste management.
- If all else fails, go to "**Search help**" on the screen!



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# SA WATERKALENDER

The Water Research Commission is placing this calendar in order to assist with the co-ordinating of water events in South Africa.

You are invited to send information about conferences, symposia or workshops to the SA Waterbulletin.

Address:  
The Editor,  
SA Waterbulletin,  
P.O. Box 824,  
0001 Pretoria  
Tel (012) 330-0340  
Fax (012) 331-2565

Legend:

- An SA Water Event arranged for these dates.
- 2nd SA Water Event scheduled for these dates.
- × 3rd SA Water Event scheduled for these dates.

See conferences and symposia pages for events.

## 1999

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Die Waternavorsingskommissie plaas hierdie kalender om te help met die koördinerings van watergebeurtenisse in Suid-Afrika.

Alle belanghebbendes word uitgenooi om inligting aan SA Waterbulletin te stuur.

Adres:  
Die Redakteur  
Posbus 824  
0001 Pretoria  
Tel: (012) 330-0340  
Fax: (012) 331-2565

Gids:

- Een SA Watergeleentheid vir hierdie dae.
- 'n Tweede SA Watergeleentheid vir dié datums.
- × 'n Derde SA Watergeleentheid vir dié datums.

Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

## 2000

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SOUTHERN  
AFRICA

1999

## MARINE SCIENCE

NOVEMBER 22 - 26

The 10th South African marine science symposium - SAMSS 2000: Land, Sea and People in the new millennium - will be held in the Wilderness, Cape Province.

Enquiries: SAMMS Secretariat, Geology Department, University of Port Elizabeth, PO Box 1600, Port Elizabeth 6000. Tel: (041) 504 2243. Fax: (041) 504 2573. E-mail: ocaehs@upe.ac.za

## HYDROLOGY

NOVEMBER 29 - 30

The 9th South African Hydrology Symposium with the theme "Hydrology and Water Resources in Southern Africa".

Enquiries: Ms Julie Haarhoff, Dept of Civil Engineering, University of Stellenbosch, Private bag X1, Matieland 7602. Tel: 021-8082100 (mornings only). Fax: 021-8084351. E-Mail: jhaarhof@ing.sun.ac.za

2000

WATER SUPPLY &  
SANITATION

FEBRUARY 21 - 25

The 10th UADE/JAWS congress with the theme "Partnerships and sustainable development in the water supply and sanitation sector" will be held in Durban.

Enquiries: Congress International, 18 Rapson Road, Morningside 4001, DURBAN, South Africa Tel: +27 (0)31 312-3494 or 312-3442 Fax: +27 (0)31 303-5875 E-mail: ci@dbn.lia.net

## CEMSA 2000

MARCH 27 - 29

The 2nd international conference and exhibition on integrated environmental management in South Africa will be held in East London.

Enquiries: Creative Public Relations, PO Box 18227 Quigney, East London 5211. Tel: 0431 437267. Fax: 0431 26914.

## WATER &amp; WASTE

MAY 23 - 26

A specialist conference on man-

aging water and waste in the new millennium - the challenges for developing areas - will be held in Midrand.

Enquiries: Roelien-M Bakker, IWA Conference, PO Box 6011, Halfway House 1685. Tel: (011) 805-6368. Fax: (011) 315-1258. E-mail: conference@wisa.co.za

## WISA

MAY 28 - JUNE 1

The Water Institute of Southern Africa (WISA) will hold its biennial conference and exhibition at Sun City.

Enquiries: Roelien-M Bakker, WISA, PO Box 6011, Halfway House 1685. Tel: (011) 805 6368. Fax: (011) 315 1258. E-mail: conference@wisa.co.za

## WATER RESOURCES

JUNE 7 - 9

The 4th biennial congress of the African division of the International Association of Hydraulic Research (IAHR) on conserving and sharing water resources in a water scarce environment will be held in Windhoek, Namibia.

Enquiries: Congress Secretariat, Ms Marelise Serfontein, PO Box 9870, Windhoek, Namibia. Tel: +264-61-251014/272031/254281. Fax: +264-61-272032 or 251014. E-mail: namlink@iwwn.com.na

## IRRIGATION

OCTOBER 22 - 27

The 6th international micro-irrigation congress together with the 51st IEC meeting of the International Commission on Irrigation and Drainage (ICID) will be held in Cape Town.

Enquiries: The Congress Secretariat, PO Box 36815, Menlo Park 0102. Tel: (012) 344 0390. Fax: (012) 344 5643. E-mail address: reservations@parkgables.co.za.

## AGROCHEMICALS

OCTOBER 25 - 26

A workshop on the control of adverse impacts of fertilizers and agrochemicals will take place in Cape Town, South Africa.

Enquiries: Prof A Mermoud, Institute of Soil and Water Management (IATE), Swiss Federal Institute of Technology, 1015 Lausanne, Switzerland. Tel: +41-21-693-3726. Fax: +41-21-693-3739. E-mail: andre.mermoud@epfl.ch

## HYDROGEOLOGY

NOVEMBER 26 - DECEMBER 1

The International Association of

Hydrogeologists' (IAH) XXX Congress 2000 with the theme Groundwater: Past achievements and Future challenges will be held at the University of Cape Town.

Enquiries: Conference Secretariat, IAH 2000, Conferences et al, PO Box 452, Stellenbosch 7599. Tel: (021) 886-4496. Fax: (021) 883-8177. E-mail: deidre@iafrica.com.

## OVERSEAS

1999

## MEMBRANE TECHNOLOGY

NOVEMBER 1 - 4

An international specialised conference on membrane technology in environmental management will be held in Tokyo, Japan.

Enquiries: Prof Kazuo Yamamoto. Fax: +81 3 3813 7294. E-mail: yamamoto@esc.u-tokyo.ac.jp

## BIOMETEOROLOGY

NOVEMBER 8 - 12

The 15th international conference on biometeorology and urban climatology will be held in Sydney, Australia.

Enquiries: Tour Hosts (Pty) Ltd, GPO Box 128 Sydney NSW 2001, Australia. E-mail: icbicuc@tourhosts.com.au Fax: +61 2 9262 2277. Web: http://www.es.mg.edu.au/ICB-99

## DESALINATION

NOVEMBER 9 - 12

An European conference on desalination and the environment will be held in Las Palmas, the Canary Islands.

Enquiries: Miriam Balaban - tel: +39 0862 3475308. Fax: +39 0862 3475213. E-mail: balaban@sgol.it]

## WASTE MINIMISATION

NOVEMBER 14 - 18

An IAWQ international speciality conference on waste minimisation and end of pipe treatment in chemical and petrochemical industries will be held in Meridan, Yucatan, Mexico.

Enquiries: Matilde Galvan, Instituto de Ingeniera, Universidad Nacional Autonoma de Mexico, Ciudad Universitaria, Apartado Postal 70-472, 04510

Mexico DF. E-mail: iawq@pumas.iingen.unam.mx Fax: +52 5 616 2164. Web: http://www.iingen.unam.mx/ccco/iawq

## WATER DISTRIBUTION

NOVEMBER 15 - 17

The 2nd international conference on the safety of water distribution - balancing chemical and microbial risks will be held in Miami Beach, Florida, USA.

Enquiries: International Life Sciences Institute, USA. E-mail: meetings@ils.org Web: http://www.ils.org/conference.html

## BIOTECHNOLOGY

DECEMBER 6 - 17

An advanced course on microbial physiology and fermentation technology will be held at the Delft University of Technology, The Netherlands.

Enquiries: Dr LA van der Meer-Lerk, Institute for Biotechnology, Julianalaan 67, 2628 BC Delft, The Netherlands. Tel: (31-15) 278 19 22. Telefax: (31-15) 278 23 55.

2000

## DIFFUSE POLLUTION

JANUARY 16 - 20

The 4th international conference on diffuse pollution will be held in Bangkok, Thailand.

Enquiries: Ms Nitayaporn Tonmanee, Department of Land Development, Phaholoyothin Road, Chatuchak, Bangkok 10900, Thailand. E-mail: ldd@mozart.inet.co.th Tel: +662 579 0111. Fax: +662 562 0732. Web: http://www.ddd.go.th/iawq

## AWWA/WEF

JANUARY 30 - FEBRUARY 2

An AWWA/WEF conference on water reuse will be held in San Antonio, TX, USA.

Enquiries: Susan Miller, AWWA, USA. E-mail: smiller@awwa.org Tel: +303-3476181. Web: http://www.awwa.org/tande/awwaconf.htm

## NATURAL RESOURCES

FEBRUARY 14 - 18

An international conference on managing natural resources for sustainable agricultural production in the 21st century will be held in New Delhi, India. Call for papers.

Enquiries: Dr AK Singh, Secretary-General, Indian Society of Soil Science, Indian

Agricultural Research Institute,  
New Delhi-110 012, India. Tel:  
91-11-5731494. E-mail:  
icmnr@bic-iari.ren.nic.in Fax:  
91-11-5755529. Internet site:  
<http://www.nic.in/icar/nrm>

## WATER

MARCH 11 - 17

The 10th world water congress is to be held at the Melbourne Convention Centre, Melbourne, Australia.

Enquiries: Lisa McNaught, ICMS Pty Ltd, 84 Queensbridge Street, Southbank, Victoria, Australia 3006. Tel: +61 3 9682 0244. Fax: +61 3 9682 0288. E-mail: [world-water@icms.com.au](mailto:world-water@icms.com.au)

## REMOTE SENSING

APRIL 3 - 7

A symposium titled Remote Sensing 2000 will be held in Santa Fe, NM, USA.

Enquiries: Dr Jerry C Ritchie, Hydrology Laboratory, Room 104, Building 007, USDA/ARS/ BARC-West, Beltsville, Maryland 20705-2350, USA. E-mail: [jritchie@hydrolab.arsusda.gov](mailto:jritchie@hydrolab.arsusda.gov) Tel: +301 5047490. Fax: +301 5048931.

## METEOROLOGY

APRIL 3 - 7

The 6th international conference on southern hemisphere meteorology and oceanography will be held in Santiago, Chile.

Enquiries: Patricio Aceituno, University of Chile, Casilla 2777, Santiago, 6511227, Chile. E-mail: [aceituno@shmo.chile2000.cl](mailto:aceituno@shmo.chile2000.cl)

## WASTEWATER

APRIL 4 - 7

A CIWEM millennium conference - wastewater treatment: standards and technologies to meet the challenges of the 21st century will be held in Leeds, England. Enquiries: Zena Hickinson, AE Technology Transfer, School of Civil Engineering, University of Leeds, Leeds LS2 9JT, UK. E-mail: [z.hickinson@leeds.ac.uk](mailto:z.hickinson@leeds.ac.uk) Tel: +44 113 2332308. Fax: +44 113 2332243.

## WATER RESOURCES

APRIL 30 - MAY 4

An international conference on water resources in extreme environments will be held in Anchorage, AL, USA.

Enquiries: Douglas Kane, University of Alaska, Fairbanks AK99775, USA. E-mail address: [ffdlk@aurora.alaska.edu](mailto:ffdlk@aurora.alaska.edu) Fax: +907 474 7979. Web: <http://www.awra.org>

## GROUNDWATER

MAY 8 - 10

The International Association for Hydraulic Research will hold an international symposium on groundwater in Saitama, Japan. Enquiries: Dr H Kazama, Saitama University, 255 Shimo-ohkubo, Urawa, Saitama 338-8570, Japan. Tel: +81 48 858 3568. Fax: +81 48 855 1378. Web: <http://www.hgl.saitama-u.ac.jp>

## LAKE MANAGEMENT

MAY 17 - 21

The 8th international conference on the conservation and management of lakes will be held in Copenhagen, Denmark.

Enquiries: Conference Bureau, Herlev Ringvej 2C, DK-2730 Herlev, Denmark. Tel: +45 4492 4492. Fax: +45 4492 5050.

## CHLORINATION

MAY 21 - 24

The 2nd international conference on the remediation of chlorinated and recalcitrant compounds will take place in Monterey, CA USA. Enquiries: The Conference Group, 1989 West Fifth Avenue, Suite 5, Columbus, Ohio 43212-1912, USA. E-mail address: [102632.3100@compuserve.com](mailto:102632.3100@compuserve.com) Tel: +800 783 6338. Fax: +614 488 5747.

## ACHEMA 2000

MAY 22 - 27

The 26th exhibition-congress and international meeting on chemical engineering, environmental protection and biotechnology will be held in Frankfurt am Main, Germany. Enquiries: Dechema. Tel: +49 (0) 697564-261. Fax: +49 (0) 697564201. <http://www.woice.de> E-mail: [woice@dechema.de](mailto:woice@dechema.de)

## GROUNDWATER 2000

JUNE 6 - 8

A conference with the theme Groundwater 2000 will be held in Copenhagen, Denmark.

Enquiries: MiaCon Meeting and Conference Services, Helsingvej 23, DK-2830 Virum, Denmark. E-mail: [gw2000@isva.dtu.dk](mailto:gw2000@isva.dtu.dk) Tel: +45 45 859727. Fax: +45 45 839727. Web: <http://www.isva.dtu.dk/grc/gw2000/>

## AWWA

JUNE 11 - 15

The AWWA 2000 annual conference and exhibition will be held in Denver, Colorado, USA.

Enquiries: David Rossiter, AWWA, USA. E-mail: [\[awwa.org\]\(http://awwa.org\) Tel: +303 3476209. Web: <http://www.awwa.org/tande/awwaconf.html>](mailto:rossiter@</a></p>
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## IRRIGATION

JUNE 20 - 24

An international conference on the challenges facing irrigation and drainage in the new millennium - meeting human and environmental needs through sustainability, rehabilitation and modernisation will be held in Fort Collins, CO, USA.

Enquiries: US Committee on Irrigation and Drainage, 1616 17th Street, 483 Denver, CO 80202, USA. E-mail address: [stephens@uscid.org](mailto:stephens@uscid.org) Fax: +303 6285431. <http://www.uscid.org>

## FLOW ANALYSIS

JUNE 25 - 29

The 4th international conference on flow analysis will take place in Warsaw, Poland.

Enquiries: Prof Marek Trojanowicz, Department of Chemistry, University of Warsaw, Pateura 1, 02-093, Warsaw, Poland. E-mail: [trojan@chem.uw.edu.pl](mailto:trojan@chem.uw.edu.pl) Tel: +48 22 8223532. Web: <http://www.congress.pbp.com.pl/flow/>

## WASTEWATER

JULY 3 - 6

The 3rd international symposium on wastewater reclamation, recycling and reuse will be held in Paris, France.

Enquiries: Ms Nicole Couesnon, GBE, Univesite Montpellier II, cc057, 34095 Montpellier cedex 05, France. E-mail address: [wrrr.2000@dstu.univ-montp2.fr](mailto:wrrr.2000@dstu.univ-montp2.fr) Tel: +33 4 6714 3310. Fax: +33 4 6714 4774.

## IWA

JULY 3 - 7

The first world congress of the new International Water Association (IWA), formed by the merger of the International Association on Water Quality (IAWQ) and the International Water Services Association (IWSA), will be held in Paris, France.

Enquiries: Aghtm-cfrp, 83 Avenue Foch - B.P. 39.16, 75761 Paris - Cedex 16 - France. Tel: +33 (0)1 53701351 or 53. Fax: +33 (0)1 53701340. E-mail: [aghtm@aghtm.org](mailto:aghtm@aghtm.org)

## METEOROLOGY

JULY 10 - 14

A conference with the theme "Meteorology at the Millennium" will be held in Cambridge,

England.

Enquiries: Royal Meteorological Society, Executive Secretary. E-mail: [execsec@royal-metsoc.org.uk](mailto:execsec@royal-metsoc.org.uk) Tel: +18 956 8500. Fax: +18 956 8571.

## EROSION

JULY 10 - 14

An international symposium on the role of erosion and sediment transport in nutrient and contaminant transport will be held in Waterloo, Canada.

Enquiries: Dr M Stone, School of urban and regional planning, University of Waterloo, Waterloo, Ontario, Canada. E-mail: [mstone@fes.uwaterloo.ca](mailto:mstone@fes.uwaterloo.ca) Tel: +519 888 4567. Fax: +519 725 2827.

## FLOODS

JULY 17 - 19

An international symposium on extraordinary floods will be held in Reykjavik, Iceland.

Enquiries: E-mail: [extremes2000@os.is](mailto:extremes2000@os.is) or Web address: [http://www.os.is/vatnam/extreme\\_s2000](http://www.os.is/vatnam/extreme_s2000)

## HYDRO-INFORMATICS

JULY 23 - 27

The fourth international conference on hydro-informatics will be held in Iowa, USA.

Enquiries: Website: <http://www.iuhr.iowa.edu/hydro2000>

## WETLANDS

AUGUST 6 - 12

The 6th wetlands symposium of the international association of ecology - INTECOL VI - "Global wetlands at the millennium" - will be held in Quebec City, Canada.

Enquiries: Ms Elizabeth MacKay, CQVB, Bureau 620, 2875 blvd Laurier, Sainte-Foy, Quebec, Canada G1V 2M2. E-mail: [cqvb@cqvb.qc.ca](mailto:cqvb@cqvb.qc.ca) Fax: +1 418 657 7934. Web: <http://www.cqvb.qc.ca>

## CLOUDS

AUGUST 14 - 18

The 13th international conference on clouds and precipitation will be held in Reno, NV, USA.

Enquiries: George Isaac, AIES, 4905 Dufferin St, Downsview, ON M3H 5T4, USA. E-mail: [george.isaac@ec.gc.ca](mailto:george.isaac@ec.gc.ca) Fax: +416 739 4605. Website: <http://www.tor.ec.gc.ca/armp/CP-Conf/CP-Conf.html>

# UAWs 2000 CONGRESS

## PARTNERSHIP AND SUSTAINABLE DEVELOPMENT FOR WATER AND SANITATION

Durban, South Africa



20-25 February 2000

**T**he 10th Union of African Water Suppliers (UAWs) Congress and Exhibition in Durban will be the first time this Congress is held in Southern Africa. At the last Congress held in Casablanca, Morocco, in February 1998 some 800 delegates from more than 38 countries attended.

**T**his Congress and Exhibition, to be held under the banner of the newly merged International Water Association (IWA), is of major importance and significance for the southern African region. It will provide an excellent opportunity for those all those involved in the water sector in South Africa, both in manufacturing and in the field of water services, to meet with potential customers from Africa and many other parts of the world.

### THEMES

The themes to be addressed during the Technical Sessions at the Congress are:

- The Institutional Reforms in the Water Supply and Sanitation (WWS) Sector in Africa.
- Sanitation: Wastewater Re-use and their By-products in Africa.
- Innovations in the Control of Water Quality.
- Water Supply and Sanitation in Peri-urban Areas, Informal Settlements and Small Municipalities.
- The Financing of Urban Sanitation: Institutional, Technical, Sanitary and Environmental Aspects.
- Information Technology and Information Management in the Water Sector.
- Performance Indicators.



### EXHIBITORS FORUM

Exhibitors Forum sessions will be held every afternoon giving exhibitors the opportunity to present new technologies which have been developed for the water sector.

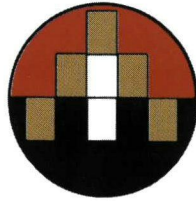
### ENQUIRIES

*Should you be interested to attend or to exhibit at the 10th UAWs Congress please direct your request for further information to:*

Congress International  
18 Rapson Road,  
Morningside 4001  
DURBAN,  
South Africa

Tel: +27 (0)31 312-3494 or 312-3442  
Fax: +27 (0)31 303-5875  
E-mail: [ci@dbn.lia.net](mailto:ci@dbn.lia.net)

# TECHNIKON



# PRETORIA

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Technikon Pretoria offers  
the following  
tertiary tuition  
programs in  
Water Care:

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**National Higher Certificate (Year 2)**

**National Diploma (Year 3)**

**B Tech Degree (Duration: 2 Years)**

*Students attend classes on a block release basis;  
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### SHORT COURSES

#### **OPERATION OF ACTIVATED SLUDGE PLANTS**

Process principles and microbiology, Operational aspects of conventional, extended aeration and nutrient removal processes, Operational problems eg. bulking scum etc.

**Date:** 1-5 November 1999

**Closing date:** 18 October 1999

**Fee:** R2 500

#### **BASIC CHEMICAL WATER ANALYSIS**

Laboratory techniques, Sampling, Data processing, Calculations; Analytical procedures and Practicals.

**Date:** 15-19 November 1999

**Closing date:** 1 November 1999

**Fee:** R2 500

*Course fees include refreshments, lunch, course notes and/or laboratory materials.  
Short courses on any water-related topic can be tailor-made to suit clients' requirements and  
can be presented on site if necessary.*

**Enquiries:** Mochzell Potgieter at Department of Physical Resources, Technikon Pretoria,  
Private Bag X680, Pretoria 0001. Tel (012) 322-9762 Fax (012) 322-7487