

# S4 waterbulletin

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## GROUNDWATER

Flooding of abandoned Witwatersrand mines investigated

## ONTWIKKELENDE GEMEENSAPPE

Huishoudelike waterbehoefte in landelike gebiede bepaal

## DRINKING WATER QUALITY

Researchers look at effects and removal of invertebrates

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# Stakeholder Forum

## for Water Resources Assessment Research Applications for membership

The continuous and accurate assessment of the dynamic state of South Africa's water resources is of major concern for ensuring equitable, adequate and sustainable provision of water to all users. Assessing the adequacy of our water resources is complicated by:

- climate variability and change
- spatial variability of resources
- population growth and mobility
- increasing competition among users
- deteriorating water quality as water use intensifies
- socio-economic and environmental considerations which affect exploitability of resources, both conventional and non-conventional.

Research has a vital role to play in helping to overcome uncertainties regarding available sources of water and their adequacy to meet growing demands. Research must provide and refine the methodologies (tools) needed for the satisfactory performance of all essential water resources assessment tasks, no matter how complex. Because of limited availability of financial and human resources for this research, it is essential that research efforts are at all times focussed on areas of highest priority for the country as a whole.

### Forum Constitution and Role

The Stakeholder Forum for Water Resources Assessment Research will be constituted before the end of 1996 and will start functioning early in 1997. Its role will be to influence the direction of water resources assessment research, so that best use is made of scarce research resources.

### Important features of the Forum are the following:

- To qualify, members must have a real interest in water resources assessment and must be prepared to contribute ideas and participate in discussions which would ultimately help to steer research in the most beneficial direction
- It is foreseen that eventually most communication and discussion will take place electronically; this makes access to the Internet a distinct advantage for participating members.
- Inputs of members will be organised and processed by an elected management group prior to being fed back to members. The management group will also be responsible for keeping members informed about water resources assessment research programmes and strategic plans
- The detailed formulation of the Forum's goals, functions and procedures will be one of the first tasks of the management group, to be undertaken in consultation with the Forum membership at large.

### Forum Secretariat & Enquiries

The Secretariat of the Stakeholder Forum for Water Resources Assessment Research will be provided by the Water Research Commission (WRC).

Any enquiries may be directed to one of the following contact persons at the WRC (Tel (012)330-0340; Fax (012)331-2565): Dr George Green, Mr Hugo Maaren, Mr Tony Reynders, Mr Meiring du Plessis.

### Applications Invited

Intending members are cordially invited to apply for membership. This may be done by sending your name, address (postal, fax, E-mail), affiliation, a brief CV and a brief statement of your particular interest in water resources assessment research to the following address: E-mail: gerda@wrc.cwr.ac.za  
or  
WRC, PO Box 824, Pretoria 0001.

**Closing date for applications: 25 October 1996**

**Although later applicants will not be excluded from membership, adherence to the above deadline will ensure the opportunity to participate fully in the Forum's inaugural activities.**



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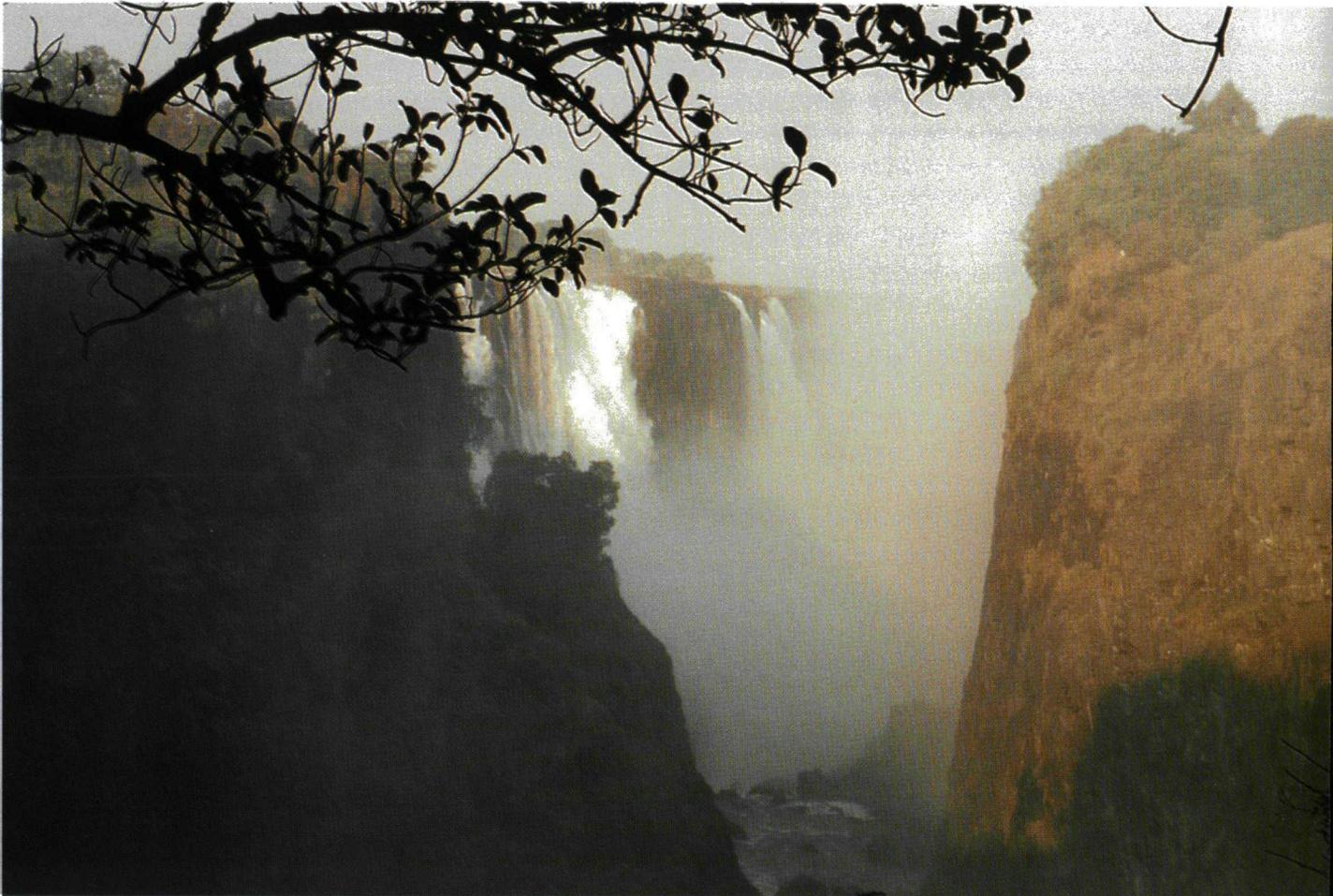
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Cover: At the Vaal River Barrage (Photo: Helene Joubert)

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# Water scientists gather at Vic Falls...



The Vic Falls conference on aquatic systems was organised by the Southern African Society for Aquatic Scientists (SASAQS), and was co-sponsored by WISA (River Basin Management Technical Division), SAICE (Water Engineering Division) and the Canadian Society for Aquatic Ecosystem Health and Management.

*No matter how many times you see it, one never really sees enough of the splendour of the Vic Falls.*

The conference attempted to bring together a wide range of water specialists from both the water engineering and water science fields. A wide range of papers were invited, selected and juxtaposed in such a way as to promote interaction between the problems around water supply in southern Africa, and the needs for protection of the water environment. A number of papers on each of these topics promoted lively debate. Progress towards meeting the water supply challenges of the future in an environmentally sustainable way was evident towards the end of the conference.

Prof Brian Davies sounded a warning to the water fraternity, with regard to water resource planning and catchment management, having recently seen the visibly negative impacts of the Cahora Bassa Dam and lack of proper management twenty years "downstream", resulting in destruction of the natural environment.

Biological monitoring, ranging through macro-invertebrates, fish and toxicology, is the one aspect of aquatic science in which much progress, from theory into practice and reality, was evident from the papers presented and discussion at the conference.



*Prof Arthur Harrison and Dr Jackie King were honoured with SASAQS medals for their outstanding contributions to the Aquatic Sciences in Southern Africa.*

SASAQS medals were presented to Professor Arthur Harrison and Dr Jackie King by the President of SASAQS, Professor Jay O'Keeffe, at the gala banquet. Prof Harrison was honoured for his outstanding contribution to the Aquatic Sciences in southern African over the past forty years, and Dr Jackie King for her commitment in this field and in particular for her Building Block Methodology, which is gaining international recognition for determining instream flow requirements.

The venue made the various "extra mural" conference activities quite unique, and a number of delegates commented on the excellent and exciting evening events. International delegates were given a taste of the real Africa. A number of delegates into adrenalin took the opportunity to go white-water rafting below the Falls and a few attempted the world's highest bungie jump off the bridge.

According to Ralph Heath (aquatic scientist known for his legendary, albeit involuntary, hippo-ride while monitoring aquatic life in a South African river), the Zambesi Gorge is spectacular and the force of the water awesome. He described the white-water river rafting as the non-official highlight of the conference, when some forty delegates got a firsthand experience of instream flow monitoring!

The conference gave both scientists and engineers some renewed insights into the complexities and challenges of their respective fields, and enhanced the ongoing interaction between these disciplines. This will allow us to meet the problems which face us in managing the water resources of this region head on. The conference was well attended with some 200 delegates of which 40 were

from overseas. Representation from the rest of Africa, however, was disappointing. A South African delegate noted the sad scarcity of fellow African delegates as funding seems to be a major stumbling block, and furthermore most of the African great lakes work is funded by overseas countries supporting their own researchers.

All in all, the conference represented a unique opportunity for SASAQS members to meet and exchange ideas with a wide range of other experts in the water field. A good time was had by all, and many delegates are already looking forward to the next special SASAQS water event.



*White-water river rafting - some of the delegates taking on the Zambesi ...*



**T**he metering of all water supplies has been accepted as crucial to the good management of water in South Africa, even in low income group housing schemes.

One of the more prominent cost inputs in a low income house, is the installed cost of a conventional water meter. The most expensive part of such a meter is the brass body. For low income group housing this cost has a double component, namely the actual cost of a new body, as well as the cost incurred as a consequence of pilferage.

A popular opinion voiced by many authorities in South Africa was that a cheaper, possibly plastic bodied water meter, would be the ideal solution, also obviating the problem of theft for the scrap value of brass-bodied meters. It was estimated that the potential market in South Africa alone could be as high as three million units.

#### **ABB KENT**

A plastic bodied domestic water meter manufactured by ABB Kent Meters has been available for many years.

In July 1986 the City Council of Durban purchased a trial batch of two hundred of these plastic meters and installed them in an area that was prone to the theft of brass bodied water meters. The method of installation was the conventional above-ground loop with the meter in the horizontal position and fully exposed to the elements.

During October 1993, after seven years of service, a representative batch was taken out of commission to test their burst strength. The tests indicated that whilst the exposed counter face of the meter showed witness of degradation, a minimum average burst pressure of 450 psi (3 300 kPa) was recorded - no mean achievement, considering that both engineering plastic materials and the method of injection moulding were comparatively primitive fifteen years ago.

The fact that the plastic meters remained operational for such an extended period without protection from the "Durban sun" was remarkable. Equally remarkable was the fact that they were not stolen!

#### **WRC**

The results of the Durban test prompted the Water Research Commission (WRC) to financially support ABB Kent Meters in the development of their latest version of the plastic bodied (KSM) water meter.

The broad objectives of this project were to:

- Select and evaluate suitable materials and develop a suitable meter;
- Re-design the product to incorporate an eight figure counter and a facility for pulse output;
- Design the injection moulding dies using the latest technology available;
- Manufacture the dies and produce trial batches;
- Undertake accelerated laboratory tests in conjunction with the SABS and Plastomark (Pty) Ltd (Engineering

Polymers);

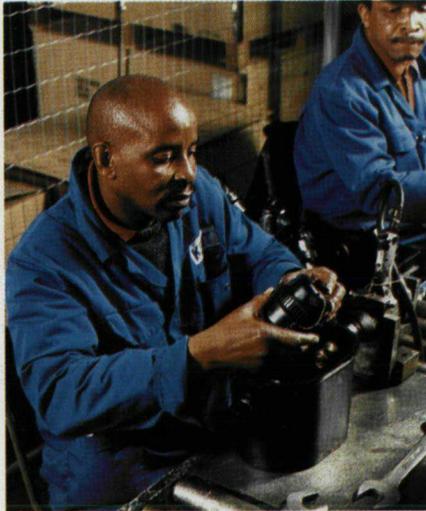
■ To hand the dies over to ABB Kent Measurement (Pty) Ltd South Africa where all plastic bodies for KSM production for the group's requirements would be manufactured.

## RESULTS

The biggest problem has been the mechanical and chemical stability of the plastics raw material under the many diverse installation conditions. Mechanical stress fractures, material creep, chemical leaching, etc. after unspecified time periods made plastics materials less attractive to users than solid brass, where the likelihood of failure was thought to be minimal.

Early prototypes of the plastics bodied water meter were made of acetal material, one plain acetal and three with various percentages of fibre additives (10, 20 and 30 per cent).

At that stage minimum burst tests were in excess of 3 000 kPa (30 bar), although



the plain acetal (without any fibre additives) performed the best with a burst test of over 5 000 kPa (50 bar). This was attributed to homogenous bonding across the weld line of the plain acetal material, whereas the fibre particles did not bind across the weld line in the other materials.

## MODIFICATIONS

The initial designs were for a meter body with an overall length of 165 mm. However, it was subsequently agreed the meter's overall length should conform to the ISO dimension of 114 mm. This decision necessitated a change in the overall strategy of the project and rendered the prototype moulds obsolete. Thus modifications were required to alleviate certain stress points that were inherent in the previous mouldings and flow characteristics of the injection process were enhanced by smoothing sharp bends with longer radii. These modifications resulted in a vastly improved product.

A spokesperson for Kent Measurement says that since the completion of the Water Research Commission project bulk manufacture of the plastic bodied water meter has started and a duplicate set of dies have been ordered by Kent Measurement to keep up with the world wide market demand. Export of the bodies to group companies has commenced.



# UNIVERSITY OF CAPE TOWN

## Department of Civil Engineering

### Water Research Group



## Post Graduate Diploma in Water and Wastewater Treatment

### Course contents

Single and mixed weak acid/base systems; alkalinity, acidity and pH control; precipitation and dissolution; corrosion; flocculation; chemistry of iron, manganese, lead, chlorine and nitrate in water.

Wastewater characterisation, activated sludge systems, biological nutrient removal, sludge bulking, secondary settling tanks, design and simulation models, sludge treatment, and other related topics.

**The one year course will commence on 17 February 1997.**

**Please apply before 30 January 1997.**

### For further information please contact:

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University of Cape Town  
Rondebosch 7700 Cape Town  
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*The reverse osmosis modules at the SASOL works in Mpumalanga.*

## Looking at the industrial applications of **MEMBRANES**

**T**he results of a study in which various experimental and established membranes and membrane systems were tested on different industrial effluents have been released by the Water Research Commission in Pretoria. According to the final report summarising the results, ultrafiltration, reverse osmosis and nanofiltration membranes were used in various applications. Technical aspects such as the cleaning of severely fouled membranes, membrane production quality control and process development were also researched.

The research team members were GF Malherbe, CE Morkel, D Bezuidenhout, EP Jacobs, MJ Hurndall and RD Sanderson, all from the Institute for Polymer Science at the University of Stellenbosch.

Copies of the report entitled "**Industrial applications of membranes**" (WRC Report 362/1/95) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 20).

**S**pecific membrane applications investigated by the research team included, inter alia, brackwater treatment, cooling water blowdown treatment with membranes, the recovery of by-products from wine rests and the restoration of membrane performance.

## BRACKWATER TREATMENT

For the purpose of desalinating brackish water to give a potable water which would comply with SABS standards, tubular ultra-thin-film reverse osmosis membranes were manufactured for on-site testing in Botswana. The standards with which the membranes were to comply were: sodium chloride retention > 90 per cent at relatively low pressures of between 2 and 3 MPa. The membranes were to be potted in modules, prior to installation on-site in Botswana, by Membratex (now Envig), a local company specialising in the manufacture of a variety of membranes and membrane systems.

The report says two experimental ultra-thin-film reverse osmosis membranes, produced at the Institute for Polymer Science, were selected for this purpose. They had been made and tested during a parallel Water Research Commission project (no 361: 1991 - 1993). The membranes were re-made in tubular form on a laboratory-scale and the best-performing membranes selected for fabrication in greater quantities.

After potting of single tubes into modules, the membrane test results did not meet the required standards of performance. Later tests on single control membranes and membranes taken from the modules suggested that the membranes might have been damaged during module fabrication.

The report says further research is required to establish most favourable conditions under which to store these membranes and to minimise damage during the assembly of the modules. This is currently being carried out as part of the "Tolerant Membrane Project" at the Institute for Polymer Science.

An ultra-thin-film reverse osmosis mem-

brane comprises a thin and relatively brittle membrane layer upon an ultrafiltration substrate membrane. For this reason it is important to handle these membranes with care during the potting process. The slightest hairline crack in the brittle ultra-thin layer could cause membrane performance to deteriorate.

The tubular membranes manufactured for the Botswana application were, however, successfully used in other applications (for example, at Sasol), where they were encased in perforated stainless steel tubes.

GF MALHERBE  
CE MORKEL  
D BEZUIDENHOUT  
EP JACOBS  
MJ HURDALL  
RD SANDERSON

INDUSTRIAL APPLICATIONS OF MEMBRANES

Report to the  
WATER RESEARCH COMMISSION  
by the  
INSTITUTE FOR POLYMER SCIENCE  
UNIVERSITY OF STELLENBOSCH

WRC report No 362/1/95

## SASOL COOLING WATER

The report says the quality of the process cooling water at Sasol has deteriorated over recent years. More specifically, the levels of sodium, chlorides, sulphates, chemical oxygen demand and total suspended solids have increased by between 50 and 150 per cent over the past five years.

Experimental ultrafiltration and reverse osmosis membranes were tested on Sasol cooling water blowdown. Different industrial effluents have different chemi-

cal compositions and therefore exhibit different properties. In the case of this particular effluent, the challenge to recover water to the extent that the water meets the desired standard for re-use, was hampered by the fact that the effluent contained a number of hydrophobic constituents which caused gel polarisation at the membranes' surfaces. Permanent fouling could fortunately be prevented by means of regular detergent washes.

Ultrafiltration reduces the fouling potential of the effluent by the removal of suspended solids and macromolecules. It could therefore be used as a possible means of pretreating the effluent prior to reverse osmosis or other desalination methods.

Cooling water blowdown was regularly sent to Stellenbosch in 200l drums. Various membranes were tested on this effluent. After extensive testing of tubular ultrafiltration, capillary ultrafiltration and nanofiltration membranes in the laboratory, the conclusion was reached that test rigs should be designed and constructed to evaluate these membranes on-site on a continuous stream of cooling water blowdown.

The ultrafiltration and reverse osmosis membranes evaluated during the course of this study proved to be, with the exception of a few, chemically stable after being tested on an effluent which consisted of a variety of dissolved and suspended solids and with a major fouling potential. The report says it was also found that subjecting the ultrafiltration membranes to a detergent wash always resulted in restoration of the original fluxes. It was found that suspended solids and macromolecules could be removed effectively by ultrafiltration, while the salt concentrations were greatly reduced by reverse osmosis.

A good quality permeate with total removal of suspended solids and close to 100 per cent removal of colour was achieved by treating the cooling water blowdown with ultrafiltration. This could result in a drastic increase in reverse osmosis flux when ultrafiltration is used as a pretreatment method before reverse osmosis. A cost study is required to

determine whether this operation is economically viable in view of the rapid declining ultrafiltration flux and the need for frequent washing to maintain high average flux-values. It was interesting to note that 50 to 70 per cent of the iron and sulphate were removed because of the presence of a gel-layer on the ultrafiltration membrane surface.

In the case of nanofiltration, the biggest problem proved to be the relatively rapid, although not permanent, fouling of the membranes. A general conductivity retention of approximately 70 per cent, with 99 per cent removal of phosphate, sulphate and colour, was achieved with nanofiltration.

Reverse osmosis showed 95 to 99 per cent conductivity retention, while individual retentions of sodium, colour, iron, phosphate, potassium, sulphate and chlorides were never lower than 90 per cent. Rapid fouling was again experienced, although not permanent. Frequent detergent washes required during operation would probably make direct application of reverse osmosis the least attractive operation.

In conclusion, the researchers say, it must be accepted that the effluent stream selected for testing of the membranes, namely cooling water blow-down, was an extreme case, especially as regards the fouling potential. It is almost certain that membrane performance, especially membrane flux, will improve when an alternate stream is selected. Evaluating membranes on site supplied valuable information regarding experimental membrane performance.

## WINE RESTS

The objective of this investigation was to determine whether membrane processes could be applied to the fractionation of wine lees to produce usable by-products such as yeast cells and cream of tartar (potassium bitartrate).

Ultrafiltration membranes were operated in a diafiltration mode to "wash" the wine lees slurry at different solids concentrations. The potassium bitartrate-rich perme-

ate collected after ultrafiltration was then concentrated using the processes of reverse osmosis and nanofiltration to precipitate the potassium bitartrate.

Tests were conducted with experimental and commercial ultrafiltration membranes at different solids concentrations. The wine lees slurry was alternately concentrated and then diluted with clean water until most of the potassium bitartrate present in the feed was removed. Ultrafiltration membrane test results showed that while fluxes stabilised at a relatively high level of 50 litres per square metre per hour, no permanent fouling occurred during tests. The permeate was collected for testing on reverse osmosis and nanofiltration membranes.

Tests were conducted on the ultrafiltration permeate with a commercial reverse osmosis membrane and two different types of nanofiltration membranes. An experimental cellulose acetate nanofiltration membrane gave good fluxes (double those of reverse osmosis membranes) with potassium bitartrate retentions of above 80 per cent.

## CLEANING

### Cleaning of polyethersulphone tubular ultrafiltration membranes

The short laboratory study conducted on membranes that had been obtained from the abattoir operating plant at Cato Ridge revealed, amongst other things, the following:

- There were indications that lipids were present on the surface of the membranes;
- Low-temperature rinsing with cleaning solutions was not as effective as medium-temperature rinsing;
- Proteolytic enzyme cleaners, especially those which have been developed and designed for use in the abattoir industry, were indeed effective in breaking up the foulant deposits;
- Sponge balls were very effective in removing the loosened protein deposits by a scouring action, particularly if air was introduced to increase turbulence;

Peptising agents, such as chlor-alkalis, were effective in bringing about an improvement in membrane pure-water flux performance; and

It was beneficial to membrane flux restoration if a proteolytic enzyme-cleaner rinse was followed by a chlor-alkali rinse.

### Cleaning of ultrafiltration membrane systems in seawater pretreatment

Medium and low cut-off ultrafiltration membranes used in the pretreatment of seawater for reverse osmosis systems were found to be prone to fouling which resulted in a lowering of productivity. Tubular seawater ultrafiltration modules (13 mm tube diameter) could be cleaned mechanically with sponge balls while in operation to maintain higher average flux values. In contrast, the tubular MEMTUF (9 mm tube diameter) and capillary modules, which could not be cleaned by sponge balls, showed substantially lower, but stable, flux. The foulant could be removed by using a biochemical cleaner with a proteolytic enzyme, followed by a chlor-alkali rinse.

Further improvements in membrane performance will require further study of the membrane and plant operating parameters, in combination with cost-effective cleaning regimes for the different geometries. On the basis of module material cost, the capillary format proved to be competitive with the seawater ultrafiltration technology, the lower flux being balanced by the reduced manufacturing costs.

### Supplemental polymer coatings

Eskom's spent and below standard cellulose acetate spiral wound modules were used for regeneration studies. Three methods of regeneration were investigated, namely, treatment of membranes with a resorcinol-formaldehyde resin, with tannic acid and polyvinylmethylether and poly(acrylic acid) and polyethylene glycol. Regeneration of cellulose acetate membranes was achieved by the treatment of membranes with coating materials to upgrade the performance of deteriorated or substandard membranes.

# 23RD WEDC CONFERENCE 1 - 5 SEPTEMBER 1997 DURBAN, SOUTH AFRICA

## WEDC 1997 DURBAN

*Water and sanitation for all:  
Partnerships and innovation*



### CALL FOR PAPERS & INVITATION TO REGISTER

Those who are involved in interesting projects and programmes in or for developing countries are invited to offer to prepare papers. Please complete the form and send it with an abstract [less than 200 words] and brief biodata of the author[s] to reach the Conference Secretariat IN DURBAN as soon as possible and not later than 31 January 1997. Selection Committees will review offers during February. During March those whose offers have been accepted will be sent information regarding paper preparation.

**Offers of papers by women authors will be especially welcome.**

WEDC will send guide sheets and *Notes to Authors* to those whose papers are accepted. Papers are strictly limited to four printed pages, including tables, diagrams and photographs. The format used for printing enables us to get two or three pages of typing in elite or courier type on one printed page. However, authors who have access to a computer are urged to submit a disk set out in accordance with the *Notes for Authors*.

#### SUITABLE TOPICS FOR PAPERS INCLUDE:

*Community management of water and sanitation supply - hygiene, education and marketing programmes - low cost sanitation - non conventional sources of water - environmental problems and their solution - solid waste management - recycling of wastes - use of solar energy - cost recovery techniques - partnerships with the private sector - local government capacity building - groundwater use - innovative water supply and sanitation solutions - gender issues - integrated community development - balancing delivery and participation - management of resources for potable water.*

**Offers of papers from authors should be sent to:**

WEDC 1997 Conference Secretariat,

Congress International, 18 Rapson Road, Morningside 4001 Durban, South Africa.

Tel: +27 31 233494

Fax: +27 31 232405

e-Mail: [ci@neptune.infolink.co.za](mailto:ci@neptune.infolink.co.za)

**Final typed papers or disks MUST be mailed [to reach WEDC before 31 MAY 1997]**

Address: John PICKFORD, WEDC, Loughborough University, Leicestershire LE11 3TU United Kingdom

## Water, Engineering and Development Centre

Loughborough University Leicestershire LE11 3 TU United Kingdom

In collaboration with the Local Organising Committee comprising Umgeni Water, Department of Water Affairs and Forestry, Mvula Trust, Durban Metro Water and Waste, South African Association of Consulting Engineers, SA Institution of Civil Engineers: Division of Water Engineering, Water Institute of Southern Africa and other Government and Non Government agencies.

**VENUE AND DATES:**

International Convention Centre [ICC], 45 Ordnance Road, Durban, South Africa  
Conference days: 1 - 5 September 1997  
Technical visits: 3 September 1997

**WEDC CONFERENCE SECRETARIAT:**

All queries pertaining to the Scientific programme, field trips, hotel reservations, social events, transport and general information, should be directed to the Conference Secretariat:  
Congress International, 18 Rapson Road, Morningside 4001 Durban, South Africa  
Tel: +27 31 233494 Fax: +27 31 232405 e-Mail: ci@neptune.infolink.co.za



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Name of author[s]:	Provisional title of paper: [not more than five words in title]
Correspondence to be sent to: [name]	Address:
Tel: Fax:	e-Mail:
If the paper is selected, I/we will submit a disk and/or typescript to reach WEDC by 31 May 1997. I and/or a co-author will attend the Conference to present the paper.	
Signed: .....	[Principal author]

# SANCIAHS/SAICE CONFERENCE '97

**Hydrologists ...**  
and all others interested:  
**Please diarise**  
the forthcoming  
**SANCIAHS Conference '97**  
which will be held  
**17 - 19 November 1997**  
at the Conference Centre  
of the **University of**  
**Pretoria.**

## Organisers

The Eighth Biennial SANCIAHS Conference will be organized jointly by SANCIAHS and the Water Division of the South African Institute of Civil Engineers. Mr Hugo Maaren of SANCIAHS and Prof Faan van Vuuren of SAICE will be on the organising committee.

## Theme

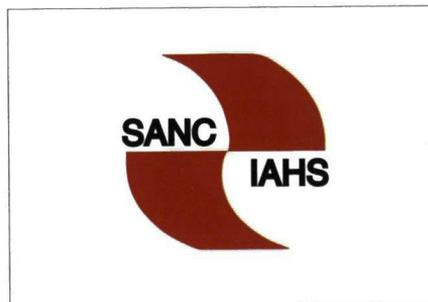
Integrated hydrological sciences for sustainable water resources management in Africa.

## Objectives

The need to recognize the holism of the hydrological cycle and to achieve sustainable development of water resources through integrated management (quantity and quality, all water, the water environment, catchments etc.) have become key principles in the South African water law review. This poses major challenges to hydrologists in terms of a more integrated approach towards their science in research and application.

The Conference will focus on improved understanding of the hydrological cycle and the application of this understanding towards sustainable development of our limited water resources. Of particular interest will be:

- the hydrological regime in different geographical settings (understanding and quantification);
- geographical and spatial characterization of water resources;
- hydrological networks (design, adequacy, integration, results);
- methods of water resources assessment;
- approaches to deal with uncertainty and heterogeneity;
- integration of research and decision making;
- international river basins; information requirements.



We need to refocus our research and development on the range of knowledge and information requirements for sustainable development, eg. for:

- resource assessment at different scales;
- water allocation for competing uses;
- water use control;
- catchment management;
- community water supply;
- water resource protection;
- water resource enhancement;
- environmental impact assessment; and
- conjunctive use.

Water supply and sustainable development of scarce water resources are at the top of the political agenda of many African countries. It is essential that the hydrological sciences are focused on this need and that African countries share their expertise in this regard.

## Conference format

The Conference will only have plenary sessions (no parallel sessions) to allow for integration across disciplinary fields. Presentation of posters will be strongly encouraged in order to cover the full spectrum of the hydrological sciences.

A series of courses will be run back to back with the Conference. Ideas are invited from SANCIAHS or SAICE members who would like to present a course.

A single key note address and about 40 papers will be presented during 2½ days (Monday - Wednesday morning).

## Paper deadlines

- Deadline for abstracts:  
30 April 1997
- Final papers (in electronic format):  
15 September 1997

## Cost

- Registration fee:  
Approximately R500.00  
(excluding accommodation)

## Enquiries to:

Ms Gerda Kruger or Mr Hugo Maaren  
Water Research Commission  
PO Box 824,  
Pretoria 0001  
Tel: (012) 330-0340  
Fax: (012) 331-2565  
E-mail: gerda@wrc.cwr.ac.za  
or  
E-mail: hugo@wrc.cwr.ac.za

## Please Note:

**A Call for Papers and Registration form will be included in the next issue of the SA Waterbulletin.**

# Flooding of abandoned mine shafts

## - effects investigated -

The Water Research Commission has released a report in which the effects of flooded mines of the Central and East Rand are investigated. The report is a first attempt to synthesise various aspects of flooding, such as: sources of water flowing into Witwatersrand mines; the resultant water level rise; the quality of the water in the mines; and expected long term impacts and results of fully flooded mines.

**T**he Central and East Rand mining areas on the Witwatersrand in Gauteng have been extensively mined since 1886. The first mines on the Central Rand developed because the gold bearing reefs were well exposed and extensions easily traced into the East Rand area where the reefs have a shallow basin-like structure. At the height of the mining activity in the late 1940s there were 39 mines operating in the area.

The area is unique in that solid rock formations were mined at relatively low grades to depths of over three kilometres. At these depths inrushes of water were experienced from the surface as well as from fissures and fractures up to one kilometre below surface. Thus during the working life of the mines, inflowing water had to be removed. Initially this was done by bailing, but later, when pumps of the required lift became available, by pumping. The water was pumped from settling sumps, launders or dams underground.

As mining developed and the mines became interlinked underground, so the task of dewatering was carried by fewer mines - usually the deepest mine had to bear responsibility for all the dewatering. Initially water committees were formed, where all the benefactors contributed to the pumping costs (about 10 per cent of the mines' operating costs) and later, as some of the members stopped par-

ticipating, the state became involved, by granting subsidies or giving assistance to cover the pumping costs.

The mines kept a fairly careful account of the volumes of water used underground, as well as the volumes pumped from underground. This was to divide the contributions paid by water committee members fairly, or to claim the subsidy from the state which was based on these volumes.

### RESEARCH PROJECT

Within the near future all mining in the Central and East Rand areas will stop and water will be allowed to freely flood the mine workings. To investigate what will happen when water starts filling up the empty mines, the Water Research Commission, at the request of the Government Mining Engineer, funded a research project at the University of the Orange Free State. The project was carried out by a researcher from the Institute for Groundwater Studies at the University, R Scott, who investigated the following aspects:

- The rate of water table recovery in the abandoned gold mines upon cessation of pumping from these mines;
- The processes affecting the quality of the water in these mines and prediction of the likely water quality in fully recovered mines;
- The quantification of possible seepages from these mines upon full recovery of the water table; and
- An evaluation of the overall impact on possible further deterioration of the surface water quality in the catchments.

The investigation was conducted by studying historical records of mining development, investigating records kept by the mines and the Department of Water Affairs as well as taking stream, groundwater and mine water samples to get a picture of the conditions that prevailed at the time of the investigation.



*Stalagmite and stalactite-like deposition of iron hydroxide (Fe(OH)<sub>3</sub>) at dripping inflow. (Waverley Gold Mine). Scale: 30 cm.*

## RESULTS

### ■ Recovery

There are many variables that govern water recovery in the mines. They are dependant on the history of mining, for example, factors such as ownership changes, mining techniques and the level of expertise attained by the company, have a bearing on the recovery.

From observing the underground water inflow, the mechanisms of recovery could be classified as follows:

■ **Rapid flows:** These flows cascade rapidly downgradient in preferred channels, such as inclined shafts, to meet the rising mine water body. Some of these inflows are closely related to rainfall events as their flow increases soon after such events.

■ **Diffuse flows:** Slow drips and trickles occur anywhere mine openings intersect water bearing geological structures. This water may move through stopes, dam up against ore heaps left in the stopes or haulages. It collects in some places forming stagnant pools. Because of its travel path this water degrades in the mine.

The nature of the underground flow can be related to the sources of recharge. Four sources of recharge are active, namely:

- Direct recharge from rainfall events
- Seepage recharge
- Surface water losses; and
- Groundwater

On the Central Rand, Witwatersrand Supergroup sediments outcrop, a large proportion (minimum of one third) of the water entering the subsurface is derived from direct recharge, seepage recharge and surface water losses. The remaining baseflow (up to two thirds) is derived from groundwater losses. The catchment area in which the reef outcrops occur has sufficient recharge to provide the groundwater contribution without an extensive cone of dewatering around the workings being evident.

On the East Rand, Witwatersrand Supergroup sediments are covered by younger rocks over most of the area and very little outcrop occurs. Direct

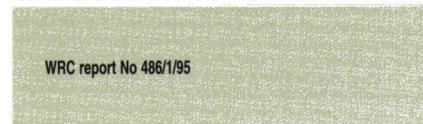
recharge occurs during exceptional rainfall, but forms an insignificant contribution to the total recharge. Most of the recharge is derived from groundwater losses, predominantly from the Transvaal Supergroup dolomites which overlie approximately one third of the investigation area. Recharge to the dolomite from within and outside the investigation area and from the swampy stream system of the Blesbokspruit is sufficient to provide the bulk of the mine inflow.



FLOODING OF CENTRAL AND EAST RAND GOLD MINES:  
AN INVESTIGATION INTO CONTROLS OVER THE INFLOW RATE, WATER  
QUALITY AND THE PREDICTED IMPACTS OF FLOODED MINES



Report to the  
WATER RESEARCH COMMISSION  
by the  
INSTITUTE FOR GROUNDWATER STUDIES  
UNIVERSITY OF THE ORANGE FREE STATE



WRC report No 486/1/95

### ■ Rate of recovery

The rate of recovery is governed by the volume of the excavations and the water inflow rate. Due to the diffuse, multiple source nature of the inflows to the workings and the inaccessibility of many of the old areas, flow gauging of the incoming water was not possible. The mines, however, kept accurate records of the volume of water that was pumped from the workings. During periods when stable underground water levels were maintained an equilibrium existed between inflowing and pumped water volumes, since no dewatering nor storage was taking place. Therefore, during such periods the pumping record will give the

best available estimate of the rate of water inflow to the mines.

On the East Rand stable water levels were maintained from 1988 until pumping stopped in 1991. The pumping records for this period show that an average of 53 Ml/day were pumped from Sallies No 1 shaft and 11.5 Ml/day were pumped from the Kimberley Reef at Grootvlei No 3 and 4 shafts. Thus over a period of almost three years when the water level was maintained at 1 606 metres below the surface, the average extraction from the system was 64.5 Ml/day.

On the Central Rand water levels have been stable in the central and eastern sections since 1977. While in the west stable water levels have been maintained since 1990. The pumping records show the following:

### ■ East Rand Proprietary Mines (ERPM) (based on 12 years of data)

At the Hercules shaft water collected on ERPM is pumped to dewater the mine: 16.02 Ml/day is pumped, but 8.93 Ml/day of this water is service water, originating from Rand Water, and ice, which is used to cool the workings. Thus 7.09 Ml/day is made on ERPM.

At SW Vertical Shaft pumping maintains the water level at 1 083 metres below the surface in the central mines (CMR to Simmer and Jack) and 1 170 metres below the surface in Rose Deep. These mines are defunct so no service water is added but some slime is disposed underground. Thus 16.58 Ml/day are pumped but 2.74 Ml/day slime is disposed, so 13.84 Ml/day is made in the central mines.

### ■ Durban Roodepoort Deep (DRD) (based on two years of data)

At DRD water is derived from the eastern neighbour Rand Leases and from DRD. Pumping maintains the water level at 2 380 metres below the surface in Durban Roodepoort Deep and 1 200 metres below the surface in Rand Leases. About 18.06 Ml/day is pumped from DRD, made up of 4.74 Ml/day from Rand Leases, 10.23 Ml/day is from DRD and 3.09 Ml/day service water, thus

14.97 MI/day is made on the western mines. Therefore, almost 36 MI/day is made daily in the Central Rand mines.

■ **Predicted recovery times**

		Mined Vol. (km <sup>3</sup> )	Inflow Rate (m <sup>3</sup> /day)	Time to fill (years)
Central Rand	Max.	283.7		22.90
	Min	224.5	35900	18.13
	Min (Unreliable)	84.1		6.88
East Rand	Max.	304.4		13
	Min	207.1	64500	9
	Extrapolated			14

■ **Discharge points**

The mine excavations, in crystalline rock, introduce porosity to an otherwise impervious rock sequence. Thus the mine openings and the surrounding mining induced fracture systems form tabular, porous zones within impervious rocks.

The mine openings are defined as mine aquifers, because due to fracturing, closure and water filling, they can no longer be viewed as stopes or haulages.

The mine aquifers of the Central and East Rand are partly dewatered. When all pumping stops and the mine aquifers are allowed to fill, water levels will be definable for the aquifers. Vertical shafts which intersect the aquifer are equivalent to boreholes drilled into a confined aquifer. They can therefore be considered to be piezometers where the piezometric surface could be measured. Shafts with collar elevations lower than the piezometric surface will become discharge points, equivalent to artesian boreholes, from the mine aquifer.

The mining induced porosity is such that the mine aquifers are highly transmissive zones and once filled, water will move preferentially via the most transmissive route, following the path of least resistance. Thus even when fully recovered, the water will move through the mine aquifers without recharging the surrounding low permeability rock. The shafts connected to the mine aquifers are therefore the potential discharge points and not geological structures such as faults or dike zones which have much lower transmissivity.

Thus identifying shafts with potential to become discharge points involves predicting what the piezometric surface would be and comparing shaft elevations with that surface. All shafts with eleva-

tions below the predicted piezometric surface have potential to become discharge points.

Historical evidence has shown that the main inflows are occurring at the outflow from Florida Lake, in the vicinity of Village Main Reef mines and the Knights and Waverley mines. The surface elevation of these points ranges between 1 670 and 1 720 m above mean sea level. The measured average ground water level in these areas is 15 m below surface. The piezometric level would be similar to, or slightly lower than this level. Thus for identifying potential outflow shafts a level of 1 660 m above mean sea level has been used.

Using this level ERPM's South East and Far East Vertical shafts have the greatest potential to flow, being 59 and 54 m below the proposed piezometric surface. This is some ten to fifteen metres lower than the next nearest shaft: Hercules shaft. The South East shaft, the most probable shaft to discharge water according to the elevation determination used in this investigation, is located adjacent to Cinderella Dam on a head-water stream of the Elsburgspruit.

All the mines on the Central Rand are interconnected at some level. It would, however, be possible to isolate Durban Roodepoort Deep by plugging present connections which exist at 14 level 580 m below surface. By doing this Durban Roodepoort Deep will fill up in isolation from the rest of the system and the discharge points will be either old incline shafts in the Klip River Valley or Durban Roodepoort Deep no 6 shaft. Some advantage may be derived from this

approach, due to the outflow volume being shared by two catchments. The water quality at Durban Roodepoort Deep may also be better than the overall quality at one outflow point.

Precise locations of the inflow points in the East Rand area are not known, thus predicting a piezometric level for the mine aquifer is difficult. Major inflows were recorded in the vicinity of Consolidated Modderfontein and East Geduld. Thus, if the piezometric surface is related to the type of shallow inflow observed at Consolidated Modderfontein no 8 shaft, where the surface elevation is 1 623 m above mean sea level, the inflow depth is 50 m below surface. The piezometric surface would then be 1 573 m above mean sea level.

Using this level, Nigel no 3 shaft is 24 m below the proposed piezometric surface, which is 9 m lower than the next nearest shaft elevations. The outflow at this point is dependant on a connection between Sub-Nigel and Vogelstruisbult Mines. If the connection is blocked then Marivale 4 or 7 shafts, which are 8 and 9 metres respectively below the proposed piezometric surface, could form outflow points.

■ **Discharge volume**

The discharge volume in the Central Rand area will be similar to the pumped volume minus service water, ice and waste disposal. Thus some 34 MI/day will discharge from the identified outflow shaft, made up of a groundwater baseflow of 24 MI/day and a seasonally variable component of some 10 MI/day. Constructed compartmentalisation at Durban Roodepoort Deep would allow 8 MI/day to discharge at this mine and reduce the volume at South East Shaft to 26 MI/day.

On the East Rand, the volume of water emanating at Nigel no 3 shaft will be less than the present inflow volume. This will be due to the recovery rate slowing down from the base of the dolomites (550 metres below surface) due to some of the inflows from the dolomites being cut off. This will particularly apply to the last 100 to 140 m of water rise.

When the water level reaches the main inflow level, estimated to be 25 to 27 m below the surface at East Geduld, equilibrium will be established. At this point the outflow rate at the decant shafts will be equal to the inflow rate from the

dolomites. The volume should be of similar order of magnitude to the river flow rate before mining and effluent disposal altered the surface and groundwater flow situation in this area. This estimate assumes that the main flow in the river, prior to mining, was derived from groundwater.

The flow rate can therefore be estimated from observations that the swamps dried up in winter, the dry period lasting for about half of the year. This means that the flow rate will be lower than the total effluent disposal to the river, which is able to keep the river flowing year round. If the total effluent disposal is 65 Ml/day, then the outflow at Nigel will be less than this figure, probably half (based on the half year dry period), that is, 33 Ml/day.

#### ■ Water quality

It has been suggested that the water quality in the filled mines will improve with time. This possibility would depend on fresh water recharging the mines and eventually forming a pool of clean water which takes part in all water exchange to and from the mine.

This investigation has shown that the water recharging the mines is degraded within the region of recharge so that fresh water does not recharge the mine. If a pool of inflow quality water were to form underground there are natural chemical processes which could cause the water quality to deteriorate.

One of the major factors contributing to water degradation is the reaction of water with sulphide minerals, producing the so called "acid rock drainage". The Witwatersrand Supergroup sediments contain varying proportions of sulphide minerals, the predominant sulphide being pyrite. In many of the gold bearing reefs this mineral may form up to three per cent (by mass) of the rock.

Mining of the Witwatersrand Supergroup sediments has produced on the surface: rock piles, sand and slime dumps; and underground: backfilled rock piles and spoil heaps in stopes and haulages. These all contain pyrite which, in the broken and crushed rock, is now exposed to air and water and oxidises. Due to this oxidation the rocks and accumulations have characteristic red and yellow staining and discoloration from secondary iron oxide minerals and mineraloids. The acid content of water that passes

through such accumulations increases. Thus the reactivity of the water increases and in its passage, it reacts with other minerals, either to generate more acid or to neutralise the existing acid. The total dissolved solids content of the water rises. The water may be characterised by one or more of the following: low pH, high total dissolved solids, high sulphate content or high heavy metal content.

Due to the variable nature of the recharge sources and to the many places where acid formation can occur, water degradation is diffuse and no one source can be identified as a major contributor to the overall degradation of the water. Surface degradation and subsurface degradation both contribute to the overall lowered water quality.

Using a model to generate the final water quality is not possible. The water quality in the filled mines is predicted from samples taken of dammed underground water and rising water in the mined basins. This is the best basis for prediction since conditions in these basins are similar to what they will be on full recovery.

The most contaminated mine water has a high density of about 1.02. This will ensure that the worst water is trapped in the deepest parts of the mine aquifer.

#### ■ Management

The management of this system must aim to reduce the influence of mine water recovery on the natural environment.

Some of the possible influences which have become evident from this investigation include the following:

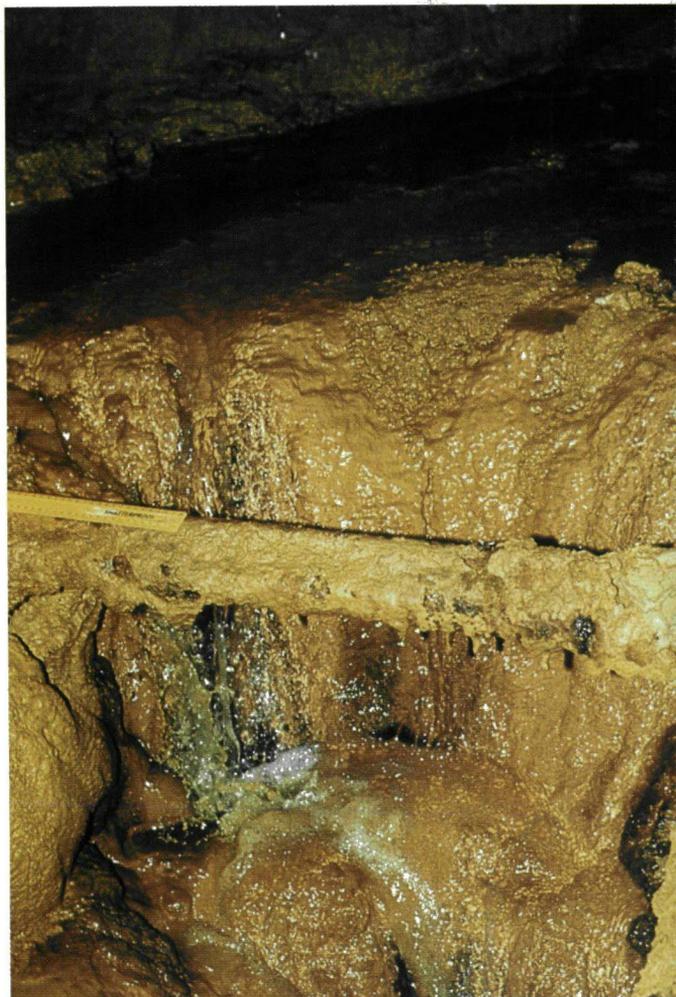
- Springs re-emerging in the Blesbokspruit river system that will inundate low lying areas and destabilise mine waste heaps.
- Increase in subsurface instability and seismic activity.

- Recharge of local aquifers by mine water. On

the East Rand it was suggested that such recharge would promote instability in the dolomites.

- Negative impacts on the natural environment around discharge points.
- Water quality deterioration.
- Negative impacts on water users downstream of the discharge points.
- Water intrudes into ERPM from the filled East Rand mining basin.

Copies of the report titled **Flooding of Central and East Rand gold mines: an investigation into controls over the inflow rate, water quality and the predicted impacts of flooded mines** (WRC report 486/1/95) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: US\$ 30).



*Deposition of iron hydroxide down a grizzly at Waverley Gold Mine. (Scale: 30 cm)*

# KNP RIVERS RESEARCH

## - a programme of participation in process

**T**he Kruger National Park Rivers Research Programme (KNPRRP) is a co-operative undertaking by resource-use managers, funding agencies and researchers. It addresses in an integrative framework the water quality and water quantity requirements of the natural environments of rivers, particularly those flowing through the Kruger National Park (KNP).

The programme, conceived at a workshop convened by the Department of Water Affairs and Forestry in March 1987, was initiated in December 1988, jointly by:

- the Department of Water Affairs and Forestry
- the Foundation for Research Development
- the National Parks Board
- the Water Research Commission
- various research institutions and provincial nature conservation authorities.

The Water Research Commission currently provides the major financial support for the KNP Rivers Research Programme.

### Guiding and driving philosophies

The Kruger National Park Rivers Research Programme is acutely aware of the implicit social contract in research programmes in which public funds are used and that when research fails to inform public policy it becomes discredited and loses public support.

The form of the Kruger National Park Rivers Research Programme's contribution to public policy is to promote the process by which decisions are made

rather than to promote a particular decision. This is in line with the urgent need to broaden meaningful participation in integrated water resources management.

The underlying philosophies which drive the Kruger National Park Rivers Research Programme represent a paradigm shift in strategic thinking on the means to attain the goal of integrated catchment management.

### Southern African context

The need to broaden participation and thereby democratise the process of integrated catchment management for sustainable water resources development is fundamental to peaceful, holistic and equitable progress in southern Africa. This need is urgent in a region so racked with conflict and riven with inequalities which exacerbate the already complex situation surrounding the sustainable development and use of scarce water resources.

In the Southern African Development Region (SADC) seventy per cent of the land area is comprised of river basins which are shared by one or more countries. Water is a scarce and truly international resource in this region. The equitable and sustainable management of our water resources therefore requires integrated efforts, backed by high quality information and communication of scientists and a whole range of stakeholders. The following quotation so aptly refers: "The task of finding compromises to water allocation problems amongst consumers with widely divergent interests, levels of sophistication and aspirations, will require skilful negotiation in an enlightened climate of magnanimity and trust."



These are indeed wise words and provide noble goals for which to strive. The key questions, however, relate to the strategies which organisations can employ both internally and inter-organisationally to empower people to play a meaningful role in the processes which will lead to the attainment of these goals. One such strategic initiative, in this direction, is the Kruger National Park Rivers Research Programme. The focus of the research in the current phase of the Programme is the development of a decision support system and accompa-

# *Legionella* and Industry

The *Legionella* bacterium causes the dreaded legionnaires' disease.

This pneumonia-like disease is contracted as a result of the inhalation of contaminated aerosols containing *Legionella* bacteria.

The disease may in many cases prove fatal.

The *Legionella* Action Group is planning a one day workshop/seminar.

If you are interested in attending, please complete the following questionnaire and send/fax it before 31 March 1997, to

**Co-ordinator:**

Audi Snýman

Environmentalist

Tel 016 703 3059

Polifin: Midland

Fax 016 703 2925

PO Box 321 Sasolburg 9570

Title : .....      Initials : .....      Surname : .....

Company : .....

Postal address : .....

Postal code : .....

Telephone : .....      Code : .....

Fax : .....      Code : .....

E-mail (Please print clearly) .....

I am interested in:

- a) Areas of interest: (number in order of importance)
- ..... i. Detection methods
  - ..... ii. *Legionella* environments (eg cooling towers, surface waters and hospitals)
  - ..... iii. Control of *Legionella*
  - ..... iv. Legislation and/or standards for *Legionella*
  - ..... v. Risk assessment on *Legionella*
  - ..... vi. Other areas of interest  
(please name them).....  
.....

- b) Industry sector: (Mining, Chemical etc)  
.....

- c) Would you like to attend:
- ..... i. Workshop
  - ..... ii Seminar
  - ..... iii. Workshop seminar combination

- d) Knowledge of *Legionella*?
- ..... i. Good knowledge
  - ..... ii. Heard of it
  - ..... iii. Poor

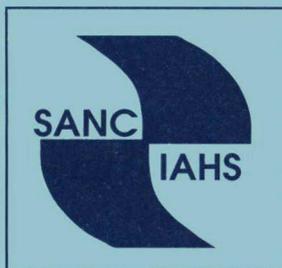
- e) Prepared to localize a workshop in your area?  
.....

First Announcement and call for papers

**EIGHTH SOUTH AFRICAN  
NATIONAL HYDROLOGY  
SYMPOSIUM**

*“Integrated hydrological sciences  
for sustainable water resources  
management  
in southern Africa”*

**17-19 November 1997,  
PRETORIA**



Organised by  
SANCIAHS

South African National Committee for  
International Association of  
Hydrological Sciences

and

SAICE (Water Division)  
South African Institute of  
Civil Engineers

**OBJECTIVES**

The Symposium will focus on improved understanding of the hydrological cycle and the application of this understanding towards sustainable development of our limited water resources.

**WHO SHOULD ATTEND**

The Symposium will be of interest to consultants, scientists, planners, managers and students. Participants from throughout the southern African region and elsewhere are welcome.

**SYMPOSIUM FORMAT**

The Symposium will only have plenary sessions (no parallel sessions) to allow for maximum integration across disciplinary fields. About 40 papers will be presented during 2½ days (Monday - Wednesday morning). A single key note address is foreseen.

A series of courses will be run back-to-back with the Symposium.

**CALL FOR PAPERS**

Contributions (oral or poster presentations) are invited on topics relevant to the theme of the Symposium. Prospective authors should note the following:

- A single page abstract (300-500 words) must be submitted before **30 April 1997** which outlines the scope and contents of the paper and summarises the major results and conclusions.
- The abstracts will be included in the programme
- Papers will be selected for oral or poster presentation by the organising committee and authors will be advised of the decision by 30 June 1997.
- Final papers must be submitted in electronic and hard copy format (preferably WordPerfect or MsWord) by **15 September 1997**.

**EXHIBITING**

Very limited space will be available to exhibit books or software of particular interest to the symposium. People wanting to use this facility should indicate their interest on the attached reply card.

**FEES AND ACCOMMODATION**

Further detail will be mailed during June 1997 to those responding to this first circular. The registration fee will be approximately R600.00 excluding accommodation which will be available at the University of Pretoria and in local hotels and guest houses. People must organise their own transport and accommodation.

**REPLY CARD**

**Eighth South African National  
Hydrological Symposium  
PRETORIA, 17-19 November 1997**

Please complete and return by **30 January 1997**

Ms G Kruger, Water Research Commission,  
PO Box 824, Pretoria, 0001.  
Tel: (012) 3300340 Fax: (012) 3312565  
E-mail: gerda@wrc.ccwr.ac.za

Name(Prof/Dr/Mr/Ms) .....

Affiliation .....

Address .....

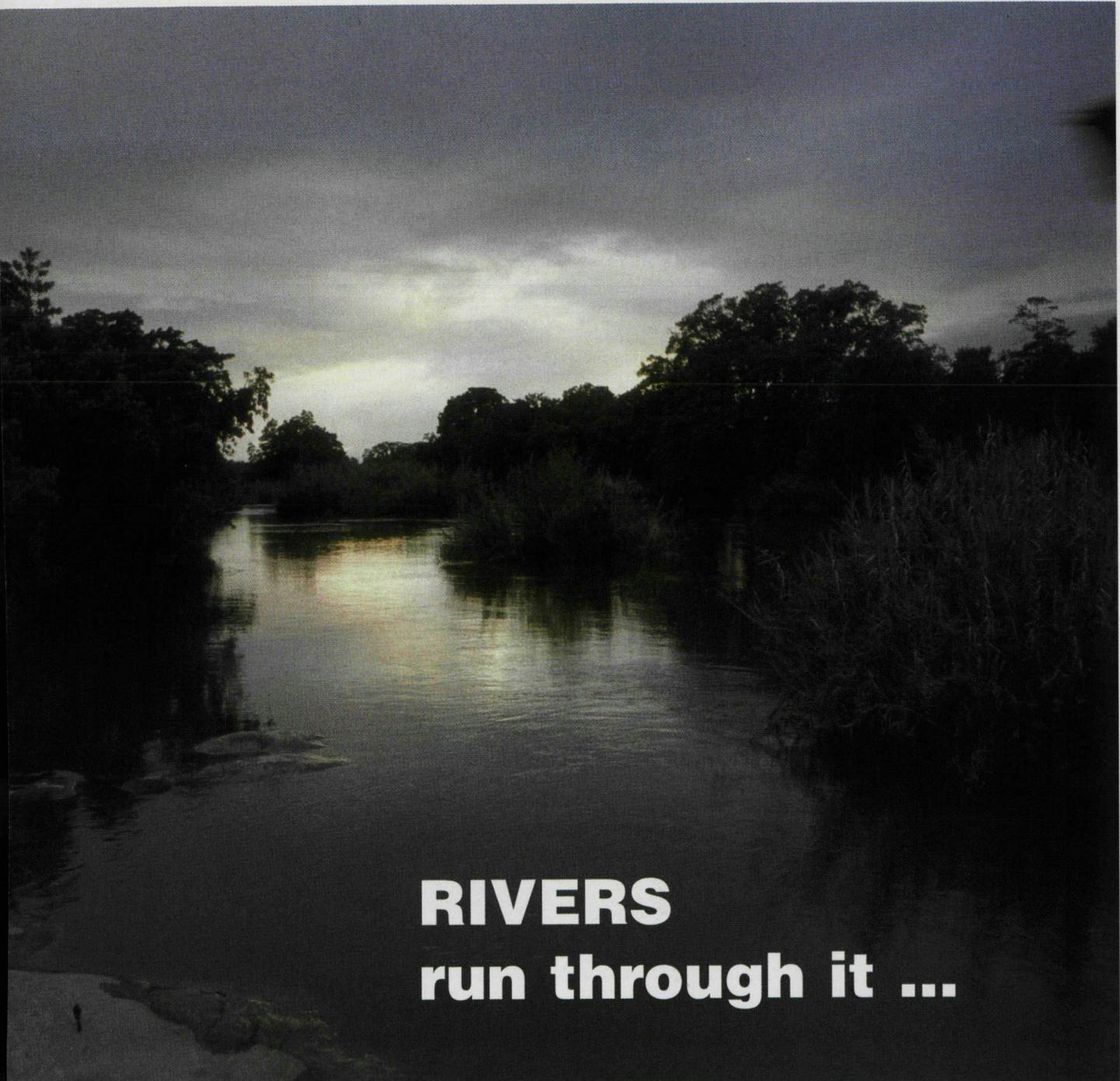
Tel ..... Fax .....

E-mail .....

I will attend Certain / Fairly certain / Uncertain

I will submit an ORAL/POSTER paper, provisionally titled

I am interested in reserving exhibition space and require details about space and costs YES / NO



# RIVERS run through it ...

nying process to assist in determining the water requirements of the natural environment of rivers. This integrative and dynamic approach is designed to:

- assist in evaluating the pressures and impacts exerted by different users of the water system and extends beyond the process of merely attempting to match supply and demand in the traditional way.
- be capable of establishing and maintaining internal consistency or detecting inconsistency of alternatives.
- be able to accommodate different

value systems amongst stakeholders.

- enable policy makers to move through the processes which are capable of identifying the critical components of the water system where policy interventions are likely to be effective and provide them with tools to make such interventions.

Integrated modelling enables outsiders (and previously marginalised constituencies) and also new generations to bring new frames of reference to bear on the shared problems. Integrated modelling

can generate scenarios so people can make informed choices between options.

The outcome of the Kruger National Park Rivers Research Programme will be a living and dynamic process. The accompanying technology and decision support systems which the Programme develops will enable progress towards the multi-functional sustainable use of water considering the needs of ALL users and ALL factors which impact on the system.

## Rivers Research Programme holds Public Forums

The Kruger National Park Rivers Research Programme (KNPRRP) recently held a series of three public forums to which politicians, agriculturalist, environmentalists, rural developers, researchers and catchment managers were invited.

In the opening address the Minister of Water Affairs and Forestry stressed the vital importance of the programme, not only to the Kruger National Park but to all the people living in the catchments of our eastern flowing international rivers. He urged that the programme continue its work to develop processes whereby strategic planning could be performed on a systems basis. This planning, he said, was essential for all to understand the difficult choices facing all the people in this region.

In his presentation to the forum Professor Charles Breen, Managing Director of the Programme, pointed out that a fundamental difference between Phases I and II of the KNP Rivers Research Programme is the recognition currently, in Phase II, that "decisions on management options need to be made in the context of historical and prevailing circumstances so as to optimise conservation of the natural environment of rivers.

The basis for achieving this is our ability to predict the behaviour of these systems under changing circumstances, acknowledging that as trade-offs have to be made continuously, there can be no absolute amount for water quality and quantity to sustain the natural environment indefinitely."

Addressing the future vision of the programme Professor Breen pointed to the new paradigms for managing water resources which are emerging internationally and which are being supported in South Africa by the emerging principles of the new water law. He concluded his presentation to the forums by saying that it is evident that in future, research programmes will need to be fashioned in the context of these new paradigms and their associated obligations. Future programmes should address matters such as bio-diversity, water allocation and water pricing, and should also promote participation in, as well as a sense of responsibility for resource management. In this way the KNP Rivers Research Programme must become increasingly part of a holistic approach to resource management.

## Report available: A Prototype Decision Support System for the Kruger National Park Rivers Research Programme.

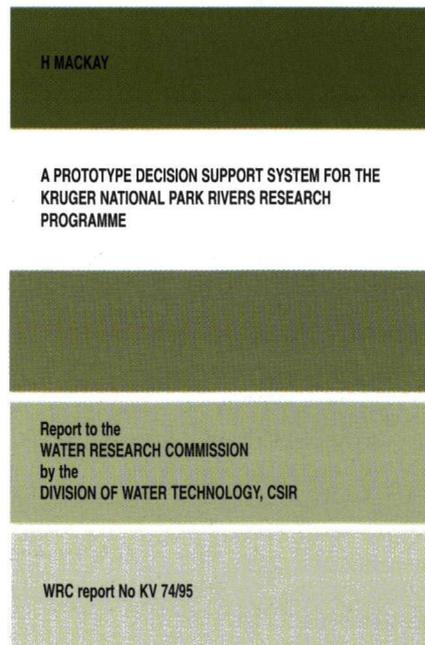
When the Kruger National Park Rivers Research Programme was initiated its objective was to determine the water quantity and quality requirements for ecological maintenance in the rivers which flow through the Kruger National Park.

Now, in the second phase of the research programme, the formally stated goals are:

- to inform researchers, water managers and stakeholders about the water quality and quantity required to sustain the natural environments of the rivers flowing through the KNP, and
- to develop, test and refine models for predicting the environmental water quantity and quality requirements of rivers in southern Africa.

The research programme's activities are focused on providing information to resource managers to support them in the decision-making process.

A project was proposed in August 1993 to develop a prototype decision support



system for the Kruger National Park Rivers Research Programme. The aim of this project was to show how such a deci-

sion support system or approach could be used

- to structure and facilitate communication between researchers, managers and stakeholders, and
- to provide information regarding management of the natural environment of rivers, and the consequences of proposed water allocation scenarios, thereby helping managers to improve the quality of their decisions regarding water allocations.

The report gives an account of the two workshops that were held in this regard. It also outlines possible future development of the decision support approach within the Kruger National Park Rivers Research Programme.

The report entitled **A prototype decision support system for the Kruger National Park Rivers Research Programme** (WRC Report no KV 74/95) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: US \$20.

## KNP Rivers Research Programme fosters co-operation on development of an integrated catchment information system

The Kruger National Park Rivers Research Programme has fostered a co-operative computing effort amongst scientists from a number of South Africa's research institutions. The effort is aimed at developing an integrated catchment information system for managing the requirements of water for riverine ecology. The software is part of a decision support system which makes use of ARCVIEW and a range of other software on a desktop machine, as well as the wide area computer networks.

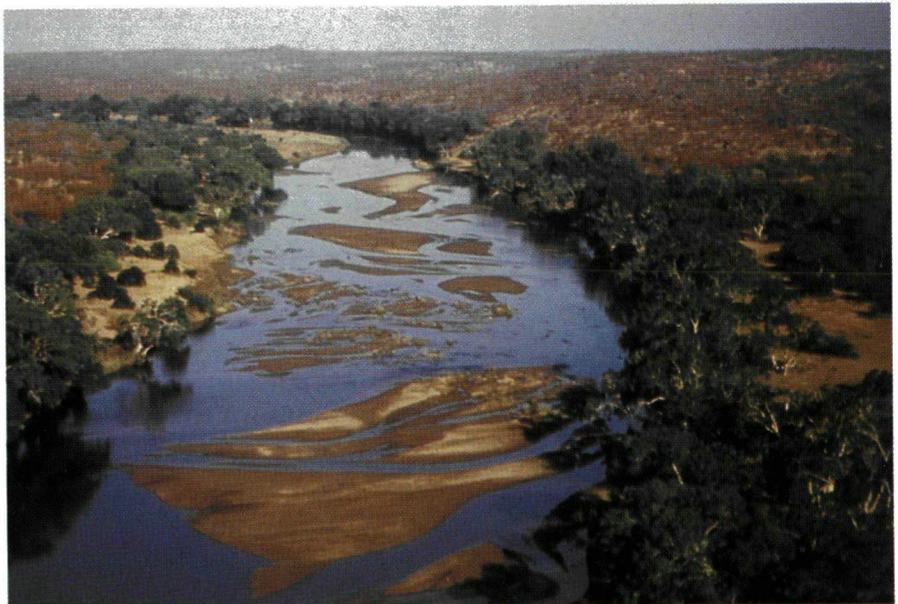
The hardware requirements to run the system are at least a 486 processor, 16 Mbytes of RAM and 60 Mbytes of disc storage (for the data alone) and a connection to the Internet. The system makes use of the multi-tasking capabilities of Windows 95 as its platform and for the most part runs in a shell developed around the ARCVIEW 2.1 GIS product. The remote process calling function of ARCVIEW is utilised to seamlessly call programmes written in Fortran, Turbo Pascal, Delphi as well as Netscape for hypertext. These programmes run on the users local machine, some of them under DOS. In addition a vital component of the system is the connectivity to the wide area networks through Telnet, X.25 or Kermit. The latter two methods are utilisable through dial-up modems.

### Communication network

The wide area connectivity is required to ensure version control to the vast quantities of simulated information which the system creates for each water resources scenario. The information is created through sophisticated simulation modelling at a powerful central computing site. Such wide area connectivity is vital in this sub-continent where the scientists are few and scattered geographically, yet are required to communicate continuously. Communication between scientists is essential for the generation of scenarios which form the basis of informed choices by society.

The system includes:

- a comprehensive computerised data



*Aerial view of a river in the Kruger National Park.*

base of scientific information on the rivers in the KNP;

- a prototype fish model which simulates and graphically displays the effects of streamflow on selected fish population dynamics in shallow waters in the Sabie river inside the park;
- connections to hypertext software systems which enable the user to interrogate the rules used in the fish model mentioned above;
- a wide range of line graphics as well as the full display graphics capabilities of ARCVIEW 2.1;
- routines to perform "animated" displays of colour coded projection of variable values on selected river segments within the catchment, (the Sabie catchment, on which the prototype is based, has been divided into 56 sub-catchments for analysis and display);
- a versatile package to display daily simulated and observed results in a range of relevant water resources formats;
- the ability to access a range of pictorial images through a simple point-and-click of the mouse, this latter functionality is exceptionally useful when communicating with a range of users and viewers

of the system who are at different levels of understanding on components of the issues;

- the display and analysis of a range of geomorphological features of rivers which are central to their ecological functioning.

The system is currently installed at twelve research, government and statutory institutions who are connected with the Kruger National Park Rivers Research Programme, and plans are advanced to install it at a number of universities, as well as in Mozambique and in Swaziland.

An essential element in the system's future usefulness and acceptability is that users feel that their needs have been accommodated within the software. For this reason the system is being shared with a wide range of users which include competing stakeholders in the water resources of the catchment.

Improvements and features which emerge from this process of sharing and interaction are included in new releases of the software.

# Estimating domestic water demand of developing communities

The Water Research Commission has released a report describing the factors which influence water demand of developing communities resident in the Northern Province, North-West and Mpumalanga (formerly Northern Transvaal) area. The researcher, A van Schalkwyk of the consulting firm Water Systems Management in Pietersburg, says water demand is related to numerous factors "and these are thoroughly investigated and assessed in the report."

He says water use in the more than 4 000 villages in this region is, in most cases, not monitored. "Therefore it is not possible to determine water use parameters from past trends; water demand has to be based on per capita water use or water use per family or per dwelling unit."

Van Schalkwyk says that to apply this approach successfully, it is essential to understand the human factor and its environment.

"This project is essentially a study to understand the water consumers in terms of their habits with respect to water use and culture, as well as their social and economic conditions. Other aspects addressed in the report include income/expenditure patterns, family structure, community structure, domestic environment and the daily activities of residents."

Copies of the report entitled **Guidelines for the estimation of domestic water demand of developing communities in the Northern Transvaal** (WRC Report 480/1/96) are available free of charge from the Water Research Commission, PO Box 824 Pretoria 0001. (Overseas price: US\$ 20).



*A rural settlement in the Northern Province.*

A large percentage of the population in South Africa has inadequate domestic water supplies and experience water shortages. The inadequacies are mainly in terms of the volume of water delivered, inappropriateness of water distribution facilities, excessive walking distance, long queues at water points, poor maintenance and inadequate bulk water development.

It is now generally accepted that appropriate and adequate water supply facilities can only be developed and sustained by fully involving the community. This implies that it is essential to focus on the requirements of the domestic water user, and not on arbitrarily fixed design rules.

This WRC report gives guidelines for:

- Determining the requirements of the domestic water user;
- Estimating present and possible future water demand;
- Assessing the parameters applicable for the design of bulk water systems; and
- Designing appropriate water distribution facilities.

## WATER DEMAND ESTIMATION

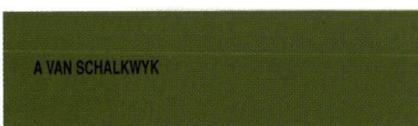
According to the report the domestic water users require potable water mainly to satisfy personal needs, as only a small quantity of water is required to sustain life. The domestic water demand is therefore essentially related to the character and make up of the domestic water user. Research and available literature suggest that domestic water demand is dependent upon the value orientation of the water user and the water tariff.

Value orientation describes the living standard of the community, but it is difficult to quantify in view of the large number of intervening variables which determine the values held by individuals. The development, priorities and attitudes of communities has also been significantly influenced by the political and socio-economic situation in South Africa.

## WATER REQUIRED FOR VARIOUS DOMESTIC ACTIVITIES

Domestic water is required for drinking, cooking, dish washing, house washing,

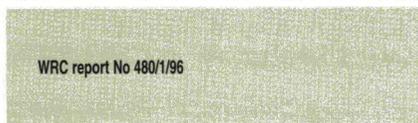
clothes washing, personal hygiene, gardening, sanitation and swimming pool maintenance. Water use and the volumes required is related to the standard of living of the water user. This in turn is related to the disposable income, value orientation, enthusiasm for gardening, ability and willingness to pay for water used, and an awareness of the scarcity of water. The volume of water required for each of the domestic activities at different levels of living is given in a table in the report.



GUIDELINES FOR THE ESTIMATION OF DOMESTIC WATER DEMAND OF DEVELOPING COMMUNITIES IN THE NORTHERN TRANSVAAL



Report to the WATER RESEARCH COMMISSION by WATER SYSTEMS MANAGEMENT



WRC report No 480/1/96

In order to determine the appropriate domestic water demand level of a community, it is necessary to categorise the community in terms of its value orientation and a standard of living index, by quantifying as many of the value orientation indicators as possible. The domestic water demand is then determined from a table or may be read off a graph given in the report. A water demand range is given to emphasise the diverse nature of human needs, conditions and values.

## PAYING FOR WATER

Having to pay for water used significantly reduces water demand. Two basic tariff systems are in general use, namely: the flat rate fee whereby households are required to pay a fixed monthly fee regardless of the volume of water used; and a tariff based on the volume of water used. The latter tariff system is often

combined with a sliding scale in which higher rates are charged for water use above certain target levels.

The degree of reduction in water demand varies in accordance with the tariff type as well as the level of living of the water user group. Water users which have a relatively lower standard of living, and therefore a modest water demand, display a small reduction in water demand, should water be charged in relation to the actual volume of water used. The reduction is marginally less should the flat rate system be applied. On the other end of the scale are communities which enjoy a higher standard of living, and have a high water demand, showing reduction of 30 per cent or more should the sliding tariff system be applied. If the flat rate fee is applied the reduction is only about 10 to 15 per cent.

## WATER DISTRIBUTION SYSTEMS

The actual use of water is quite often considerably less than the estimated water demand and this may be ascribed to various inhibitors which include inappropriate water distribution systems and the unavailability of sufficient quantities of bulk water.

The criteria for selecting an appropriate water distribution system should be based on its capability to deliver the required water at an acceptable level of access. The general practice to date was, however, to select a water distribution system (for example a street tap system or handpump system) without taking cognisance of the needs of the domestic water user. In many instances this has led to a situation where the facility is incapable of delivering the required volume of water. Typically there would be insufficient taps available, therefore limiting access to the water and resulting in long queues at water points. In other cases, walking distances are excessive. To date the design of water supply facilities for developing groups has essentially been based on supply driven principles, which is fixed at only 25 to 50l/c/d, with very little or no consideration given to the real needs of the community. These shortcomings lead to a situation of gross dissatisfaction, which in turn gives rise to a resistance of paying for water, the sabotage of facilities and the construction of crude unauthorised yard connections which result in excessive water loss.

The report says that the selection of an appropriate water distribution system is dictated by the volume of water which needs to be delivered to the community.

**DAILY WATER DEMAND DISTRIBUTION**

In the planning and design of bulk water works, cognisance needs to be taken of the daily and seasonal variation in the water demand.

Two distinct peaks occur in the daily distribution of water use. The peaks occur at about 7 - 8 am and 4 - 7 pm. This pattern occurs regardless of the type of water supply system in use. The daily distribution of water use is influenced mainly by the water collection habits of the domestic water user group and the type of water distribution system.

Residents who fetch water from water points located outside their homes, usually make 2 to 3 trips per day, or more frequently should the water point be located close to the dwelling. Generally, other household chores are done first, before the first water fetching trip is made. Households without yard or house connections have about one day's water requirements in storage in the dwelling; this is used until water supplies are topped up later in the day.

Garden watering significantly influences the late afternoon water use pattern. The presence of street lighting also tends to flatten the afternoon peak by allowing water fetching after dark. Residents having house connections commence drawing water from about 4.30 am reaching a peak at about 8 am. Weekend water use may increase, particularly in less developed villages where the number of weekend visitors returning from distant work places is high. In most instances, however, the increased water use is insignificant and it may be assumed that the pattern of daily water use on average remains more or less constant for each day of the week.

**SEASONAL WATER DEMAND DISTRIBUTION**

Seasonal water demand is influenced mainly by the level of gardening activity. As the living standard and value orientation of the community rises, so the enthusiasm for gardening also increases. The ability to apply water on gar-

dens is only possible for residents who have house or yard connections. The potential for garden watering increases as enthusiasm and desire for gardening increases and the level of sophistication of the water supply service improves. Increased garden watering results in greater variation in water use between summer and winter and induces a higher summer daily demand. Large volumes of water are required to maintain gardens during the summer months when the net evaporation is normally high.

**FUTURE WATER DEMAND ESTIMATION**

Future water demand estimations are based on an estimated per capita water demand and the estimated population for various future time horizons.

A scenario approach is suggested in the report for the estimation of future per capita water demand and includes:

■ **Scenario 1** (low rate of increase in water demand)

Vigorous economic conditions prevail and stable political situation occurs. Standard of living is assumed to increase and sufficient funds are available to improve services, including water supply. Residents pay for water. The net result is that water demand increases at a low rate.

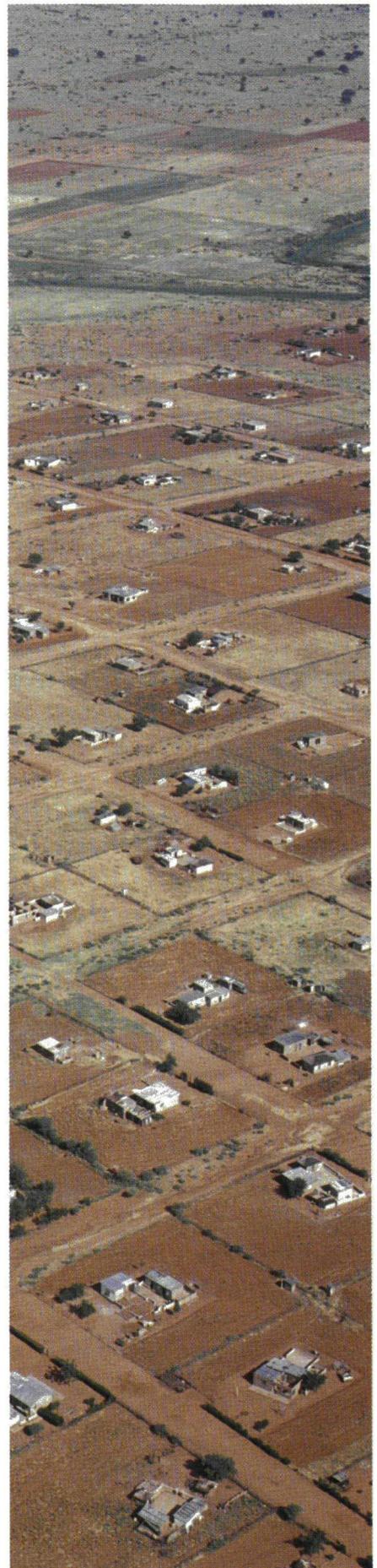
■ **Scenario 2** (moderate rate of increase in water demand)

Poor economic conditions and an unstable political situation prevail, associated with a low level of improvement in the level of living. Limited funds are available for the improvement of water supply systems. Residents do not pay for water and water wastage is high. A moderate increase in water demand occurs.

■ **Scenario 3** (high rate of increase in water demand)

Stable economic and political conditions prevail, and a moderate improvement in the level of living occurs. Services are improved at a moderate rate with water shortages occurring occasionally. Residents in general do not pay for water.

The anticipated water demand for various future time horizons and the various scenarios considered above, are given in the report.



# Visual MODFLOW

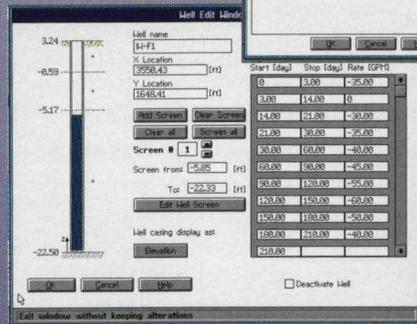
Version 2.0

A fully-integrated, graphical modeling environment combining the USGS's MODFLOW and MODPATH in one easy-to-use software package.

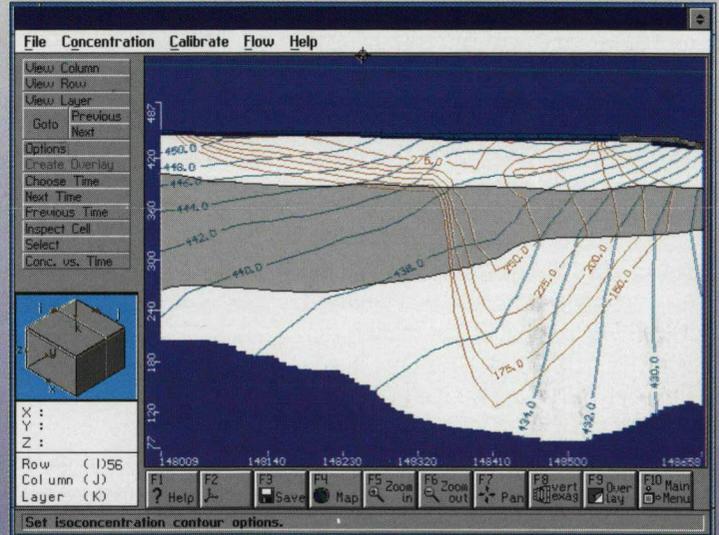
Now includes a Visual Interface for MT3D input and output!



Easily Assign Aquifer Properties, Boundary Conditions, and Pumping Schedules



Applications in Risk Assessment, Remedial Design, Wellhead Protection, & Capture Zone Analysis



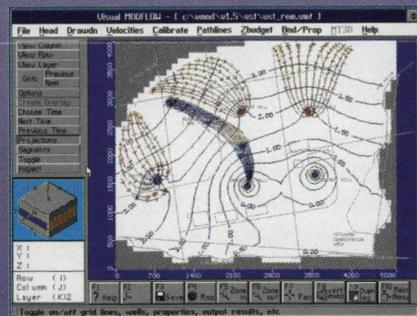
Example of a flow and transport simulation in a highly anisotropic and fractured rock aquifer

Design the model...

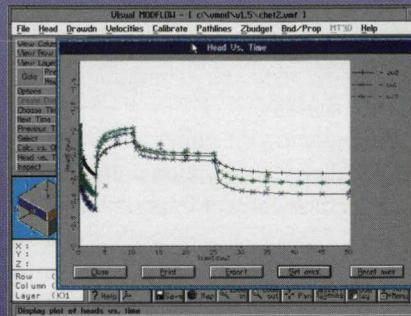
...run the simulation...

...and visualize the results!

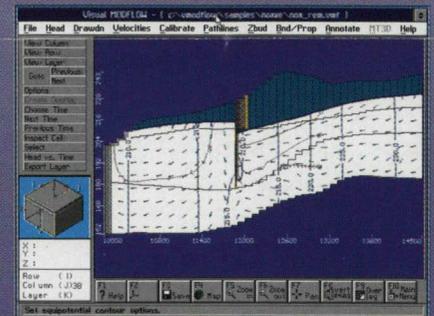
Package includes MODFLOW, MODPATH and MT3D



Display and overlay well capture zones, pathlines and head contours.

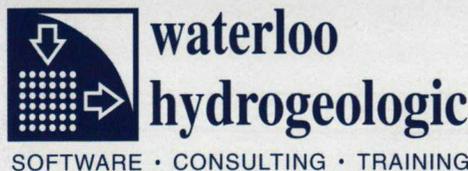


Plot calculated and observed heads or concentrations vs time for multiple points.



Plot the water table, pathlines and flow velocity vectors in cross-section.

**"Visual MODFLOW is the only MODFLOW modeling platform that I fully recommend."**  
**Michael McDonald, principal author of the official USGS MODFLOW.**



For more information or a demonstration diskette contact:

Waterloo Hydrogeologic, Inc.  
 180 Col. ENVIROSOFT, P/Bag X01104  
 Betty's Bay 7141 12L 3L3  
 Waterloo, Ontario N2L 3L3  
 Tel: 02823-28571  
 edurek@iafrica.com  
 Ph. (519) 746 www.africa.com/pages/geo/262

Other Waterloo Hydrogeologic software products include: FLOWPATH FLONET/TRANS, AquiferTest, AIRFLOW/SVE and PRINCE

**Visual MODFLOW** is the most complete and easy-to-use modeling platform for the official USGS MODFLOW and MODPATH and the popular contaminant transport package MT3D.

Visual MODFLOW's intuitive modeling environment makes three-dimensional groundwater flow and transport simulations more accessible and practical than ever before. The innovative graphical interface has been specifically designed to maximize the user's productivity and minimize the model complexity. The result is cost-effective modeling and better model conceptualization.

## ANALYSIS FEATURES

There are many specialized versions of MODFLOW available, but there is only one official USGS MODFLOW, the one included with Visual MODFLOW. For defensible 3-D groundwater flow and transport modeling, Visual MODFLOW is the only package you need. It fully supports and runs all of the most popular and established MODFLOW packages for analysing steady-state or transient groundwater flow in confined or unconfined aquifers with heterogeneous, anisotropic porous media and variable layer thicknesses. The model simulations use standard USGS MODFLOW input files. This is important for establishing the credibility of model results in potential court cases.

Visual MODFLOW also supports the latest version of MODPATH, the USEPA version of MT3D (v. 1.1) and the latest version of S.S. Papadopoulos Inc.'s MT3D (v. 1.86).

MODFLOW Packages supported by Visual MODFLOW include:

- Horizontal Flow Barrier
- Zone Budget
- PCG2 Solver
- Cell Re-Wetting
- Recharge, Evapotranspiration, Rivers, Constant Head, General Head, and Drains boundary conditions (steady-state or transient)

## MAIN FEATURES

- Runs under Windows 3.x, Windows 95, DOS and OS/2.
- Fully-integrated modeling platform allows you to assign input parameters, run the simulation, calibrate the model, and visualize the results, all within one package.
- Free technical support and complimentary upgrades within 6 months of purchase.
- Includes source codes and executable files for the latest versions of MODFLOW and MODPATH, and the USEPA version of MT3D.
- Includes WHS Solver, the fastest and most stable MODFLOW solver available.
- Supports Zone Budget for determining zone-to-zone exchanges and calculating a detailed summary of mass balance results.
- Calibration tools for comparing calc. vs. obs. results (head or concentration) or plotting transient results vs. time for multiple observation points.
- Switch between plan view and cross-section at any time during input or while displaying simulation results.
- Import irregular layer surfaces and initial head estimates from SURFER (.GRD) or ASCII (x,y,z) files.
- Obtain site coordinates and dimensions from AutoCAD (.DXF) sitemaps and overlay several different maps.
- Import fully 3-D MODFLOW data sets from previous simulations.

## INPUT FEATURES

The input is structured such that the user concentrates on developing the physical characteristics of the hydrogeology using standard (x,y,z) locations and real times rather than grid block numbers and model time steps. Some input features of Visual MODFLOW include the following:

- The site can be visualized in cross-section or plan view at any time.
- Irregular layer surfaces and initial head estimates can be imported from ASCII (x,y,z) or SURFER (.GRD) files.
- All model input parameters can be graphically assigned and modified.
- Grid refinements are easily accounted for as the model transparently readjusts properties, boundary conditions and well locations.
- Well pumping schedules and calibration data for observation points can be input graphically or imported from an ASCII file.

## OUTPUT FEATURES

The display and output of results from Visual MODFLOW includes steady-state or transient contouring of layer surfaces, heads, drawdown, concentrations, and layer-to-layer gradients and fluxes; plots of velocity vectors and flow pathlines; calibration graphs of calculated vs. observed heads or concentrations with

calibration statistics; plots of calculated heads or concentrations vs. time for multiple observation points; and a complete summary of water balance results and zone-to-zone exchanges.

The advanced contouring algorithm allows the user to select from five contouring speeds and provides many options for customizing the contour intervals, locations and labelling.

Results from the model simulation can be directed to the screen, printers or plotters, or to a .DXF or postscript file. In addition, the model properties and results can be exported to ASCII files.

## DOCUMENTATION & SUPPORT

Visual MODFLOW includes a comprehensive user's manual as well as a full set of USGS reference manuals and reports. The user's manual contains detailed instructions and a step-by-step tutorial to demonstrate some of the features and capabilities of Visual MODFLOW. Free technical support is available during business hours via phone, fax or email.

## REQUIREMENTS

PC 486 or Pentium with a minimum of 8Mb RAM and 35Mb free disk space, VGA display and a mouse.

Other Waterloo Hydrogeologic software products include:

FLOWPATH • AIRFLOW/SVE • FLONET/TRANS • PRINCE • AquiferTest



**WATERNAVORSINGSKOMMISSIE**

# **WNK STUDIEBEURSE 1997-98**

## **FASILITERING VAN GEMEENSKAPS-BETROKKENHEID BY DIE BESTUUR VAN WATER AS NATUURLIKE HULPBRON**

Die vraag na Suid-Afrika se skaars waterhulpbronne deur 'n wye verskeidenheid gebruikers gaan in die toekoms steeds toeneem. Openbare bewustheid en betrokkenheid is noodsaaklik as ons op grondvlak sukses wil behaal in die bestuur van water as 'n natuurlike hulpbron.

Daar is reeds verskeie hulpbronbestuursprogramme geïnisieer wat steun op deelneming en betrokkenheid van die gemeenskap. Die sukses van hierdie projekte hang af van die suksesvolle fasilitering van gemeenskapsbetrokkenheid. Daar is elders in die wêreld bevind dat universiteitsgeskoolde fasiliteerders die beste bekwaam is om rigting te gee aan sulke nie-tegniese aspekte van waterhulpbronbestuur. Gespesialiseerde kundigheid en vaardighede moet ontwikkel word, en aangewend word om die ontwikkeling van gemeenskapsbetrokkenheid te rugsteun. Dit geld egter nie net vir ontwikkelende gemeenskappe nie, maar is net so van toepassing op ontwikkelde gemeenskappe.

Ten einde te help om in hierdie behoefte te voorsien, bied die Waternavorsingskommissie beurse aan vir nagraadse studie vir die tydperk 1997 tot 1998. Aansoeke word ingewag van toepaslik gekwalifiseerde persone wat belangstel om nagraadse opleiding te ondergaan in die fasilitering van gemeenskapsontwikkeling in hulpbronbestuur as 'n eerste stap in die rigting van 'n loopbaan op hierdie gebied.

### **VEREISTES**

- Ten minste 'n honneursgraad in gedragwetenskappe, hulpbronekonomie of omgewingsbestuur
- 'n Belangstelling in gemeenskapstrukture en -ontwikkeling
- 'n Belangstelling in meganismes vir die bestuur van water as hulpbron
- 'n Belangstelling in die fasilitering van gemeenskapsbetrokkenheid.

### **AARD VAN DIE NAVORSINGSBEURS**

'n Ruim finansiële pakket word aangebied om alle koste te dek vir 'n nagraadse kwalifikasie wat gesamentlik bepaal sal word deur die suksesvolle kandidaat en 'n paneel adviseurs wat deur die WNK aangestel word. Die duur van die navorsingsbeurs is twee (2) jaar.

### **VERPLIGTINGE**

Die suksesvolle kandidaat sal kontraktueel gebonde wees om navorsing by 'n gekeurde Suid-Afrikaanse universiteit of ander instansie te doen. Die kontraktyd sal gelykstaande wees aan die duur van die navorsingsbeurs.

### **AANSOEKE**

Aansoeke moet 'n volledige CV en die name van ten minste twee referente insluit en gestuur word aan:

Die Uitvoerende Direkteur (VIR AANDAG: Mnr P Smit)

Waternavorsingskommissie

Posbus 824

PRETORIA

0001

Die sluitingsdatum vir aansoeke is **15 November 1996**.



WATER RESEARCH COMMISSION

# WRC FELLOWSHIPS 1997-98

## FACILITATING COMMUNITY INVOLVEMENT IN MANAGEMENT OF WATER AS A NATURAL RESOURCE

The future will bring increasing demands on South Africa's scarce water resources from a wide variety of users. Public awareness and public participation are essential if we are to achieve success in managing water as a natural resource at grass roots level.

Already there are various resource management programmes being conducted that hinge on public participation and community involvement. These will not meet with success if public participation and involvement cannot be successfully facilitated. Experience elsewhere in the world has shown that university-trained facilitators are best able to give focus to such non-technical aspects of water resource management. Specialised know-how and skills need to be developed, and applied to facilitate the fostering of community involvement. This, however, does not only apply to developing communities, but is equally valid for developed communities.

To assist in satisfying this need, the Water Research Commission is offering post-graduate fellowships for the period 1997-1998. Applications for such fellowships are invited from suitably qualified persons interested in undertaking post-graduate training in facilitating community involvement in resource management as a step towards pursuing a career in this regard.

### REQUIREMENTS

- A minimum of an honours degree in behavioural sciences, resource economics or environmental science
- An interest in community structures and development
- An interest in water resource management systems
- An interest in facilitation of community participation

### NATURE OF FELLOWSHIPS

A generous financial package is being offered to meet all study costs towards a higher degree as determined jointly by the successful candidate and a panel of advisers appointed by the WRC. The duration of the fellowship will be two (2) years.

### OBLIGATIONS

The successful candidate will be contractually bound to serve in a research environment at a WRC approved South African university or other institution. The period of the contract will be equal to the duration of the fellowship.

### APPLICATIONS

Applications must include a complete CV and the names of at least two referees, and be sent to:  
The Executive Director (FOR ATTENTION: Mr P Smit)  
Water Research Commission  
PO Box 824  
PRETORIA  
0001

The closing date for applications is **15 November 1996**.

# GETTING TO KNOW AND USE WR90

The WR90 publication *Surface Water Resources of South Africa 1990* has been available from the Water Research Commission for about a year. Description of the Reports and Order Forms were distributed in a recent SA Waterbulletin and in some Journals. It is time now to ensure that water engineers and earth scientists are able to make the best use of the vast store of data and design aids in the Reports. The Commission has accordingly arranged for two-day courses at the main centres and mini-courses at other centres to be held during 1997.

The cost of the two-day course is R600 per participant and the mini-course R400, including lunches and refreshments. Participants may purchase a manual and one set of regional maps and appendices for R100 which is roughly half the normal price.

The two-day course will take the form of computer hands-on problem-solving sessions followed, on the afternoon of the second day, by a feed-back discussion session at which it is hoped to identify errors and elicit suggestions for additions, improvements, ideas for future updating of the Survey. The mini-courses will be presentations of how WR90 information can be used for problem-solving.

<b>TWO-DAY COURSES</b>	<b>DATE</b>	<b>PROBABLE VENUE</b>
Durban/PMB	10 & 11 February 1997	Univ of Natal - Pietermaritzburg
Grahamstown/Port Elizabeth	13 & 14 February 1997	Univ of Port Elizabeth University
Pretoria/Johannesburg	6 & 7 February 1997	Univ of Pretoria University
Stellenbosch/Cape Town	28 & 29 January 1997	Univ of Stellenbosch University
 <b>MINI-COURSES</b>		
Swaziland/Nelspruit	18 February 1997	Drum Rock Complex
Lesotho/Bloemfontein	31 January 1997	GRI Bloemfontein University
Pietersburg	21 January 1997	Library Activity Centre
East London	4 February 1997	King David Hotel

## APPLICATION FORM : WR90 COURSE

Name: ..... Organisation: .....

Postal Address: .....

Tel.: ..... Fax: .....

I wish to attend the course in: .....

Registration fee: R600/R400 (inc VAT)                      Purchase of manuals: R100 (inc VAT)

I enclose cheque of: R..... made out to SRK WR90 course.

*Please complete and return to:*  
 Brian Middleton, SRK, P O Box 55291, Northlands, 2116 **before 30 November 1996.**  
 Enquiries to Harriet at Tel.: (011) 441-1265 Fax: (011) 441-1174





Filter pool



Sand bed



Backwash

# The effect of Invertebrates on drinking water quality researched

Although free-living organisms form an integral part of nature and the chemical processes which keep the ecosystem in balance, free-living organisms should not be present in potable water, say researchers of Rand Water in a report to the Water Research Commission. These organisms, which include algae, protozoa and invertebrates, may cause adverse health effects, aesthetic problems, objectionable tastes and odours, or may act as a food source for fungi and bacteria, and can interfere with potable water treatment and distribution.

The specific health and aesthetic effects of viruses, bacteria, protozoa and algae on potable water production and quality are well studied and documented. Very little information, however, is available with regard to the effect of invertebrates on the production and quality of potable water.

Knowledge of the identity and abundance of invertebrates in potable water supplies is essential

- to determine their possible effect on potable water quality,
- to identify treatment options to remove invertebrates from raw water, and
- to determine future water quality guidelines for invertebrates, say Dr MC Steynberg and co-workers at Scientific Services, Rand Water.

As the status of invertebrate related potable water quality in South Africa is unknown, the Water Research Commission contracted Rand Water to do a basic study on the invertebrate content of Rand Water's water and to note international trends in this regard. The report entitled **The removal of invertebrates by sand filtration and the influence thereof on water quality** (WRC Report KV 76/95) is available, free of charge, from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: US \$20.



*Cyclops sp.*



*Daphnia pulex*



*Chironomid larvae*

Some invertebrates which occur in filtrates from sand filters, as seen under a microscope (actual sizes vary between 1-4 mm) (Photo's: MC Steynberg).

Various organisms are present in distribution systems, but they vary in density and composition of the populations. Few distribution systems are without any animals. Approximately 150 different kinds of invertebrate animals have been found in British water mains. It is, however, important to keep the numbers of these organisms as low as possible to prevent consumer awareness of their presence either directly or indirectly. Several authors note/state that the occurrence and persistence of invertebrates in potable water supplies is a common consumer complaint.

The presence of organisms in potable water may be due to penetration of unit processes or colonisation of the total purification system. Invertebrates usually enter into the distribution system by initially penetrating the treatment works. The types of invertebrates which enter in this way are those that are aquatic for either a part, or the whole, of their life cycle. Service reservoirs, however, may also be a point of entry for flying insects which gain access through badly protected vents and overflows.

### CHIRONOMIDS

The midges (chironomids) which is an exceedingly complex family of about 3000 described species in the world, are masters in penetrating unit processes. The majority of chironomids cannot complete their life cycle in a water main, the adult midge being a flying insect. Chironomid adults (midges) are commonly seen flying in large numbers near water. Adult females lay a mass of eggs in the water. These eggs hatch into larvae that require about one to two months or more to reach pupation. The larvae go through four instar stages during which they wriggle and swim close to the bottom sediment. The larvae are very small and transparent during the first two stages and are practically invisible to the naked eye. Penetration of filters by both eggs and larva is mostly due to large sand particles and cracks on the filter bed. The occurrence of eggs and larva is especially apparent in poorly maintained filters bed. Flying adults may also gain entry to unprotected filter basins and reservoirs to deposit eggs directly into the purified water.

### AIMS

This study attempted to address the lack of knowledge regarding the presence of invertebrates in potable water in South Africa and the possible effects of their presence, by studying the following aspects:

- The relationship between invertebrate population in filtered water and specific properties of filter media.
- The effect of invertebrates on water quality determinants such as turbidity and biological assimilable organic carbon (AOC).
- The effect of recycling filter backwash water on the occurrence of invertebrates on filters and in filtered water.

It was expected that the results of this research project would:

- give an indication of the presence and type of invertebrates in purified water, as well as the effect of invertebrates on the water quality of purified water;
- indicate which water quality variables are affected by the presence of invertebrates in water and whether secondary problems can be expected i.e. increases

in assimilable organic carbon (AOC) concentrations, turbidity and consumer complaints; and

■ be used to compile South African water quality guidelines with regard to invertebrates in potable water.

## RESULTS

At the full scale purification plant (at Vereeniging) the removal of invertebrates through a sand filter containing old sand (Filter 5) was compared to that of new filter sand (Filter 113). Filter 5 is an example of a filter containing large sand particles (effective size > 1 mm) which is not properly fluidised during backwash. Filter 113 contains smaller sand particles (effective size < 0,7 mm) which is properly fluidised during backwash.

The following observations made regarding the efficiency with which these two filters removed invertebrates.

■ The water before filtration at Filter 113 contained less invertebrates than the inlet water to Filter 5. This may indicate that the sedimentation system of the new purification plant removes invertebrates more effectively or inhibits breeding better than that of the old system.

■ The number of organisms/m<sup>3</sup> in the filtrate of Filter 113 was lower than that in the filtrate of Filter 5. If, however, the removal efficiency is expressed in terms of organism density in the inlet to the filter, then the removal efficiency of Filter 113 is only slightly better than that of Filter 5, for most of the time.

■ The lower number of organisms present in the filtrate of Filter 113 may be due to the smaller effective sand size and lower uniformity coefficient compared to that of Filter 5. A more effective backwash at Filter 113 compared to that at Filter 5 may also contribute to the smaller number of organisms present in the filtrate of Filter 113.

■ The percentage removal could not always be correlated with the number of organisms present in the inlet to the filter.

■ The invertebrate population was dominated by the Rotatoria and Cyclops. Midge larvae (Diptera) were present in

higher numbers in the filtrate of Filter 5 compared to that of Filter 113, which indicates possible breeding in filters. There was no notable difference in the age of the other invertebrates found in the inlet water of the filters compared to those found in the filtrate. It was, however, obvious that the larger organisms were retained more efficiently by the sand filters.

M C STEYNBERG  
M KOK  
B CHALE  
J A GRUNDLINGH  
J H B JOUBERT  
J C GELDENHUYS

THE REMOVAL OF INVERTEBRATES BY SAND  
FILTRATION AND THE INFLUENCE THEREOF ON WATER  
QUALITY

Report to the  
WATER RESEARCH COMMISSION  
by  
SCIENTIFIC SERVICES, RAND WATER  
JOHANNESBURG, SOUTH AFRICA

WRC report No KV 76/95

## PILOT PLANT

The above results initiated a pilot plant study that was aimed at defining sand characteristics, filtration and backwash rates in relation to invertebrate removal. In spite of several technical problems experienced in the first few months the following observations were made:

■ Turbidities higher than 1 NTU in all the pilot plant runs may indicate that the filtration process was less efficient compared to Filter 113. This may explain the higher number of organisms observed in the filtrate of the different pilot plant filters compared to that of Filters 5 and 113.

■ Most of the pilot plant filters, containing sands with different characteristics, removed invertebrates with the same efficiency. It was only the filter(s) with

very coarse sand that showed a lower removal percentage than the other sand filters.

■ Proper disinfection of the filters and backwash of filters at the fluidisation point of the sand resulted in improved removal of the invertebrates.

■ The invertebrate population in the pilot plant was again dominated by Rotatoria and Cyclops, while the Diptera presented in significant numbers as well.

These results can be used in the design and operation of filters and the specification for filter media i.e. procedures to optimise filter running times and backwashing procedures, selection of filter media and effect of recycled backwash water on filtrate quality.

## CONCLUSION

The pilot plant study clearly indicated that the percentage removal of organisms can be improved significantly by proper backwash and disinfection of the filter. Filter media size less than 0,8 mm should be effective to remove invertebrates. Proper maintenance of filters is the key to effective removal of invertebrates.

A proposal regarding the setting of guidelines for invertebrates in potable water, based on the above information, is made in the report. The suggested guidelines are based on the chance of consumers detecting these organisms in a glass of water; a lower number of organisms/m<sup>3</sup> are recommended for the bigger and more visible organisms, compared to the smaller microscopic invertebrates of which more organisms/m<sup>3</sup> may be tolerated.

The proposed set of guidelines also took note of the fact that the researchers isolated some opportunistic pathogens as well, which were associated with the invertebrates found in this study. It was found that the number of invertebrates do not contribute significantly to the assimilable organic carbon (AOC) concentration.

In conclusion the researchers say that although invertebrates are aesthetically not acceptable, their net effect on reducing water quality is minimal.

## WRC Personalia elected to top ranks ...



**Dr Nozibele Mjoli**, Research Manager at the WRC, was appointed Deputy Chairman for the National Water Advisory Council (NWAC) in June 1996, for a period of two years.

The Council advises the Minister of Water affairs and Forestry on matters relating to development and management of water resources, including subterranean and private water, environmentally and ecologically sensitive issues related to the development of water resources, also regarding the provision of water supply and sanitation services, pollution of water and disposal of effluents, and any other water-related matter referred to the Council by the Minister.



**Mr Piet Odendaal**, Executive Director of the Water Research Commission, was recently re-elected as Vice-president of the IAWQ at the bi-annual IAWQ conference, which was held in Singapore. Prof Tom Kennath from the USA was re-elected President, and Prof Tomanori Matsuo of Japan was re-elected as Vice-president.



**Mr Vincent Bath**, Chief Executive of Rand Water and Commission Member of the Water Research Commission, was elected Vice-president of IWSA at the 20th IWSA congress that was held in Durban last year.

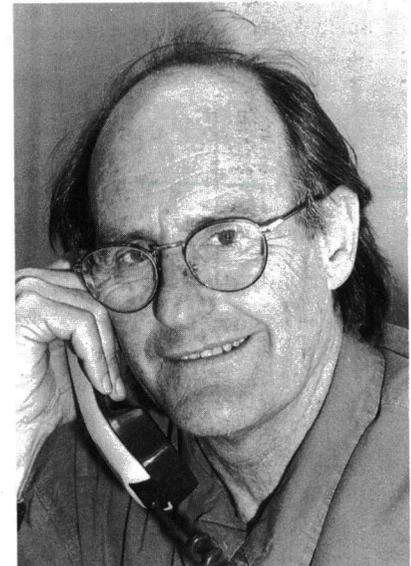
## WRC Research Manager resigns

Charles Chapman, Research Manager: Municipal water distribution and sanitation, recently resigned from the ranks of the WRC after 19 years' service.

Soon after joining the WRC in 1977, he raised the issue of water wastage by way of leakage in municipal systems, publishing a news snippet saying "Every day we lose 350 olympic pools full of water". He initiated and became actively involved in the municipal leakage detection research locally. He introduced and demonstrated the leak noise detector in South Africa after visiting manufacturers in the UK, Germany and Austria. This piece of equipment has now become a regular and important partner in the local Water Industry.

This success led to further research on water loss control and water management. He was already talking water conservation in 1978 when he suggested that a reduction in pressure could reduce water losses from the distribution system by as much as 30 per cent.

In the last number of years he progressively became involved with the questions and research centering around water supply and sanitation needs of the developing communities. He says that problems facing developing communities are more of a socio-cultural and socio-



Mr Charles Chapman

economic nature rather than technological.

His interest in Developing Communities has led to the development of a plastic bodied water meter, in collaboration with Kent Measurements, and pre-payment water metering devices.

Charles now intends applying his knowledge of research results and water management in practice, at Rand Water.

# 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.

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.

## 1996

### SEPTEMBER

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## 1997

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SOUTHERN  
AFRICA

1996

## ISIAME '96

NOVEMBER 4 - 8

An international symposium on industrial applications of the Mössbauer effect will be held in Johannesburg.

Enquiries: Prof Herman Pollak (Chairman), Mössbauer Laboratory, Department of Physics, University of the Witwatersrand, Private Bag 3, Johannesburg 2050. Tel: (011) 716-4053 Fax: (011) 339-8262. E-mail: 005KLKS@WITSVMA.WITS.AC.ZA

## SURGE ANALYSIS

NOVEMBER 27 - 29

A short course on Surge analysis in water systems - micro-computer analysis of transient flow in pipe networks will be held at the University of Pretoria.

Enquiries: LGI Centre for Continuing Education - Tel: (012) 342-6460. Fax: (012) 342-4151.

1997

## METEOROLOGY

APRIL 7 - 11

The 5th international conference on southern hemisphere meteorology and oceanography will be held at the University of Pretoria. Enquiries: Conference Planners: Amie Wissing. Tel and Fax: (012) 46-0170.

## FORESTS

MAY 11 - 17

A workshop with the theme: Forests at the limit: Environmental constraints on forest function will be held at Skukuza in the Kruger National Park, Mpumalanga.

Enquiries: Ms Tisha Greyling, IUFRO Workshop Secretariat PO Box 95823, Waterkloof 0145. Tel: (012) 346-1517 Fax: (012) 46-7909 E-mail: liaison@cis.co.za

## SAICE

JUNE 2 - 4

The 2nd international mining and industrial waste conference will be held in Midrand, Gauteng.

Enquiries: Lesley Stephenson, Conference Secretary, PO Box 327, Wits 2050. Tel: (011) 716-5091 Fax: (011) 339-7835.

ENVIRONMENTAL  
MANAGEMENT

SEPTEMBER 8 - 10

A specialised conference on Chemical process industries and environmental management will be held at the new five-star Table Bay Hotel, Waterfront, Cape Town.

**Call for papers:** Deadline for abstracts is 30 November 1996. Enquiries: Conference Secretariat: Ms Cilla Taylor, Conference Planners, PO Box 82, Irene 1675. Tel: (012) 63-1681. Fax: (012) 63-1680.

## DAM DESIGN

NOVEMBER 3 - 4

A course on the design of smaller dams will be offered under the auspices of SANCOLD at the University of Stellenbosch.

Enquiries: Prof A Rooseboom, University of Stellenbosch. Tel: (021) 808-4353. Fax: (021) 808-4361.

## HYDRAULICS

NOVEMBER 5 - 7

The third in the series of international River Flood Hydraulics conferences will be organised by HR Wallingford in partnership with the University of Stellenbosch at Stellenbosch. Topics to be covered include flood hydraulics and hydrology, management of developments on flood plains, flood control, sediment transport and river morphology, flow measurement: social, economic and environmental aspects. **Call for papers.** Deadline: December 1996.

Enquiries: Prof A Rooseboom, University of Stellenbosch. Tel: (021) 808-4353. Fax: (021) 808-4361.

## OVERSEAS

1996

WATER SUPPLY &  
SANITATION

OCTOBER 7 - NOVEMBER 29

An eight week professional development programme in the design, provision, operation and maintenance of the infrastructure required to support water and sanitation services will be presented in Loughborough, UK.

Enquiries: Water Engineering and Development Centre, Institute of Development Engineering, Loughborough University Leicestershire LE11 3TU, United Kingdom. Tel: +44 (0) 1509 222885. Fax: +44 (0) 1509 211079. E-mail: WEDC@lboro.ac.uk

## WATER HONG KONG '96

NOVEMBER 11 - 17

The 10th IWSA-ASPAC regional conference and exhibition will be held in Hong Kong.

Enquiries: Technical Sub-committee, Water Hong Kong '96, c/o Water Supplies Department, 48/F Immigration Tower, 7 Gloucester Road, Wan Chai, Hong Kong. (Attention: Ms Daisy S M HO). Fax: (852) 2824 0578 Tel: (852) 2829 4444.

1997

## GROUNDWATER

APRIL 7 - 11

An international conference and course on Analytic based modeling of groundwater flow will take place in Nunspeet, the Netherlands.

Enquiries: The Conference Secretariat, MOORGA, Buerweg 51, 1861 CH Bergen, the Netherlands. Tel: +31 7258-99062 Fax: +31 7258 99040

## RAINWATER

APRIL 21 - 25

The 8th international conference on rainwater catchment systems will be held in Tehran, Iran.

Enquiries: Mr J Ghoddousi, PO

Box 13445-1136, Tehran, IR Iran. Tel: +98 21 6418335 Fax: +98 21 6407214 E-mail: RAIN@NEDA.NET.IR

## WATER INDUSTRY

APRIL 21 - 25

An international water industry exhibition will be held in conjunction with Wasser Berlin '97 in Berlin, Germany.

Enquiries: Messe Berlin GmbH, IFW/M3, Messedamm 22, D-14055 Berlin. Tel: (030) 30380. Fax: (030) 3038-2079.

## DEPOLURB '97

MAY 18 - 22

Depolurb '97 - an international conference on waste pollution control and environmental management in large metropolitan areas will be held in Sao Paulo, Brazil. The conference themes will include:

- conventional and non-conventional technical approaches and solutions
- policy issues; institutional structures and arrangements legal and regulatory aspects
- economic and financial instruments
- environmental restoration
- health and socio-cultural issues and
- privatisation aspects

Enquiries: IAWQ Brazilian National Committee, Rua Conde de Irajá, 260/1 andar, 22271-020, Rio de Janeiro, Brazil. Tel: +55 21 537 4338. Fax: +55 21 537 7991. E-mail: depolurb @fageventos.com.br

## ASIAN WATERQUAL '97

MAY 20 - 23

Asian Waterqual '97 - the 6th IAWQ Asia-Pacific regional conference will be held in Seoul, Korea. Main topic areas will include:

- water and municipal wastewater treatment technologies
- industrial wastewater treatment and management
- water quality monitoring and modelling
- clean technology/pollution prevention
- instrumentation, control and automation
- design and operation of treatment plants
- integrated watershed management

Enquiries: The Secretariat, SL Kangnam, PO Box 305, Seoul

135-603, Korea. Tel: +82 2 3476 7700. Fax: +82 2 3476 8800. E-mail: koconex@chollian.dacom.co.kr

### WATER SYSTEMS

MAY 25 - 28

An IWSA and IAWQ specialised conference on the Upgrading of water and wastewater systems will be held in Kalmar, Sweden. Enquiries: Dr Ulf Lidman, Dept of Natural Sciences, University of Kalmar, Box 905, S 391 29 Kalmar, Sweden. Tel: (46) 480-446235 Fax: 480-446262

### AD-97

MAY 25 - 29

The 8th international conference on anaerobic digestion will be held in Sendai, Japan. Enquiries (local): Prof Trevor J Britz, Department of Food Science, University of Stellenbosch, Private Bag X1, Matieland 7602. Tel: (021) 808-3578 Fax: (021) 808-3510. E-mail: voed-selw@land.sun.ac.za

### SEWERS

MAY 26 - 28

The 2nd international conference on The sewer as a physical, chemical and biological reactor, will be held in Aalborg, Denmark. Enquiries: Kirsten Andersen, Environmental Engineering Laboratory, Sohngaardsholmsvej 57, DK-9000 Aalborg, Denmark. Tel: +45 98 158522 ext 6522. Fax: +45 98 142555. E-mail: i5ka@civil.auc.dk

### ACID DRAINAGE

MAY 31 - JUNE 6

The fourth international conference on rock acid drainage with the theme: "Application of Technology" will take place in Vancouver, British Columbia, Canada.

Enquiries: 4th ICARD, Att. Peggy Shepard, Venue West Conference Services, 645 - The Landing, 375 Water Street, Vancouver, BC Canada V6B 5C6. Tel: (604) 681-5226. Fax: (604) 681-2503. E-mail: congress@venuewest.com

### WATERMATEX '97

JUNE 18 - 20

Watermadox '97 - the 4th international symposium on systems analysis and computing in water quality management will be held in Quebec City, Canada. Themes for the symposium will include:

- model calibration and system identification, uncertainty and ecosystem risk assessment
- environmental characterisation
- alternative computational frameworks
- forecasting environmental change
- filtering theory and time-series analysis

Enquiries: Dr Paul Lessard, Department Genie Civil, Pavillion Pouliot, Universite Laval, Quebec, QC, Canada, G1K7P4. Tel: +1 418656 7293. Fax: +1 418 656 2928. E-mail: paul.lessard@gci.ulaval.ca

### INSTRUMENTATION

JULY 6 - 11

The 7th IAWQ workshop on instrumentation, control and automation of water and wastewater treatment and transport systems will be held in Brighton, UK.

Enquiries: Concorde Services, 10 Wendell Road, London, W129RT, UK. Tel: +44 181 743 3106. Fax: +44 181 743 1010. E-mail: 101611.3664@compuserve.com

### ENVIRONMENTAL RESTORATION

JULY 7 - 9

The first international conference on environmental restoration will be held in Ljubljana, Slovenia. Conference themes: river, soil and groundwater contamination, pesticides/PCB/oil pollution, disposal of domestic waste/industrial waste/construction industry wastes and hazardous waste management.

Enquiries: Dr Milenko Ros, Slovenian Water Pollution Control Association, Hajdrihova 19, PO Box 3430, SLO-1001 Ljubljana, Slovenia. Tel: +386 61 1760237 Fax: +386 61 125 9244 E-mail: milenko.ros@ki.si

### ACTIVATED SLUDGE

JULY 21 - 23

The second international conference on Microorganisms in activated sludge and biofilm processes will be held at Berkeley in California, USA.

Enquiries: Professor David Jenkins, Microorganisms Conference, Department of Civil & Environmental Engineering, University of California at Berkeley, Berkeley CA 94720-1710, USA. Tel/Fax: 510 527-0672. E-mail: jenkins@ce.berkeley.edu

### LARREN '97

AUGUST 25 - 28

An international conference on land reclamation and rehabilitation will be held in Penang, Malaysia.

Enquiries: Larren '97, School of Civil Engineering, Universiti Sains Malaysia, Perak Branch Campus, 31750 Tronoh, Perak, Malaysia. Tel: 605-3676901 ext 5412. Fax: 605-3677440.

### IWRA

SEPTEMBER 1 - 6

The 9th world water congress of the International Water Resources Association (IWRA) will take place in Montreal, Canada. Theme: Water resources outlook for the 21st century - Conflicts & Opportunities.

Enquiries: Aly M Shady, Canadian International Development Agency, 200 Promenade du Portage, Hull, Quebec, Canada K1A 0G4. Tel: +1 (819) 994-4098 Fax: +1 (819) 953-3348 E-mail: aly-shady@ACDI-CIDA.GC.CA

### SEDIMENTS

SEPTEMBER 7 - 11

An international conference on contaminated sediments will be held in Rotterdam, the Netherlands. Conference themes include:

- national policies and strategies
- site investigation and characterisation
- fate of contaminants
- physico-chemical analysis and characterisation
- risks and quality criteria

Enquiries: Van Namen & Westerlanden Congress Organisation Services, PO Box 1558, 6501 BN Nijmegen, the Netherlands. Tel: +31 24 323 44 71. Fax: +31 24360 1159.

### LANDFILL

OCTOBER 13 - 17

The sixth International Landfill Symposium will be held in Cagliari, Sardinia, Italy.

Enquiries: Ms Anne Farmer, CISA - Environmental Sanitary Engineering Centre, Via Marengo 34 - 09123 Cagliari (Italy). Tel: +39-70-271652. Fax: +39-70-271371. E-mail: cossur@vaxca3.unica.it

### WEFTEC '97

OCTOBER 18 - 22

The American Water Environment Federation's 70th annual conference and exposition will be held in Chicago, Illinois USA. **Call for papers:** Deadline: 16 December 1996.

Enquiries: WEFTEC '97 Program, 601 Wythe Street, Alexandria, Virginia 22314-1994 USA. Tel: 1-703-684-2452 Fax: 1-703-684-2471.

## KEEP US POSTED

**SA WATERBULLETIN** welcomes news and information of relevant (forthcoming events such as) conferences and symposia for inclusion in this regular feature page. Please send details of such events to:

The Editor,  
SA Waterbulletin,  
P.O. Box 824,  
Pretoria  
0001

SHORT COURSE ● SHORT COURSE ● SHORT COURSE

University of Pretoria  
Department of Civil Engineering

presents

# SURGE ANALYSIS IN WATER SYSTEMS:

Microcomputer analysis of transient flow in pipe networks

27-29 November 1996

## Course Objectives

The objectives of this short course is to provide hands-on training for using a powerful, general purpose computer for the analysis of transient flow and pressure in piping systems.

The computer program SURGE5 begins with a steady state analysis and proceeds through a user-specific transient analysis. An advanced graphics module (GEMS) is available which allows the user to evaluate, in detail, conditions occurring during transient operation. This advanced technology, available in a low cost microcomputer package, is capable of performing the complex analysis associated with transient pipe system operation and surge control. Proficient use of this technology provides engineers with a powerful tool for pipeline engineering.



**Lecturers:** Dr Don Wood (University of Kentucky)  
Dr James Funk (University of Kentucky)  
Prof Johannes Haarhoff (Rand Afrikaans University)  
Prof Fanie van Vuuren (University of Pretoria)

**Venue:** Conference centre at the University of Pretoria

**Cost:** R2 964 (including course materials, teas and lunches).  
The course fee for SAICE members will be R2 622

Registration and enquiries to:

LGI - Centre for Continued Education, Tel (012) 342-6064  
Fax (012) 342-4151.

Enquiries regarding the course contents to:

Prof SJ van Vuuren, tel (012) 420-2438.



TECHNIKON PRETORIA  
*presents*

# Optimisation of Potable Water Purification Plants

*21 - 25 October 1996*

## ■ Objectives

Course attendants should, after completing the course, be able to operate a plant to produce a good quality water at minimal costs.

## ■ Course contents

Optimisation of the following unit processes:  
inlet work, pretreatment, chemical dosing, settling, filtering, disinfection, distribution, record keeping, and personnel.

## ■ Who should attend

Operators of potable water purification plants.

## ■ Costs

R1 000 per person (includes lecture material, teas and a certificate).

## ■ Venue

Technikon Pretoria: Lecture Room 101, Arcadia Campus, Vermeulen Street.

## ■ Enquiries to:

Miss MAA Coetzee or PA Kotze at Tel(012) 318-6232/4/5 or Fax (012) 318-6233.