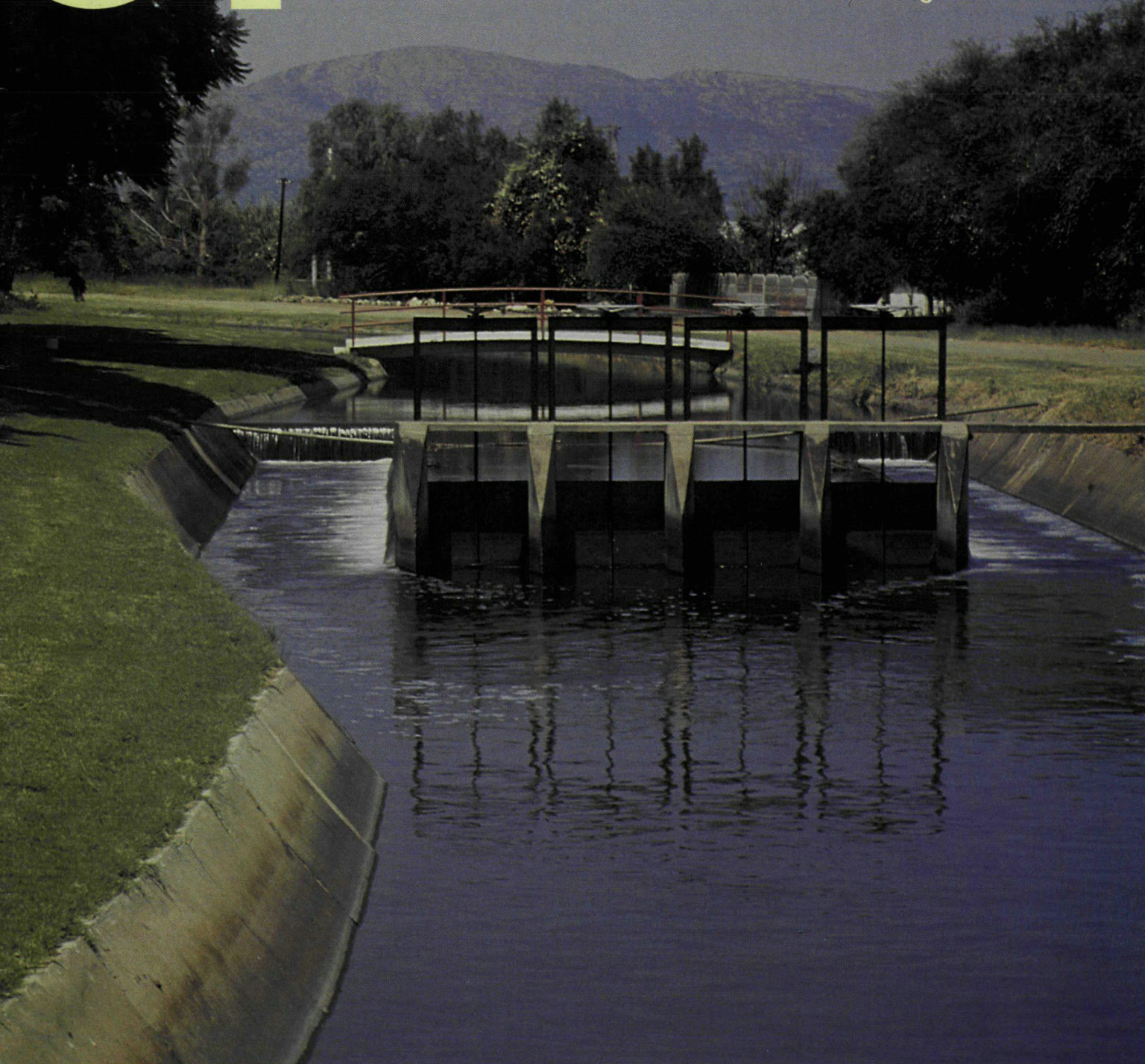


S4 waterbulletin

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WATER QUALITY

Researcher reports on the impact of urban runoff on PE's Swartkops estuary

BESPROEIING

Rekenaarmodelle bevorder doeltreffende waterverbruik in verskillende grond-klimaat-besproeiings-kombinasies

WATER ECOLOGY

Monograph compiled on South African river ecosystems

00020058

INTRODUCTORY COURSE IN WATER MICROBIOLOGY

18 - 21 October 1994 &

14 - 17 February 1995



Water Technology CSIR

organised by Health Programme,
Division of Water Technology, CSIR, Pretoria

PURPOSE

The purpose of this course is to provide a practical approach where participants will be trained in the basic concepts of health-related water microbiology. The course will include practical (60%) and theoretical (40%) aspects.

COST

R1 350 per person. All teas and lunches included.

COURSE MANUAL

A course manual will be supplied to all participants.

WHO SHOULD ATTEND

The course is aimed at people working in the water industry who require knowledge about basic techniques for the microbiological analysis of water. Industry, municipalities, government departments, water boards are among the bodies who may find such a course useful.

ACCOMMODATION

Accommodation as well as the travelling to and from the CSIR are not included in the price.

ATTENDANTS

A maximum number of 12 attendants will be allowed to ensure personal attention.

CONTACT PERSON

Mr Gerrit Idema

Tel (012) 841 3948

Fax (012) 841 4785

COURSE CONTENTS

Attendants will be trained in the basics of water microbiology.

Detection and analyses of faecal indicators of pollution: Standard plate count; Total coliform; Faecal coliform; Faecal streptococci/Enterococci; Coliphage and the confirmation of *Escherichia coli*.

Interpretation and reporting of results.

Demonstrations on the detection of other pathogens in water: Viruses; Parasites; *Legionella*; Bioassays for toxicity and Ames mutagenicity test.

Quality control.

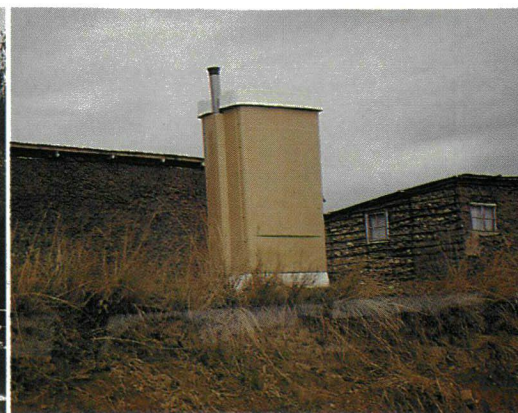
Laboratory safety.



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Voorblad: 'n Besproeiingskanaal met water uit die Hartbeespoortdam. (Foto: Helene Joubert)

SA Waterbulletin is a two monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament. Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source. Editorial offices: Water Research Commission, PO Box 824, Pretoria 0001, Republic of South Africa. Tel (012) 330-0340. Fax (012) 331-2565. Editor: Jan du Plessis. Asst Editor: Helene Joubert. Ed Secretary: Rina Human. Layout: Cover to Cover, Pretoria. Colour Separations: Lithotechnik. Printing: Beria Printers.

EXPERTS MEET AT TROUT '94 WORKSHOP

A very successful mini-symposium, the Trout '94 Workshop, was recently presented by the Federation of South African Flyfishers (FOSAF) in Pretoria. What was originally intended to be a small workshop grew into a mini-symposium, bringing together a very wide and varied spectrum of people. Amongst those who attended were representatives from the provincial nature conservation agencies, industrial companies, researchers, consultants, trout farmers and flyfishermen as well as water managers from the Department of Water Affairs and Forestry (DWAF).

Mr Charel Bruwer (DWAF) said "it is fantastic that outside people took up the challenge of organising this workshop where the layman could be informed about river and water ecology, water quality and management, and resource management".

With this workshop FOSAF created an excellent opportunity and forum for researchers and water managers to disseminate information and management principles to an interested group of the public such as trout farmers and the flyfishing fraternity.

PAPERS

Papers were presented addressing many different aspects relating to water biology, water management, conservation and ecotourism and there was much to glean from all of this expertise brought together. A number of the papers were presented by researchers whose research were funded by the Water Research Commission.

Representatives from the various provincial nature conservation agencies gave overviews of their present policies with regard to trout and troutfishing. Dr Cas Hamman (Cape Nature Conservation) aptly pointed out that in a modern dynamic world it is imperative for nature conservation organisations to be flexible and pragmatic in their policy development, to adapt and accommodate new situations which regularly arise due to new perceptions as well as greater understanding and growing knowledge of nature and the environment.

Mr Fred van Zyl (DWAF) gave delegates an overall perspective with regard to water as a resource and its management in the broader South African context. He said that it is of utmost importance that South Africa's already scarce and limited water resources remain fit for use on a sustained basis.

Aspects of the Water Act was briefly discussed by Mr James Perkins (DWAF), while the question of afforestation in mountain catchments was discussed by Mr Dennis Owen (DWAF). Mr Owen noted that the Forestry Act of 1984 was primarily aimed at water resource protection.

FOSAF (Natal) presented a short paper expressing their concern regarding streams and the adverse effects of afforestation. While the present water conservation management practices in SAPPI forests was well illustrated with slides in the paper presented by Dr John Scotcher.

Dr Jackie King and Dr Mark Chutter introduced the delegates to the biological world of "water bugs" (invertebrates) and river ecology. Jackie King spoke on rivers and the water need of rivers as complex ecological systems with interdependent components such as sponges, wetlands and estuaries.

In his paper on a rapid bioassessment protocol for the monitoring of streams or river water quality, Dr Chutter pointed out that various invertebrate species disappear from places where the water quality is not suited to their requirements. Pollution biologists can detect pollution by detailed analysis of the various invertebrates either present or absent at sites of concern in rivers or streams.

Dr Andrew Wood (SRK) discussed artificial wetlands as a means of natural pollution control and wastewater treatment, with specific reference to its application in trout farming. The development of natural wetlands protect receiving downstream water courses by acting as a nutrient sink to reduce nutrient levels of discharged waters.

Mr Eddie Goister of Ekokonsult discussed environmental impact assessment (EIA) as

a tool to adequately consider disruptive environmental consequences in development planning. He says the term "environmental" relates to both biophysical as well as socio-economic components, and that the purpose of integrated environmental management (IEM) is to resolve or mitigate negative impacts and to emphasise positive aspects of development proposals.

Mr Jake Alletson (Natal Parks Board) presented a highly informative and very practical paper on the basic ecology and design of trout dams, referring in particular to small "farm" dams.

Researchers discussing alien plant invaders, aquatic plants and freshwater macroalgae made delegates aware of the "green" side of water ecology. Biological and chemical control of aquatic weeds were also addressed in further papers.

Ecotourism was a well discussed topic with papers from both FOSAF and SA-TOUR.

FIELD DAY

The two days of papers, information and discussions which stimulated interest and promoted water and river management, was followed by a field workshop day at Waterval Boven.

The field day was an opportunity for the layman and researcher or consultant to get together informally. Dr Mark Chutter and Dr Jackie King captivated their audiences with the wonderful watery world they opened up to the uninitiated. Insect life in the river really came alive with them showing delegates what variety and how much life there really is in a water stream.

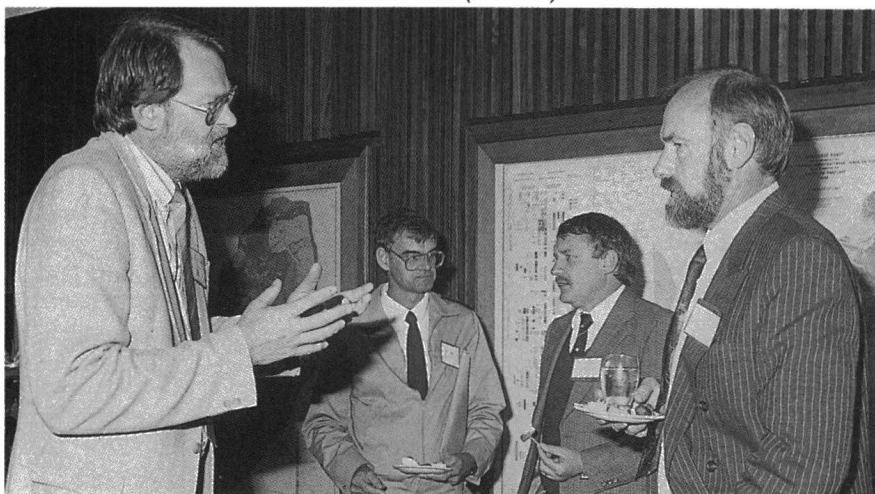
Mr Eddie Goister had his groups doing a little "environment versus development" exercise, while Dr Andrew Wood with his group was actively planning the placing and use of reedbeds (wetlands) all along the Elandsriver!

For those with "farm dams and trout" Mr Alletson was the just the person to consult as his group went around the trout dams at Waterval Boven.

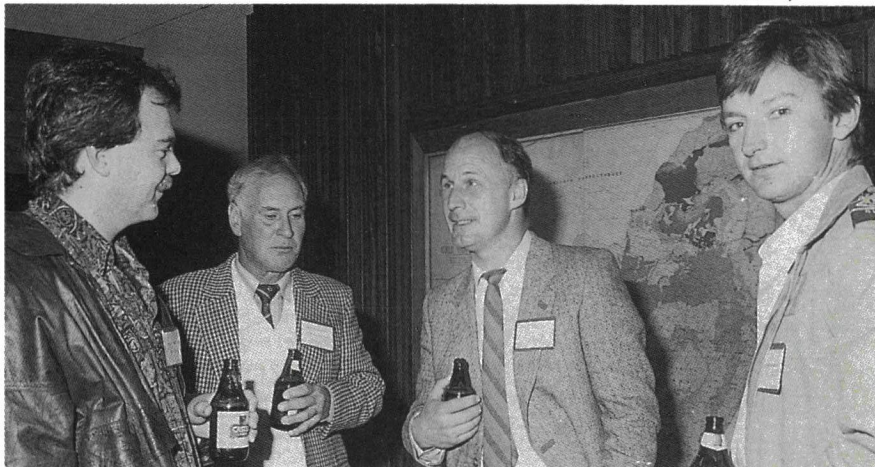
FOSAF, who with the help of Charel Bruwer and Dudley Davidson from the Department of Water Affairs arranged such an excellent programme, are to be commended for having presented this very informative and stimulating workshop.



Mr Eddie Goister (Ekokonsult) in a discussion with Mr Garth Brook (FOSAF) and Mr Bill Minscher (FOSAF)

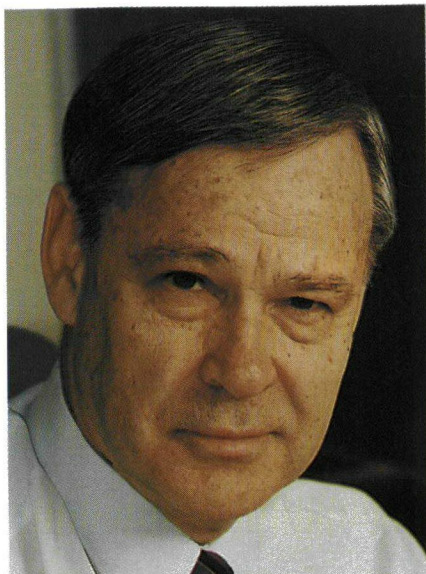


Mr Charel Bruwer (Dept. Water Affairs) having a word with Mr Wynand Fourie (Dept. Environmental Affairs), in the background is Mr Garth Batchelor (Transvaal Nature Conservation) and Mr Dudley Davidson (Dept. Water Affairs)



In a good mood at the Workshop, Mr G Mockler (Millstream Farm Shareblock Development), Mr B van Holdt (FOSAF), Mr Martin Davies (Rhodes University) and Mr Pierre de Villiers (Free State Nature Conservation).

PIET ODENDAAL ELECTED



Mr Piet Odendaal

At the Governing Board meeting of the International Association on Water Quality (IAWQ) held in Budapest on 21 to 22 July 1994, Mr PE Odendaal, Executive Director of the Water Research Commission, was elected one of the Association's two Vice-Presidents.

Professor Tom Keinath, Dean of the College of Engineering, Clemson University, USA, was elected President unopposed, while the other elected Vice-President is Professor Tomo Matsuo from the Department of Urban Engineering, University of Tokyo, Japan.

Mr Odendaal says that in addition to his normal responsibilities as a member of the IAWQ Executive Committee, his specific brief will be to devise strategies for interfacing IAWQ expertise and strengths with the needs of developing countries.

The IAWQ was established in 1965 and is dedicated to the professional advancement of the science and practice of water pollution control. Members come from all professions within the water pollution control industry and include scientists, engineers, managers and administrators. Present membership comprises 51 national members, 527 corporate members and about 4 888 individual members. Thirty specialist groups also operate under the IAWQ banner.

WRC buys Russian radar

The first dual-wavelength weather radar in South Africa, and the only one of its kind in Africa, was recently put into operation outside Bethlehem in the eastern Orange Free State.

The Water Research Commission (WRC) bought the radar from a company in Russia for R1,5 million - a quarter of the price for the Western equivalent.

The radar is a tremendous asset for hydrological and atmospheric research in South Africa and will also be of great benefit to the WRC's precipitation research project in the area.

The radar facility is unique in that it can sweep the same atmospheric volume with both 10 cm and 3 cm wavelengths. This capacity means that more accurate readings can be done in thunderstorms to enable, among other things, greater distinction between water and ice within a storm. This will aid the timely identification of hail-producing storms and will therefore lead to better short-term forecasting of severe storms.

Since the radar facility also has the potential to make accurate area rainfall calculations, it will now be able to give flood warnings much sooner and with greater confidence. Apart from the fact that the weather office is now better equipped to supplement their rainfall networks, the radar also covers a large geographical area that includes Lesotho.

The radar will be operated as a joint project by the Weather Bureau, the Department of Water Affairs and Forestry and the University of Pretoria.

Nuwe Navorsings- bestuurder aangestel

Mev. Annatjie Oelofse is onlangs as navorsingsbestuurder by die Waternavorsingskommissie aangestel. Sy sal voortaan die projekte rakende drinkwatergehalte en -gesondheidsaspekte behartig.



Mev Annatjie Oelofse

Mev. Oelofse het 'n BSc graad met industriële chemie aan die Universiteit van Potchefstroom behaal. Sy het verder studeer aan die Universiteit van Pretoria se Afdeling Waterbenuttingsingenieurswese en 'n M Sc graad verwerf.

Sy was voorheen verbonde aan SASOL III as Eerste Skeikundige by die Afdeling Waterwerke. Vroër was sy as lektor aan die Pretoria Technikon betrokke by die Waterversorgingstechnologie en Chemiese Ingenieurswese diplomakursusse.

Mev Oelofse is 'n lid van WISA, verder dien sy op die advieskomitee vir Waterversorgingstechnologie (Technikon). Sy is ook lid van die Transvaal se Munisipale Vereniging.

In haar vrye tyd maak sy graag tuin en doen naaldwerk. Op Secunda was sy ook baie betrokke by die kultuurbedrywighede van die Stadsraad. Sy is getroud met 'n landboukundige en het 'n seun en twee dogters waarvan die jongste tans in matriek is.

Prof Gerrit Marais honoured by IAWQ for his research achievements

Gerrit Marais, former Professor of Water Resources and Public Health Engineering at the University of Cape Town, has been awarded the International Association on Water Quality's prestigious Karl Imhoff-Pierre Koch medal for his sustained scientific contribution to water quality control – an area of engineering which is extremely complex and empirical. The medal was presented to Professor Marais at the recent IAWQ biennial conference in Budapest, Hungary.



Professor Marais has had a long and distinguished career as a sanitary engineer in the field of water research. At the age of 26, after serving as an apprentice fitter and turner on the South African Railways and as lecturer at the Port Elizabeth Technical College, Gerrit van Rooyen Marais commenced his university studies and obtained a BSc degree in Civil Engineering from the University of Cape Town in 1955.

After two years as a research engineer in the mining industry, he spent six years with the then Northern Rhodesian Housing Board doing research in low cost housing, water supply and sanitation. During this time he did post-graduate studies at the Imperial College, London, and was awarded a DIC in Public Health Engineering in 1963. In 1965 he obtained his MSc degree from the University of the Witwatersrand. The research that he conducted during this time resulted in 19 publications in the low cost water supply and sanitation area.

One of these papers described a novel instrument for measuring dissolved oxygen in oxidation ponds, for which he was awarded a prize for the most innovative short paper by the South African Institute of Civil Engineers in 1967. The quality of the research from this first phase of his career as a sanitary engineer was such that in 1970 he was appointed as a member of the Expert Committee on Environmental Sanitation of the World Health Organisation (a position he held until 1987), and in 1972 he was invited to the United States of America by the American Society of Sanitary Engineering as Distinguished Foreign Professor.

After a very brief spell as senior lecturer in Soil Mechanics at Witwatersrand University, the second and most successful phase of Professor Marais' research career in sanitary engineering commenced in 1967 when he was appointed to the Chair of Water Resources and Public Health Engineering at the University of Cape Town – a position he retired from at the age of 65 in 1992.

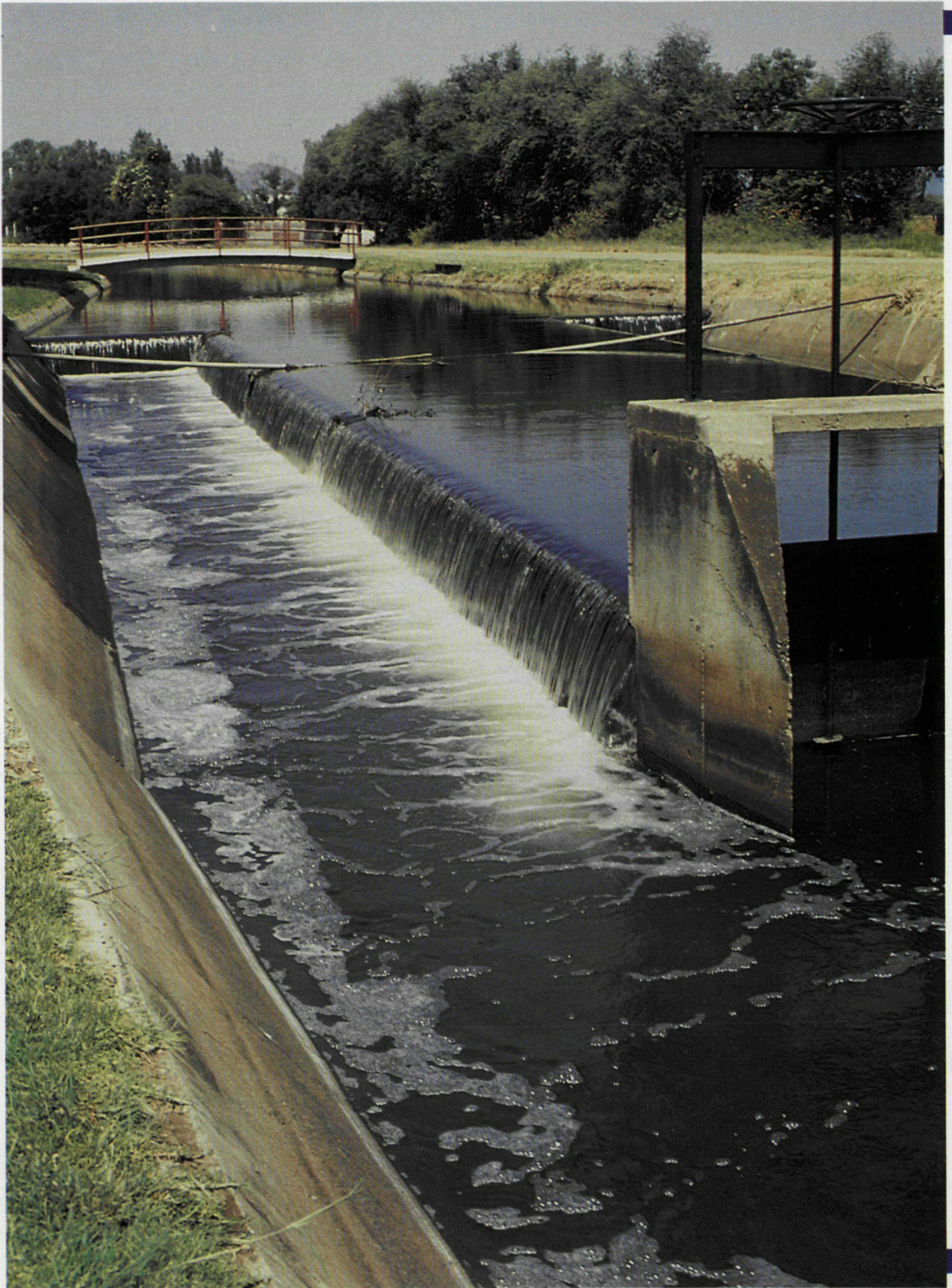
As Professor his main research interests have been in municipal water and wastewater treatment, covering such topics as water chemistry and water conditioning, activated sludge kinetics and modelling, biological nitrogen and phosphorus removal from municipal wastewater and, more recently, anaerobic digestion and filamentous bulking control in activated sludge systems.

As a result of his indefatigable research activity since his appointment as Professor, he was elected Fellow of the University of Cape Town for distinguished research in 1977, while in 1983 he was awarded a DSc degree in Engineering by the University of Cape Town – one of only four who have been awarded this distinction since the inception of the Faculty of Engineering in 1921. On two occasions he was appointed short term consultant by the World Health Organisation, in 1976 to Brazil and in 1980 to Colombia, to advise on wastewater treatment problems. In 1983 he was appointed by the IAWQ together with four other research scientists and engineers to serve on an international task group for modelling biological wastewater treatment systems. In 1984 Professor Marais

was a major contributor to a short course at Richmond, Virginia, on the design of biological nitrification denitrification biological excess phosphorus removal systems for practising engineers, plant operators and state legislators to promote the technology in Virginia and the surrounding East Coast States. On many occasions Professor Marais has been invited as plenary speaker at international conferences to present state of the art review papers in the field of activated sludge kinetics and biological nutrient removal.

At present Professor Marais, although officially retired, and his research team are compiling the experimental information on biological nutrient removal acquired since 1984 into a revised edition of the 1984 design and information monograph, covering additional topics such as wastewater characterisation and acid fermentation for augmented biological excess phosphorus removal.

With his exacting standards of research, Professor Marais is recognised today as one of the world's doyens of sanitary engineering who, through his incisive thinking and thorough research technique, has instilled confidence in biological nitrogen and phosphorus removal to the extent that today it is the preferred technology for municipal wastewater treatment in South Africa. With nitrogen and phosphorus removal from wastewaters becoming increasingly urgent in the USA, Europe and Australia, these countries are now looking to South Africa's biological nutrient removal experience and practice, to which Professor Marais has made a major contribution, for guidance.



Computer models maximise irrigation project efficiency



"The decreasing availability of water has made it necessary to attain maximum crop production from all water used for irrigation, and the best way to do it is by utilising computerised system analysis." This is the view of researchers R Mottram and JM de Jager from the Department of Agrometeorology at the University of the Orange Free State in a report to the Water Research Commission on maximising irrigation project efficiency in different soil-climate-irrigation situations.

A mathematical modelling approach was used extensively throughout the project. This computerised, numeric, quantitative method, the researchers say, ensures non-subjectivity and furthermore makes it possible to apply elsewhere the exact procedures developed with the research.

Consideration of a variety of climate-soil situations was achieved by conducting investigations in four markedly differing localities, namely:

- ☐ Winterton in Natal (now Natal/KwaZulu) - medium rainfall and hilly terrain
- ☐ Taung/Molatedi (Northwest) - dry Highveld
- ☐ Karkloof in the Umgeni catchment area, Natal/KwaZulu - humid, high rain-fall
- ☐ Reitz in the Orange Free State - continental, good rainfall

Furthermore, the various types of irrigation systems, water supply and convey-

ance systems employed at each locality provided numerous irrigation scenarios.

SITUATION SURVEYS

The researchers say one of the specific objectives of the project was to carry out situation surveys on selected irrigation projects and, if possible, to develop a mathematical model for each project.

Situation surveys were carried out at 24 sites, but in most cases no mathematical formulation was possible. However, information gathered was compiled in guidelines for efficient water use and management on irrigation projects. These guidelines were presented to certain water boards and brought about significant changes in their *modus operandi*. The Little Tugela/Sterkspruit Irrigation Board, for instance, adopted a new method of decision making based upon the workshops, technology transfer and research results obtained in the area. This improved the effectiveness with which water was apportioned to users.

These guidelines were also applied by the Karkloof Irrigation Board in Natal and assisted greatly in the formalisation of the board and the management of their irrigation water.

MODELS

The researchers say another specific objective of the research project was to use and refine computer models for analysing current operations and make recommendations for increasing overall project and on-farm productivity and water use efficiency.

The fact that commercial irrigators are employing the PUTU models, albeit on their own, or through the University of the OFS, testifies to the fact that these models are both operational and valid.

The validation tests proved that, given suitable yield-water stress response parameters, the models provided accuracies acceptable for decision support purposes. Furthermore, the validity of the additive form of the model for use in linear pro-

gramming procedures was demonstrated.

Different aspects of crop growth and water balance models were validated at three different sites, namely Roodeplaat, Taung and Molatedi

The models, when applied in practical situations, highlighted the procedures to be implemented for increasing both overall project water use efficiency and on-farm productivity.

SAVINGS

- ❑ On perennial pastures an individual farmer realised an almost 50 per cent decrease in pumping costs below the previous season when he himself applied the automatic weather station data and computational procedures. Another dairy farmer in the same district was able to survive on irrigated pastures through the dry 1992 and 1993 seasons, whereas other dairy farmers in the vicinity were forced to reduce herd size due to lack of adequate irrigated pasture.
- ❑ In Reitz, in the north-eastern Free State, the validity of using the PUTU system to irrigate (by drip irrigation) high quality potatoes for the local market, the chipping industry and especially the lucrative export market, was proved. Since employing the PUTU procedures, the particular farmer claims a 40 per cent saving in pumping costs.
- ❑ Floods disrupted the early experiments at Taung and Molatedi in Bophutatswana (now Northwest), but thereafter it was possible to conduct water management trials which could only serve as demonstrations to the local community. One trial, however, did prove the validity of the water stress factor for identifying stress conditions. A 50 per cent value was found accurately reflected the onset of stress.
- ❑ In the Winterton area centre pivot irri-

R. MOTTRAM
J.M. DE JAGER

RESEARCH ON MAXIMISING IRRIGATION PROJECT EFFICIENCY IN DIFFERENT SOIL-CLIMATE-IRRIGATION SITUATIONS

Report to the
WATER RESEARCH COMMISSION
by the
DEPARTMENT OF AGROMETEOROLOGY
UNIVERSITY OF THE ORANGE FREE STATE

WRC Report No 226/1/94

Copies of the report entitled "Research on maximising irrigation project efficiency in different soil-climate-irrigation situations" (WRC Report 226/1/94) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price for the report: \$25.

gation farmers on average attained approximately 40 per cent increases in yields above those attained in the surrounding area in which scheduling took place according to normal practice.

MAXIMISATION

According to the researchers a third specific objective was the application of the models to irrigation project management as well as the refinement of the models with the aim of maximising overall irrigation efficiency.

Equations for quantifying efficiencies were developed and applied. Water use

efficiency was improved in all the cooperator sites. This was mainly due to the effective irrigation scheduling technique made available by the PUTU-system.

Linear programming procedures for planning strategies for optimising the area to be cultivated and the amounts of water to be applied in the different crop growth stages were formulated.

With regard to pre-season planning, two farmers from Little Tugela utilised the linear programming procedures developed during the dry 1991/1992 season when water restrictions were operative. Significant financial gain accrued.

The researchers say routine information regarding irrigation which evidently had good impact upon users was provided to boards, estates and individuals. Advices on water management and distribution as well as efficient irrigation scheduling were distributed.

CONFIDENCE

Irrigators using the PUTU-system and allied linear programming procedures for irrigation scheduling have gained considerable confidence in their own irrigation management capabilities. Several entrepreneurs, both large and small, now employ the system. The researchers say that some resistance to change, especially on the larger estates, is still evident. This is however diminishing. The fact that the models have been applied in actual situations and have produced good results has done much to enhance their credibility. Less electricity and subsequently less water have been consumed to produce increased yields and quality at farm level.

The industry is eager to adopt the programme and procedures now available. This is borne out by the willingness of farmers and farm cooperatives to contribute, for their own account, seven automatic weather stations towards the project. Other farmers have also expressed the desire to become involved in the near future.



Eerste resultate van proteïenherwinning uit abattoir-uitvloeisel lyk positief

In die Mei/Junie 1994-uitgawe van SA Waterbulletin is berig dat 'n proteïen-produksie-aanleg by die Johannesburg Abattoir geopen is. Die inbedryfstelling- en optimisasieperiode is nou voltooi en volgens die raadgewende ingenieurs, Burger Pretorius en Vennote (BPV), is positiewe resultate met die proses verkry.

GANGBAARHEIDSTUDIE

Dié proteïenherwinningsprojek van ABAKOR en die Waternavorsingskommissie is gebaseer op 'n gangbaarheidstudie wat deur BPV raadgewende ingenieurs voltooi is. Loodskaalnavorsing van BPV is gebruik om resultate te genereer vir die gangbaarheidstudie en dit het getoon dat die kapitale uitleg en bedryfsonkoste binne twee jaar gedelg sal word deur besparings in uitvloeiseltariewe en verkope van die proteïenprodukt. Na aanleiding hiervan is die uitvloeiselsuiweringaanleg by die Johannesburgse Abattoir deur BPV in 'n proteïenherwinning- en -produksie-aanleg verander.

Die optimisasie van die aanleg is in die daaropvolgende ses maande onder leiding van mnr Gideon de Villiers, 'n vennoot

van BPV, gedoen en deur ABAKOR en die Waternavorsingskommissie gefinansier.

Volgens mnr De Villiers stem die prosesresultate goed ooreen met wat voorspel is en dui dit op 'n suksesvolle opskaling vanaf loodsskaal. Hy sê die gangbaarheidstudie moet nog opgedateer word, maar 'n verbetering teenoor die vorige gangbaarheid word verwag.

RESULTATE

Evaluasie van die proses is op drie gebiede gedoen, naamlik: stelselstabilisasie en bedryfbaarheid, slykeienskappe en besinkbaarheid en suiweringsdoeltreffendheid.

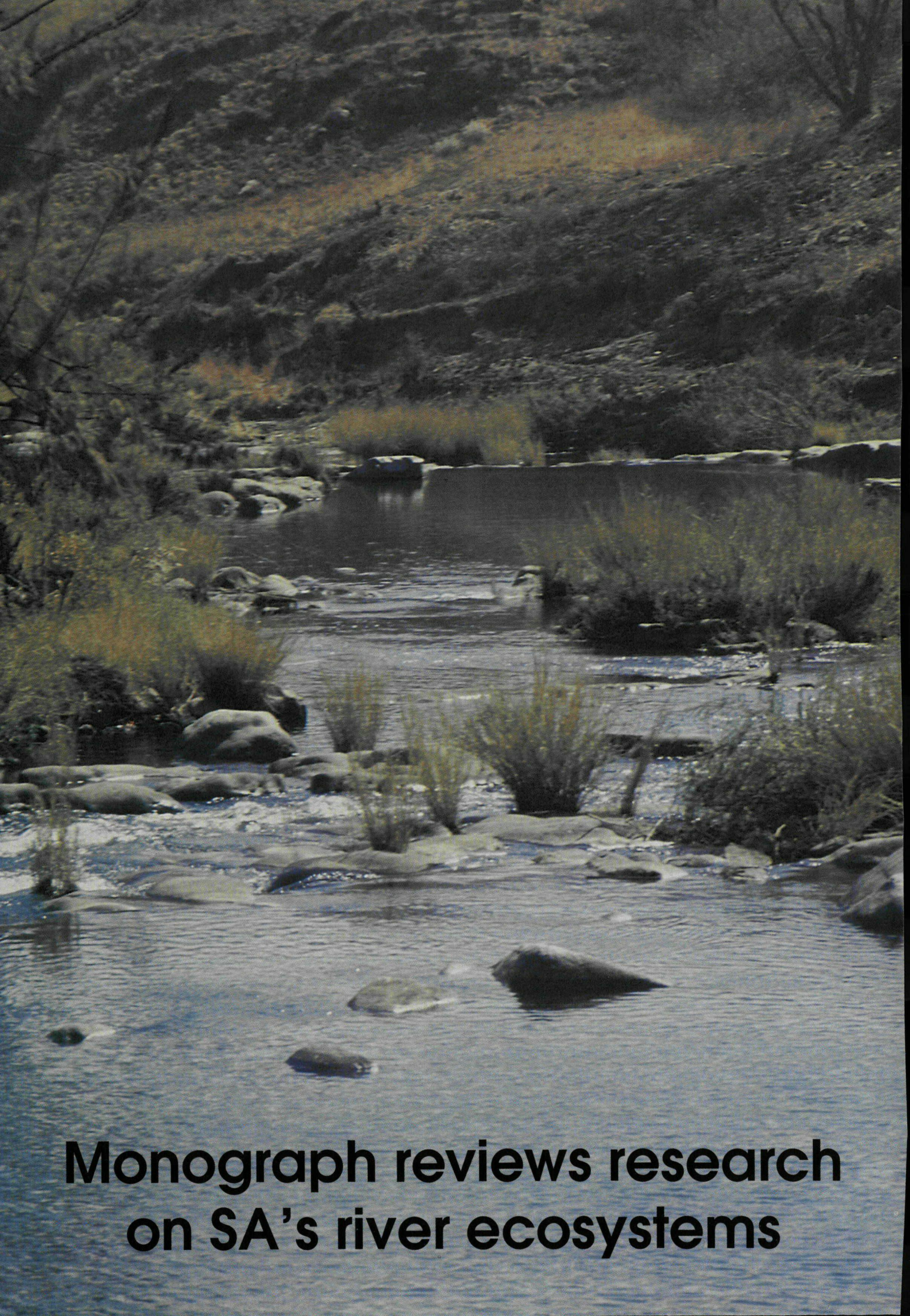
Mnr De Villiers sê hoewel die enkelladingsproses wat toegepas word nooit biologies in ewewig kan wees nie, kon dit gestabiliseer word. Die resultate is betroubaar en die proses kon goed beheer word terwyl die bedryf van die aanleg by die behoefte van die abattoir aangepas is. Elektriese verbruik vir suurstoftoevoeging - een van die grootste bedryfsuitgawes - kon heelwat verminder word deur die toe-

passing van 'n kort slykouderdom en anoksiese toestande gedurende die vulperiodes.

Volgens mnr De Villiers was die proteïenwaarde van die proteïen geproduseer sowat 40 persent. Die slykvolume-indeks, wat 'n aanduiding is van die volume wat slyk beslaan, was 80 ml/g en 'n goed besinkbare slyk is verkry. Die proteïenprodukt kon met behulp van 'n bandpers tot 'n soliede inhoud van 31 persent ontwater word.

Die suiweringsresultate wat BPV verkry het, was hoër as wat vir die gangbaarheid aanvaar is. Gesuspendeerde stowwe in die finale uitvloeisel was 45 mg/l en nadat 99 persent van die gesuspendeerde stowwe verwyder is, is die chemiese suurstofbehoefte, 'n maatstaf van onsuiverhede in die water, met sowat 96 persent verlaag.

Die afhandeling van die optimisasieperiode was die laaste fase van 'n suksesvolle prosesontwikkeling en implementering van 'n projek wat in die laboratorium begin is en op volskaal geëindig het. Dit is 'n goeie voorbeeld van die kundigheid wat in Suid-Afrika beskikbaar is.



**Monograph reviews research
on SA's river ecosystems**

"Southern African lotic ecosystems appear to be "predictably unpredictable", because variation and uncertainty are the two main characteristics of Southern African rivers, both from the point of view of understanding their ecological functioning, and of their management as sustainable water resources", says Davies, O'Keeffe and Snaddon in a review of research on South African river ecosystems, recently published by the Water Research Commission. The monograph entitled **A synthesis of the ecological functioning, conservation and management of South African river ecosystems** (WRC Report no. TT 62/93) is available, free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Please note: Foreign orders will be charged a list price of US\$ 30.)

In the past few years there has been a new impetus to river research, particularly in terms of conservation, river classification, instream flow requirements, ecosystem processes, inter-basin transfers, so called "assimilative capacities" for pollutants, and long-term ecosystem research as well as a renewed interest in the law and legislation governing water rights.

This renewed emphasis on river ecosystem functioning in Southern Africa, as well as on the acute shortage of manpower in the field of lotic ecology, are important changes in direction away from unenlightened use and abuse of rivers, towards a better understanding of the ecological needs of the rivers of the region.

It is within this context that the authors attempted to compile a comprehensive review of the nature and functioning of the rivers of Southern Africa, together with an historical perspective of river research in the region, an overview of the major findings, and concluding with some personal views on future research, conservation, and management requirements.

CHARACTERISTICS

According to the authors some of the major river ecosystem characteristics in Southern African can be summarised as follows:

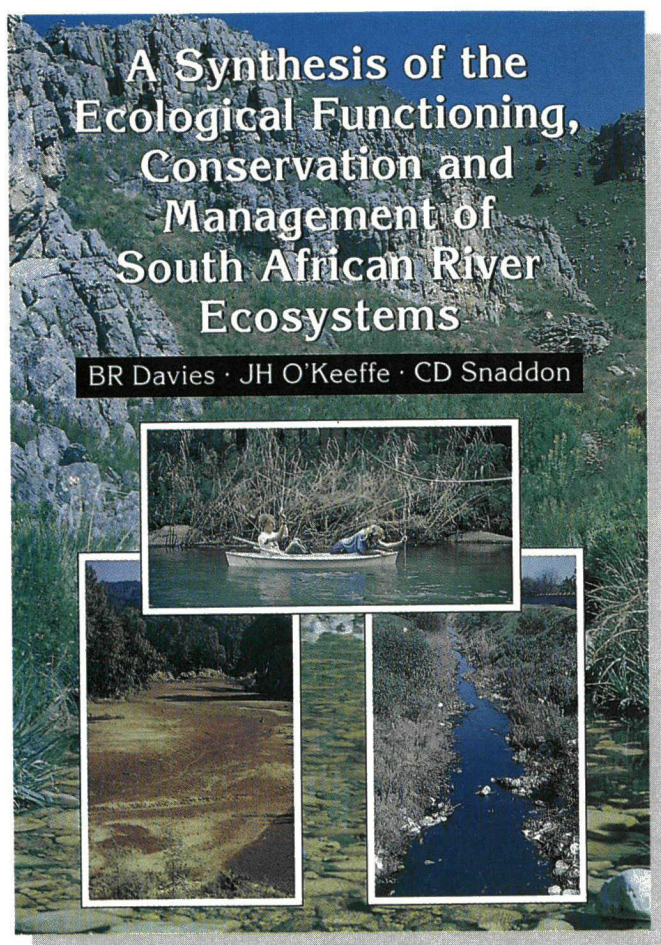
- The overriding characteristic of Southern African rivers are their variability in terms of the mean annual precipita-

tion and run-off – the rivers are "predictably unpredictable".

- Very high evaporative components, severe flooding and drying episodes are common to all parts of the sub-continent.
- Most South African rivers are geologically young and consequently may tend to be fast flowing canyon rivers, with very few floodplains. Where floodplains do occur they have considerable ecological importance.
- With the exception of western Cape rivers, most Southern African rivers carry high loads of suspended solids. The dominant discharges of the rivers are high, with total suspended solids a seasonally important factor at least.
- The channel morphology of the rivers are structured to cope with highly variable hydrological events, and are often very complex.
- Water chemistry is clearly linked to the geology throughout the region and appears to bear some relationship to the limnological regions of Southern Africa.
- Many South African river ecosystems do not have forested headwater reaches and are, therefore, more reliant on instream plant material rather than the input of plant matter from the catchment, with concomitant structuring of the biota.

- Debris dams are not common features of Southern African systems, and leaf packs are either rapidly utilised, or have short residence times due to the flashy properties of our rivers. Leaf packs appear to act as *refugia* during harsh conditions.
- A large number of rivers which normally would have had natural open-canopied headwaters are now under closed canopies, due to commercial forestry of exotic tree species (eg Sabie and Levuvhu catchments), with inevitable effects on the riverine processes and the biota.
- The rivers of the region are highly susceptible to invasion by exotic biota, ranging from fish through aquatic insects and other invertebrates to floating and rooted aquatic macrophytes.
- River regulation has led to an increased spread of pest species and disease vectors.
- Subsurface flow in rivers are of great importance as a refuge for aquatic organisms, and also as recolonising source for the river itself when flowing.
- In contrast to more stable rivers, it is possible that the biota of Southern African lotic systems comprises hardy opportunists, able to exploit suitable habitats between catastrophic floods and droughts.
- Having noted the lack of pronounced seasonality and the unpredictable nature of Southern African rivers, the authors point out that the riverine biota must have evolved to cope with this unpredictable hydrology, so much so that it actually requires the unpredictable extremes in order to survive.
- South African rivers have notably been disturbed through river regulation. Some systems have been so severely disturbed that they are now showing signs of resistance to reversion to their original condition.

For example, more than forty per cent of the indigenous invertebrate species in the Great Fish River have disappeared following the introduction of constant flow by way of inter-basin transfer of water. The alteration of the natural variation because of river regulation through impoundment



A Synthesis of the Ecological Functioning, Conservation and Management of South African River Ecosystems

BR Davies · JH O'Keeffe · CD Snaddon

and inter-basin transfers have had a profound influence upon almost every aspect of river functioning in Southern Africa, says the authors.

REVIEW OF CONTENTS

Chapter one is an introductory chapter to the monograph.

Chapter two deals with the **concepts** of lotic functioning. In this chapter the authors briefly review the major concepts used world-over that underlie the bulk of river and stream research and management elsewhere, as seen from a South African perspective.

The authors also attempted to record some of the difficulties researchers have experienced in applying these concepts to local conditions, and state their views within a Southern Hemisphere context.

However, the authors say that as they presented the various chapters on the geomorphological, hydrological, climatic, geological, chemical, as well as limnolog-

ical features of the region, and the findings of Southern African river ecologists, they noted, to their surprise, that some of the earlier perceived difficulties progressively fell away in the light of recent research.

Chapter three briefly touches on the **geology and geomorphology** of the Southern African region.

Chapter four succinctly discusses the **climate** of Southern Africa in terms of the rainfall and hydrology, accentuating the high variability with regard to rainfall in this region.

Chapter five gives a very concise summary of the **soils and vegetation** found on the subcontinent.

In chapter six the authors discuss the **regional limnology** of Southern Africa in terms of a subdivision of Southern Africa into five limnological regions, namely, a subtropical peneplain, the summer rainfall region of the elevated plateau, the elevated mountain massif of Lesotho, the tem-

perate acid waters of the South and Western Cape, and the arid west which includes the Karoo and Namibia. In this chapter each of these regions and their limnology is outlined and summarised for the reader in five sections.

The **water chemistry** of the Southern African inland waters is covered in chapter seven. An additional section to this chapter touches on sediment transport in particular.

Chapter eight is a comprehensive chapter on the **lotic ecosystem functioning** dealing with the various aspects and processes of the lotic ecosystem, namely:

- ☐ allochthonous inputs and related processes
- ☐ benthic organic matter and leaf-pack dynamics
- ☐ retention and discharge
- ☐ the effects of fire on stream processes
- ☐ impacts of catchment condition and vegetation manipulation (other than fire)
- ☐ primary producer dynamics and community respiration
- ☐ hyporheic processes; the role of spate-generated foams and organic matter transport
- ☐ floodplains
 - case study: the Pongolo River floodplain
- ☐ secondary producers
 - introductory comments by the authors
 - invertebrate taxonomy and systematics
 - invertebrate characteristics, zonation and life histories (well discussed and illustrated)
 - invertebrates and decomposition processes
 - invertebrate functional feeding groups
 - pollution and invertebrates
 - invertebrate drift
 - vertebrate community distribution and ecology.

Chapter nine deals at length with **river regulation** in Southern Africa, specifically from an ecological point of view, under the following headings:

- introductory comments – giving some background to the rest of the chapter
- dams and interbasin transfer schemes – some statistics
- river regulation by dams: a review of ecological research
- the Buffalo and Palmiet studies: a comparison of contrasting systems
- farm dams: the influence of small-scale water harvesting
- the impacts of inter-basin water transfers
- case studies of inter-basin transfers (IBT's):

- Great Fish River, Eastern Cape
- Eastern National Water Carrier, Namibia
- Lesotho Highlands Scheme

River conservation is the subject of chapter ten and briefly discusses some facts and findings with regard to the present status of seven SA rivers. This chapter comprises the following sections:

- background
- when "pristine" is not pristine
- invasive species
- case studies
- water allocations for the environment.

Chapter eleven deals very briefly with the **water law** in South Africa; the authors refer to an analysis of the Water Act of 1956 which discuss the Act in terms of the provisions it does make and the

present day shortcomings, particularly with regard to the aquatic environment and ecology.

Chapter 12 is titled **ecosystem generalisations**, and summarises, in point form, the major ecosystem characteristics of the Southern African region and its rivers.

Chapter 13 sets forth **research priorities, conservation and management objectives**, ever so briefly in 35 points, as perceived by the authors.

In conclusion the authors say that man is a part of the ecosystem he inhabits and that the strategic importance of rivers, coupled with their rapid deterioration, makes the development and refinement of longterm strategies for research and management absolutely vital.

The monograph is well illustrated with black and white photographs and an ample amount of maps, graphs and tables to compliment the text.

APPLIED GROUNDWATER TECHNOLOGY COURSE

Presented by the Borehole Water Association of Southern Africa

5 - 7 OCTOBER 1994

VENUE

BALALAIKA PROTEA HOTEL, 20 MAUDE STREET, SANDOWN

TIME

08:30 - 16:30

Enthusiastic response received after the June '94 course has prompted the Borehole Water Association to offer a second course this year. Practical case studies will be incorporated to reinforce the learning process. The course covers the following topics:

- ☐ Groundwater location
- ☐ Borehole drilling and completion techniques
- ☐ Test pumping
- ☐ Selection and installation of pumps
- ☐ Groundwater system performance monitoring
 - system cost-effectiveness
 - preventative maintenance techniques
 - borehole encrustation and bio-fouling

To enrol, please contact L'aura at (011) 942-1123; fax (011) 942-1402 or
Beryl at tel (011) 477-7577; fax (011) 477-5710.



Report published on the impact of urban run

The Swartkops estuary lies within the municipal boundaries of Port Elizabeth, while the Swartkops River, above the tidal head, runs through the industrial areas of Uitenhage and Despatch. The river, and especially the estuary, is a natural water body of great biological diversity and productivity with a high recreational value for Port Elizabeth residents and visitors.

Recent rapid development of high density residential areas within the lower catchment has led to problems in the estuary and the river due to polluted runoff from such areas.

In a study financed by the Water Research Commission and carried out by HM Mackay of the industrial and environmental management firm, Talbot & Talbot, an attempt was made to assess the impact of this urban runoff on water quality in relation to other known sources such as treated effluent discharges upstream, and to suggest options for future management of the Swartkops estuary.

A report, KV 45/93, summarising the final results of the study is now available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. (Overseas price: \$25.)

Concern regarding the water quality of the Swartkops River, which drains into Algoa Bay to the north of Port Elizabeth, is not new. The effects of pollution from anthropogenic sources on the quality of the River's water have been observed ever since urbanisation of the catchment began early this century. As a result of this concern, a Department of Water Affairs pollution control office was established in Port Elizabeth and the Swartkops Trust was formed in 1968.

The aim of the Swartkops Trust was to protect the estuary as a recreational area and to preserve the estuarine ecosystem. A structure plan for the lower Swartkops valley was drawn up by town planners and was intended to serve as a guide for development.



off on PE's Swartkops estuary

Polluted urban runoff sometimes have severe effects on water quality. The problem will grow in extent with urbanisation in future, but research results indicate that the options for dealing with the problem are relatively simple.

Research has been conducted in the estuary for some thirty years, although it has been mostly ecological in scope. In September 1987 a symposium was held in Port Elizabeth with the aim of integrating the research findings into an advisory management plan for the Swartkops estuary. Since the symposium, progress has been made in the provision of education and consultation mechanisms and control over exploitation of bait and fish resources following the appointment of a Swartkops conservation officer.

MOTHERWELL

According to the report published by the Water Research Commission, the main aim of this study, initially, was to quantify

the impact of urban runoff from Motherwell township on the water quality of the estuary. Construction of Motherwell began in 1985 and all stormwater was routed directly to the estuary via a single concrete canal. By 1986, complaints from the public were already being received concerning the apparently polluted discharge from the canal in both dry and wet weather.

Following preliminary studies, it soon became clear that the discharge had a severe impact on water quality in the vicinity of the outfall, particularly in terms of numbers of faecal bacteria.

At the same time as the township of Motherwell was being developed, other high density townships were being planned and built over much of the lower catchment area

of the Swartkops river and estuary. The same type of problem, i.e. polluted urban runoff, was being observed in other reaches of the river and estuary, and was also being reported in other parts of the country as influx control in major cities was relaxed and both formal and informal urbanisation proceeded rapidly.

STUDY

In 1990, the Water Research Commission provided funding for a three-year study to investigate the problem. The field work was to include measurements of pollutant loads reaching the estuary from Motherwell, investigations of dispersion and mixing of effluent in the reach of the estuary between the Wylde Bridge and Redhouse and an assessment of the fate of the pollutants in the estuary and their impact on the receiving water quality.

Early on in the study, it became clear that dry-weather pollutant loads were relatively low due to the low flow rates. However, the impact was severe over a small local area in the middle reaches of the Swartkops estuary. Remedial measures were fairly obvious: the most polluted dry-weather flow should be prevented from reaching the estuary by diversion of the flow, either to an artificial reedbed or to the sewage works for treatment.

CHAPTERS

Each of the first five chapters in the report is designed to stand alone to some extent, as each deals with a different aspect of water quality in the estuary. In Chapter 1 problems associated with urban runoff are covered and the water quality management objectives for the estuary are presented and discussed in some detail.

Chapter 2 gives an overview of the study area, while Chapter 3 is a review of available water quality information from the Swartkops estuary and the river. In Chapter 4 sources of runoff to the estuary are discussed and the results of a runoff sampling programme are presented. The hydrodynamics and mixing characteristics of the estuary are covered in some detail in Chapter 5.

In Chapter 6 potential impacts on water quality in the estuary are evaluated, based on the information from the first five chapters. Chapters 7 and 8 deal with future management options and research needs.

Mechanisms of phosphate removal studied

The results of a study undertaken to gain a better understanding of the microbiological phosphate removal process and the factors influencing it, have been released by the Water Research Commission in Pretoria.

The researchers, M Bosch and TE Cloete, from the Department of Microbiology and Plant Pathology at the University of Pretoria, say that in South Africa millions of rands have been invested in the development of activated sludge plants for carbon, nitrogen and phosphorus removal from wastewater. "Although the activated sludge systems are operating successfully, the mechanisms by which phosphate removal takes place are still unclear and due to this lack of knowledge plants are unable to meet legislated standards biologically."

The researchers say currently ferric chloride is being added to most of South Africa's activated sludge systems to remove phosphorus to the legislated levels. To try and eliminate this chemical treatment entirely, the activated sludge plants need to biologically remove phosphorus more efficiently. However, before this can happen, the mechanisms involved and factors affecting phosphate removal need to be determined and manipulated.

According to the researchers' report, the study was divided in two sections, the aims of which were as follows:

SECTION A

- ❑ To isolate a number of *Acinetobacter* strains from activated sludge and to identify and classify the strains using sodium dodecyl sulphate-page (SDS-PAGE) and numeric analysis;
- ❑ To determine the ability of these strains to grow and accumulate phosphate in mixed liquor;

- ❑ To determine if any variation in phosphate uptake could be ascribed to the different species;
- ❑ To determine if the variation in phosphate uptake could be ascribed to the presence or absence of certain proteins, using the SDS-PAGE data;
- ❑ To investigate the effect of growth phase on phosphate uptake;
- ❑ To determine the effect of alternating anaerobic-aerobic conditions on the viability, growth and phosphate uptake of *Acinetobacter* strains; and
- ❑ To determine the ability of *Acinetobacter* strains, immobilised in sodium alginate or kappa-carrageenan, to grow and accumulate phosphate in mixed liquor.

SECTION B

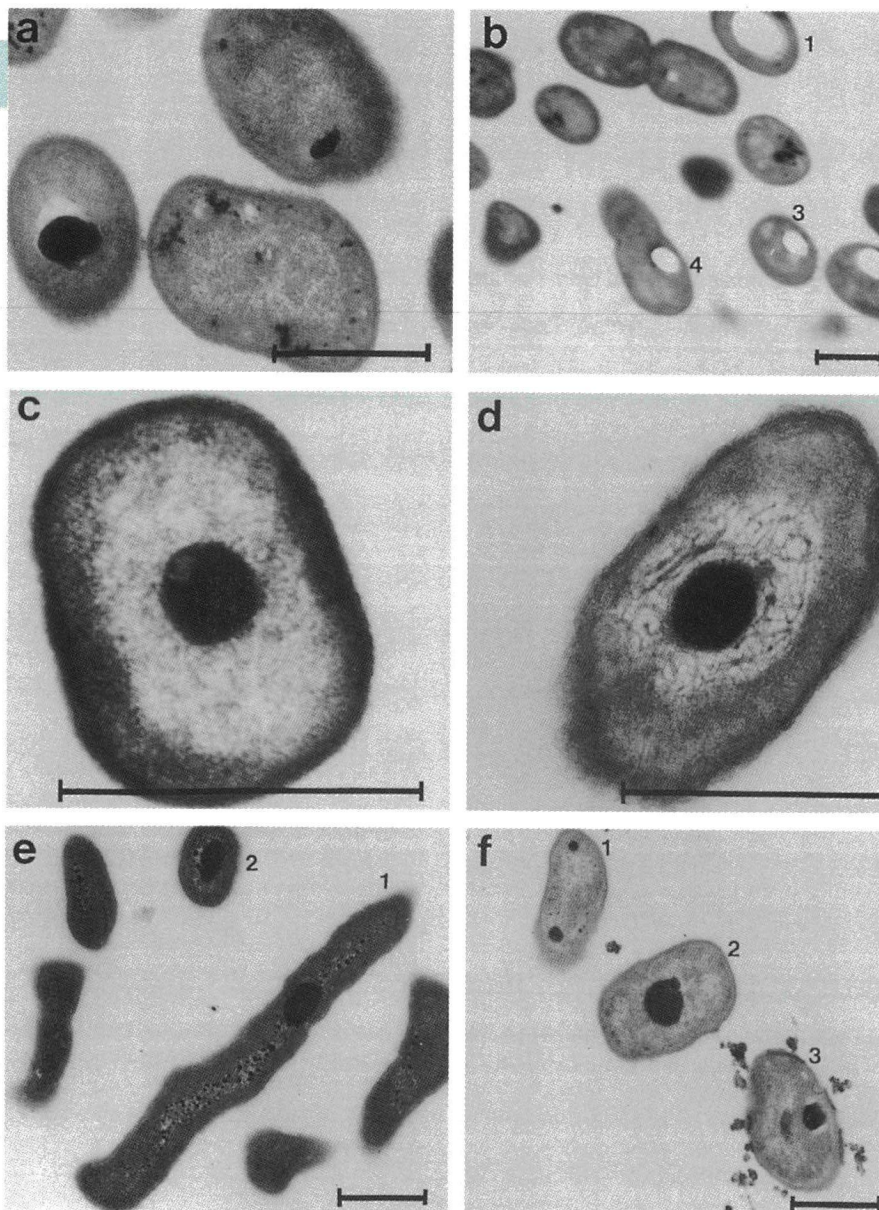
- ❑ To determine the survival of immobilised *Acinetobacter* cells;
- ❑ To determine if immobilised cells were evenly distributed throughout the alginate beads, using scanning electron microscopy;
- ❑ To expose the immobilised cells to the activated sludge system and to determine whether the immobilised bacterial cells could accumulate;
- ❑ To determine whether the original *Acinetobacter* cells could be regained from the alginate and studied after exposure to activated sludge, using an indirect antibody staining procedure;
- ❑ To determine if bacteria, other than *Acinetobacter*, were capable of phosphorus removal; and
- ❑ To determine if activated sludge bacteria displayed any synergism in their ability to remove phosphate.

RESULTS

According to the report the following results were obtained.

SECTION A

- ❑ Nineteen *Acinetobacter* strains were isolated from activated sludge and a further 21 strains were obtained from culture collections. With two exceptions, all the strains tested were able to remove phosphate from mixed liquor to varying degrees. The numerical analysis of the protein profiles obtained by SDS-PAGE indicated that *Acinetobacter* was a heterogeneous genus, a characteristic which was also manifested in the ability to accumulate phosphate.
- ❑ The reclassification of *A. baumannii* (ATCC 19606) and *A. haemolyticus* (ATCC 17906) as a subspecies of *A. calcoaceticus* is proposed.
- ❑ Phosphate accumulation was strain specific rather than specie specific.
- ❑ Due to the heterogeneity of the genus, the protein patterns of strains within a cluster were too diverse to associate any variations in the patterns (i.e. the presence or absence of certain proteins) with variations in phosphate accumulation which was equally diverse.
- ❑ Phosphate was accumulated in the lag phase of growth and in the stationary phase. Phosphate release took place at the onset of logarithmic growth. Cells appeared to have a limit to the amount of phosphorus that could be accumulated per cell and phosphate was mostly accumulated by small, slow growing cells. This indicated that phosphate removal was biomass related and not growth related.



Photographs of *Acinetobacter* strains.

ed, with smaller cells exhibiting slower growth.

- Anaerobic-aerobic cycles resulted in the release of phosphate under anaerobic conditions and the uptake of phosphate under aerobic conditions. However, during the first aerobic cycle, when logarithmic growth took place due to the availability of sufficient nutrients, phosphate was released. Significant phosphate uptake took place only in the second or third aerobic cycle, when cells were no longer actively multiplying and the magnitude of this uptake appeared to be related to the magnitude of the release in the previous anaerobic cycle. This also points to a limited capacity within each cell for phosphate accumulation.

- Immobilised cells remained viable, multiplied and accumulated phosphate while immobilised. Immobilised cells removed ten times more phosphorus than free cells which was probably due to the large biomass. Cells, however, leach out of both the alginate and kappa-carrageenan matrixes at the highest practical concentrations tested, namely 3.5 per cent for alginate and 4 per cent for kappa-carrageenan respectively.

- Alginate and kappa-carrageenan were not considered suitable immobilisation matrixes for processes where the leaching of bacteria from the matrix would be undesirable. The ability of these bacteria to remain viable and metabolically active while immobilised

in these matrixes indicated that the immobilised state did not adversely affect bacteria.

SECTION B

- The immobilised cells were able to multiply in the immobilised state at both 4°C and 37°C. Scanning electron microscopy indicated that the cells were entrapped and dispersed throughout the matrix.
- The ability of the immobilised bacteria to accumulate phosphate *in situ* was indicated by metachromatic staining techniques. The immunofluorescent antibodies were used to indicate that the original immobilised bacteria could be retrieved, after exposure to an activated sludge system, for further study. All organisms tested were capable of accumulating volutin containing phosphorus within 4h and were also capable of phosphate removal from activated sludge mixed liquor under laboratory conditions.
- Various bacteria other than *Acinetobacter* (i.e. *S. aureus*, *S. faecalis*, *P. fluorescens*, *B. megaterium* and *E. coli*) were also immobilised and tested for their ability to remain viable and remove phosphate. These bacteria removed phosphate from mixed liquor.

- Immobilised anaerobic and aerobic sludge were both capable of phosphate removal, with the aerobic sludge having a faster initial removal rate. This could be due to the community structure acting synergistically due to the selective pressure applied in the anaerobic zone. In view of the results obtained, it was concluded the immobilisation procedure could be used to study pure cultures *in situ*.

Copies of this report Research on Biological Phosphate Removal in Activated Sludge (WRC Report 314/1/93) are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: \$25.

S. PETERS

FLUOROCARBON COATING OF ION-EXCHANGE
MEMBRANE SURFACES TO OVERCOME FOULING AND
GENERAL SCALING

Report to the
WATER RESEARCH COMMISSION
by
ESKOM

WRC Report No 466/1/93

Researcher looks at the coating of electrodialysis membranes to prevent fouling

In South Africa, and in particular at Eskom, electrodialysis is used for the desalination of saline waters emanating from cooling tower blowdown during power generation. Electrodialysis is an electrochemical separation process in which ions are transferred through membranes, from a less concentrated to a more concentrated solution. This transfer results from the flow of a direct electric current. The basic building block of the electrodialysis system is the membrane stack.

Two types of membranes are utilised in the electrodialysis process, namely anion and cation transfer membranes. The physical appearance of a membrane is that of a plastic sheet. The membrane is reinforced with a synthetic fibre cloth and the surfaces are uniformly flat, with a smooth texture. Anion transfer membranes are manufactured from a styrene divinylbenzene copolymer. During the production of these membranes, positively charged ions are affixed to sites throughout the membrane matrix. These fixed ionic charges are quaternary ammonium ions and therefore repel positively charged ions, allowing only negatively charged ions to transfer through the membrane.

Cation transfer membranes are manufactured from the same base polymer as anion transfer membranes. However, during production negatively charged ions are affixed to sites throughout the membrane matrix. These fixed charges are sulfonate groups which repel negatively charged ions, and allow positively

charged ions to transfer through the membrane.

The spaces between the membranes represent the flow paths of the demineralised and concentrated streams, respectively. These flow paths are formed by plastic separators between each cation and anion membrane. In the membrane stack, spacers are arranged so that all the individual demineralised and concentrated streams are manifolded together, respectively. A repeating section is called a cell pair and consists of the following:

- Cation transfer membrane
- Demineralised water flow spacer
- Anion transfer membrane
- Concentrated water flow spacers

A typical industrial membrane stack may have from 300 to 500 such cell pairs. As water flows across the membrane surfaces, ions are electrically transferred through the membrane from the demineralised stream, to the concentrated stream, due to a direct current potential. Top and bottom steel plates are used, together with tie rods, to compress the stack and seal the membranes and spacers. Thus, discrete concentrated and demineralised flow paths are formed and leakage from the sides of the membrane stack is prevented.

One of the major problems in the electrodialysis process is the fouling of perm-

selective membranes. Fouling causes an increase in membrane resistance, which in turn causes an increase in power consumption and adversely affects process economics.

Fouling may be caused by the precipitation of colloids on the membranes. As most of the colloids present in natural waters are negatively charged, it is generally the anionic membranes which are affected. Because of fouling, water splitting occurs on the surface of anion transfer membranes and the number of hydroxyl ions transferred at higher current densities is markedly increased. This results in a pH change of the water and causes the formation of scale on the membrane surface.

MEMBRANE POISONING

The fixation of organic, multivalent or counter-ions on or within the membranes is called poisoning of membranes. These ions have a molecular mass of between 200 and 600 g per mole. If the ion is small enough to pass through the membrane by electromigration, a slight increase in the electrical resistance of the membrane and a corresponding decrease in the permselectivity of the membrane can be expected. Therefore, the

electrodialysis process is then economic only if a high value product is produced.

If the anion is small enough to penetrate the membrane, but has a low electromobility within the membrane, poisoning occurs. The retention of ions in the membrane causes a sharp decrease in permselectivity and a sharp increase in electrical resistance of the membrane. The electrodialysis process then becomes virtually impossible to operate economically. If the anions are too large to penetrate the membrane, they will accumulate on the surface and can then be removed by mechanical cleaning.

PROJECT

Fouling or poisoning of membranes decreases their lifespan, resulting in more frequent replacement costs. The Water Research Commission therefore contracted a researcher from ESKOM, S Peters, to investigate the possibility of developing a suitable coating for anionic electrodialysis membranes, to prevent fouling and general scaling of the membranes by organic colloids present in natural waters. The aims of the study were as follows:

- To determine the effects of coating thickness of a fluorocarbon or polyvinyl alcohol layer on the reduction of the flux;

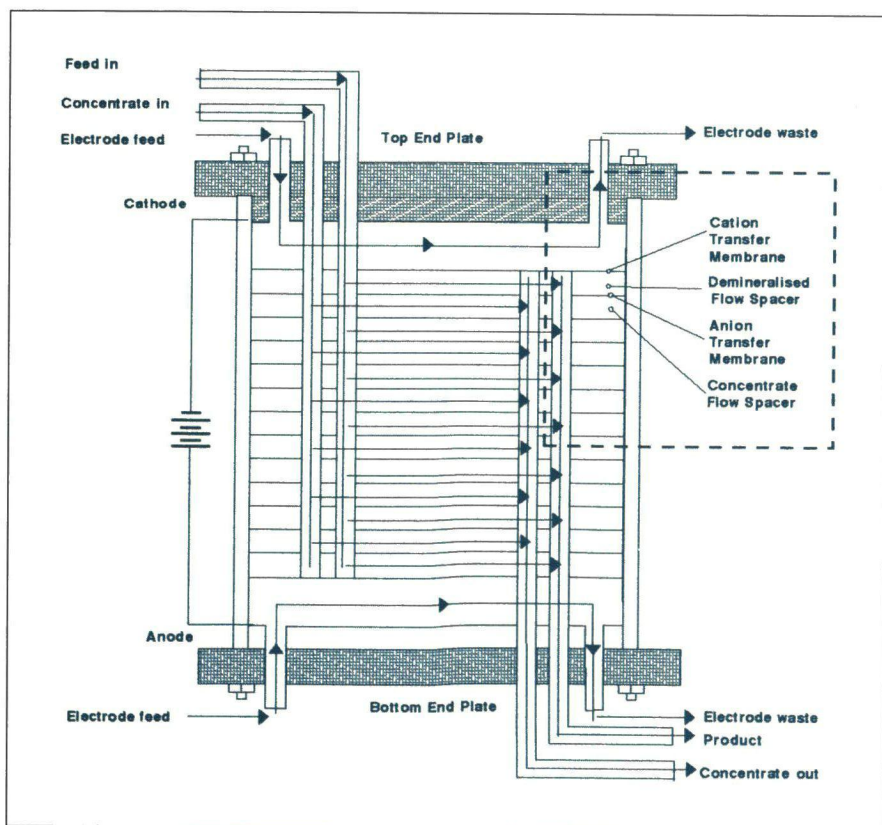
- To provide a membrane with an extended operating life and a reduction in mechanical cleaning requirements;
- To determine the ion-exchange capacities and electrical resistance of the coated membranes; and
- To perform a feasibility study into the full-scale implementation of the coating technique by means of a pilot plant.

RESULTS

The major results and conclusions of the project are summarised as follows:

- Upon application of the fluorosurfactants and polyvinyl alcohol as surface coatings, membrane ion-exchange capacities, and therefore permselectivities decreased below the required limit.
- In all cases, desalination properties decreased upon application of surface coatings. An increase in coating layer thickness resulted in a decrease in flux or desalination properties.
- Only in certain cases was a greater resistance to fouling exhibited, when compared to the uncoated reference membrane.
- Membrane electrical resistance decreased with increasing fluorocarbon and polyvinyl alcohol layer thickness (coating concentration).
- Although the application of coatings to membranes did not provide the desired enhancement of mechanical cleaning requirements, it should be borne in mind that this limited feasibility study did not investigate many different coatings. In order to ascertain whether membrane coatings offer any benefits, such as a reduction in fouling, a wider range of coatings need to be investigated.

Illustration of how the concentrated and demineralised streams flow through the membrane stack.



Copies of this report entitled **Fluorocarbon coating of ion-exchange membrane surfaces to overcome fouling and general scaling (WRC Report 466/1/93)** are available free of charge from the Water Research Commission, PO Box 824, Pretoria 0001. Overseas price: \$15.



HYDROLOGY and the INTERNET

The Internet grew out of both the United States Department of Defence (DOD) computer network linking military sites and the National Science Foundation (NSF) network linking university campus computer networks throughout America. Today the Internet is a truly global network connecting users and computers in countries all over the world covering a range of fields and organisations, including universities, government agencies, corporations, the commercial world, the military and researchers as well as interested individuals. In the past, access to the Internet was restricted to academics but in recent years commercial access has become commonplace.

In South Africa access to the Internet is provided by two main organisations. Firstly, Uninet, which links all the universities and other research/academic institutions, such as the Computing Centre for Water Research (CCWR), to each other and "the Net", as the Internet has affectionately been called. Secondly, The Internetworking Company of South Africa (TICSA), which provides commercial access to the Internet via a number of value added resellers (VARs). A VAR usually charges a small monthly fee and a time-of-day dependant hourly charge for a login account on a computer connected to the Internet normally running the UNIX operating system.

Access to the VAR computer is usually provided through modem dialup or via an X.25 (Telkom public data network) link. TICSA also provides full Internet link-up facilities whereby your own computer becomes an integral part of the worldwide network. However, this requires expensive equipment and high monthly charges are involved.

Most practising hydrologists and hydrological engineers in South Africa are therefore able to access the Internet at little or no cost using one of the following three routes:

- 1) A South African university login account, forming part of the academic privilege.
- 2) A bona fide water researcher or non-researcher user account on the

CCWR computer via direct, modem dialup or X.25 access.

- 3) A commercial login account on a TICSA VAR computer.

An international computer network linkup is therefore within relatively easy reach of the hydrologist in the New South Africa, but you may well ask the question "So what?". In answer to this question a few general and specific advantages to being on "the Net" are presented below.

ELECTRONIC MAIL

Electronic mail, or e-mail as it's commonly called, has become a powerful medium for communication between all Internet users including practising hydrologists, hydrological researchers and model developers. It enables informal discussion regarding standard practice and new developments as well as philosophical debate regarding the way ahead.

Above all, it has enabled quick, reliable, informal intra- and interdisciplinary communication between people who need to be in contact whether they are across a city, country or the globe. Particular examples which come to mind are:

- (i) My own communications with hydrodynamic reservoir model developers in Australia and the UK, including automatic mail forwarded from the University of Western Australia in Perth to City University in London, thereby maintaining the communication link transparently. In this instance e-mail enabled model application support, feedback loops and source code bug-fixes within a matter of hours of initial queries.
- (ii) Our water quality scientists have requested, discussed and received water quality model updates from model developers in the USA.
- (iii) Dr Mark Dent of the CCWR has forged links via e-mail with the HSPF (Hydrological Simulation Programme - Fortran) model suite developers in the USA for the purposes of its application in the Kruger National Park Rivers Research Programme, and is

using local e-mail communication to arrange and co-ordinate workshops as part of the KNP Rivers Research Programme.

Another example of the benefit of Internet e-mail, is the availability of mailing lists. A particular example is the "Hydrology and Water Resources" mailing list based at Monash University in Melbourne, Australia, that has been set up "to allow hydrological scientists and engineers to keep in touch and to share experiences". Although this mailing list is biased towards Australian and New Zealand issues, matters of general interest do arise. Perhaps a similar mailing list specifically aimed at a South African audience should be set up, by say the CCWR. Should you already be on the Internet and wish to subscribe to the Monash hydrology mailing list, simply send an e-mail message containing only the following line:

SUBSCRIBE HYDROLOGY firstname
surname

to: **LISTSERV@eng.monash.edu.au**

Thereafter you will be forwarded any mailing list discussions. Should you wish to contribute to a discussion or request information, simply send an e-mail message to:

HYDROLOGY@eng.monash.edu.au

To unsubscribe from the mailing list simply send the line:

SIGNOFF HYDROLOGY

via e-mail to the above listserv address.

USENET NEWS

In addition to e-mail, the Internet also acts as a global scale bulletin board system (BBS) via what are termed Usenet newsgroups (also known as Netnews). These newsgroups provide discussion forums for numerous wide ranging topics and at present over 5000 newsgroups are available.

A new newsgroup called **sci.geo.hydrology** has recently been created (through worldwide voting) to serve as a forum for discussions on hy-

drology and other related topics. In excess of 200 messages from a range of countries have been posted to the newsgroup since its inception and topics such as groundwater modelling, rainfall/runoff modelling and IAHS symposium information have been discussed.

Other related newsgroups are **sci.engr.civil** for general civil engineering discussion and **sci.mech.fluids** for hydraulic and fluid mechanics' messages.

At present the CCWR computer does not have a "newsfeed" due to the disk storage requirements. However, a partial "newsfeed" or link-up to the University of Natal at Durban's (UND) Usenet News is being investigated. Netnews is therefore only available to those who have accounts on Uninet or TICSAR VAR computers that have access to Usenet newsgroups. Alternatively CCWR users can register with the Cleveland Freenet (literally a free Internet access computer at the Case Western Reserve University in Ohio, USA) which offers Usenet News (telnet kanga.ins.cwru.edu).

One possibility with regard to Usenet News for South African hydrologists would be to try to set up a South African hydrology newsgroup called say **za.hydrology** along the lines of the existing general newsgroup set up by the University of Natal at Durban called **za.und.news** or the environmental issues newsgroup **za.environment**

This would however depend on the whim of the international Usenet community who would vote on whether or not to allow the creation of such a group.

FILE TRANSFER

Besides the resources discussed above, the Internet offers a range of other facilities including terminal access to any computer on "the Net" on which you have an account and publicly accessible, searchable software archives and file transfer capabilities.

With particular reference to hydrology, a colleague of mine has made contact with someone who is endeavouring to set up a software archive for Public Domain (and Shareware) hydraulic, hydrological and related computer programs such as the HEC suite, DAMBRK, etc. This could prove to be invaluable in the dissemination of up to date versions of several of the models currently used by Hydrologists/Engineers in South Africa. This soft-

ware source would also circumvent the often cumbersome communication channels between the SA Hydro community and US government agencies such as the Hydrologic Engineering Centre (HEC), the National Weather Service (NWS) and the Environmental Protection Agency (EPA) who develop and maintain numerous applicable models.

In closing, I believe that the Internet resources as outlined above can be used

effectively to foster and build Community in Hydrological Science as put forward by Dr Mark Dent at the 1993 SANCIAHS Symposium and I therefore encourage all those involved in this and related water fields to gain access to, and communicate via, the global Internet community.

Kevin de Smidt (Pr Eng)

Ninham Shand Consulting Engineers

(e-mail: desmidt@aqua.ccwr.ac.za)



BUILDING DATABASES FOR SPECIFIC PURPOSES

Developments in the field of personal computers have made it possible for a highly specific, easily searchable inhouse database to be developed and maintained on a network of personal computers for direct access by a group of users.

Within a selected field of interest, a database of references can be built from a range of sources including online databases, CD-ROMs and material typed directly into the database. Index terms according to an inhouse policy can be added, as well as information such as reference numbers, location of copies of the full document etc.

Information overload is a common complaint in many organisations. A well-designed database can be a powerful instrument for effective management. Not only is the need for a wide range of expensive journal subscriptions reduced, but the amount of paper crossing the desks of staff can be limited to the most essential core journals. With a well designed profile which picks up the relevant references from a range of sources, staff can rest assured that when they require information in the specific field, the references will be immediately available from the database.

The great temptation for organisations is to attempt to develop such databases with existing software packages, and while this is possible, the pitfalls are numerous. Many inhouse databases and catalogues have fallen into disuse when they have become too cumbersome or it has become apparent that it is not easy to search them or extract information accurately from them. Whereas the choice of software is an important factor, it is most important that

the initial planning of the database be undertaken by a skilled information professional as the final success of the project is determined at this stage.

Organisations frequently have quite a number of inhouse reports which tend to get lost in cupboards and forgotten once their authors move on. This vital and often costly information can be kept accessible to the whole organisation by means of an effective database. Reinvention of the wheel may be prevented, and the information may also be used as a source of income if the report collection is well-organised and copies are sold on request.

Probably the most effective use of such database is within a small group of specialists. Once the core database has been built up by means of literature searches, the database can be kept current by the automatic inclusion of references from alerting services. When publications are produced, the list of references can be organised automatically and formatted according to the requirements of the publishing journal. Such databases can be relatively inexpensive to develop.

With extensive experience in the development of WATERLIT and other databases, staff of the South African Water Information Centre are in a position to advise organisations, groups or individuals on the development of specific customised databases. Although the individual requirements will vary, there is a range of options available.

For more information, please contact the South African Water Information Centre. Tel (012) 841 2048/3083.

Aspects to be considered when “designing” pit privies.

by RJH Schroeder Pr.Eng*

Rapid urbanisation in South Africa has brought thousands of people to informal settlements where water supply and sanitation services often constitute a major problem for authorities. One of the adopted alternatives to supply low-cost sanitation is by means of pit latrines. However, this is not always as simple as it sounds and the following aspects should be kept in mind by those designing or specifying pit privies.

PIT FILL-UP

Factors affecting the rate of fill-up.

- ❑ **The extent of water flow through the pit.** Water flow through the pit is an important factor in pit privy design because faecal matter dissolved in water will undergo rapid part decomposition of soluble solids. Following the soaking away of the suspension water, the suspended particulate matter is left in a compact deposit.
- ❑ **The permeability of the soil surrounding the pit and the porosity of the pit liner, if fitted.** It will be obvious that the slimes of decomposition will block pit faces at a rate inversely proportional to their porosity. Sealed, concrete block pits, that are employed to facilitate water retention as an aid to pit pumping will therefore fill rapidly, particularly as inward flow due to groundwater pressure in rainy weather will be much less restricted by wall surface plugging, than will outward flow.
- ❑ **The degree of pit ventilation.** The extent of air exposed organic materi-

al surface is a factor of decomposition and liquefaction.

FAECAL MATERIAL

Human waste from adults, in fresh form, represents a daily contribution of approximately 100 ml of material with a specific gravity in the range of 1,0 to 1,06. It also comprises 85 per cent to 90 per cent water. The solids are both soluble and insoluble in the approximate ratio of 45 per cent and 55 per cent respectively. Faecal material introduced into an adequate suspension of water will rapidly disperse and dissolve.

NEWSPAPER CLEANSING MATERIAL

Newspaper is often used as the main cleansing material by users of pit privies. Newsprint has a volume per standard sheet of approximately 15 ml and, on the basis of one third of a sheet with each excreta contribution, the annual per capita use is 1,8 litres. Presuming no decomposition in the pit and 15 ml solids per excreta contribution, the annual total becomes 5,4 litres or 7,2 litres with the newspaper contribution. A ten person daily pit usage on this basis will therefore fill a two cubic metre pit in 27,7 years. This theoretical period illustrates the inefficiency of a typical pit, which fills up in a much shorter period. This accelerated fill-up of the typical pit is explained by the pit contents remaining in an amorphous, water retaining, state and highlights the great importance of pit porosity and drainage. Conversely, the practice of lining pits for the purpose of water retention to

facilitate pit pumping, is clearly not advisable.

DECOMPOSITION

According to a recent technical paper from the University of Cape Town, soluble organic material in a dissolved state will decompose very rapidly. Therefore, the potential for decomposition in a typical pit where little water is introduced, is limited.

On the other hand, insoluble solids under anaerobic conditions as are to be expected in a pit privy, will also reduce little in volume, since the reduced organics (sludge) of this process represents a considerable percentage of the end products of bio-decomposition. Noting also that the total solids introduced into the pit by a large family is only some 72 litres per annum, volume reduction due to bio-decomposition can only be of limited value.

DISEASE

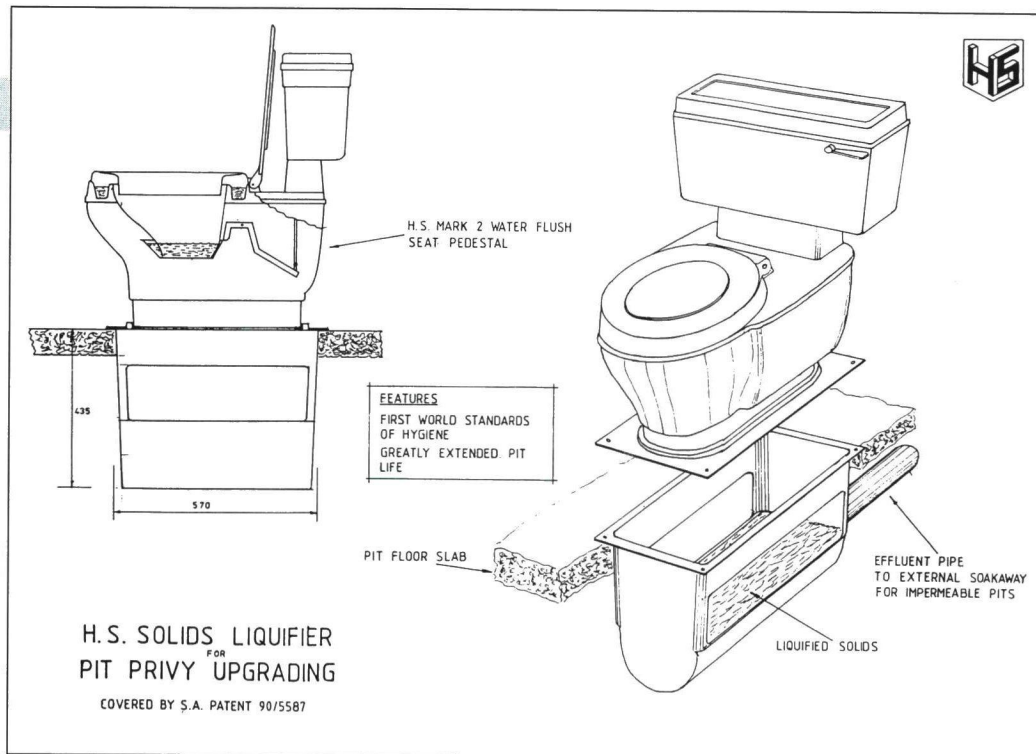
The contents of a pit privy always remain a repository for disease organisms and is a major reason why pit privies should not be employed in the crowded townships.

The fact that pit privies exist in very large numbers in South Africa's peri-urban townships and regrettably continue to be employed, necessitates that every effort should be made to minimise the risk of the spread disease and to improve hygiene with these installations.

Factors to be borne in mind are the following:

- ❑ **Flooding.** The need to ensure that

* The HS Organisation, PO Box 1736, Pinetown 3600. Tel (031) 7003493. Fax (031) 7003496.



The HS Solids Liquifier used for pit privy upgrading.

pit contents cannot be washed out to ground level as is common during rainy weather. Here the top levels of the pit walls should be impervious to the passage of water. Any protrusion of the pit above ground level should be avoided and if this is not possible, earth banking should be employed.

- ❑ **Flies.** Every effort must be made to exclude flies. While screened vent pipes are able to trap flies this is not sufficient since seat pedestals of the open type are always a source of fly entry and exit. One effective answer is a low volume water flush seat with a water seal.
- ❑ **Pit location.** While choice of position is limited in crowded areas, every effort should be made to avoid water courses, earth banks and other positions which enable disease bearing effluent to flow into areas of human contact.
- ❑ **Odours.** It is not realistic or technically supportable to suggest that the "modern" ventilated pit privy improves matters by inducing large pit ventilating air flows that dilute and disperse pit odours to the atmosphere. The hydrogen sulphide "rotten eggs" smell which is the basis of pit odours, re-

sults from anaerobic conditions within the pit. The degree to which these odours will escape via the seat pedestal, or the vent pipe, will depend almost entirely upon the direction and strength of the prevailing wind. Strong airflows through the door opening of the privy will result in an airflow through the pit via the seat pedestal, if open, and out through the vent pipe. The general stench noticeable in crowded areas will nevertheless remain the same, providing another reason why pit privies should not be employed in crowded areas. Matters can only be improved by avoiding anaerobic conditions and the associated hydrogen sulphide emissions.

IMPROVEMENTS

As indicated, the life of pit privies can be extended if human excreta is first dissolved before being introduced into the pit. This procedure which not only results in the rapid destruction of the soluble organic material, will also with the carriage water soaking away enable the suspended insoluble solids to settle in a concentrated condition at the bottom of the pit. This process will considerably extend the life of the pit and is achievable with the typical open privy seat pedestal normally used, substituted with a low water flush unit and a liq-

uifier. These arrangements which are shown in Figure 1 are quickly installed at low cost in any existing pit privy having a concrete floor. The pit privy liquifier concept of which a large number have seen satisfactory service since 1990, was created to bring one of the benefits of septic tank principles to pit privies.

SUMMARY

The upgrading of pit privies with a solids liquifier is possible at no great cost and is a simple and quick undertaking. The standards of hygiene thus obtained are comparable to full water flush installations, and given a pit in permeable ground, there is little likelihood of human contact with disease organisms, while anaerobic odours are reduced if not avoided. If the pit installations are in impermeable ground, or if the pit has become clogged, the liquifier unit can be fitted with an effluent discharge pipe permitting disposal via a soakaway created with imported coarse sand. At the same time the pit would remain a repository for plastic bags and similar non-biodegradable material.

In further upgrading, such an arrangement using a low water flush unit seat pedestal can be connected to sewer mains since the effluent from the liquifier is free of sewer blocking solids.



UNIVERSITY OF CAPE TOWN

Department of Geological Sciences

1995 MSC Course in Environmental Geochemistry

Eleven course modules of one to three weeks duration will be lectured intensively between February and June, followed by an examination in July 1995.

The modules will cover the chemistry of the atmosphere, natural waters, solids and sediments, quantitative analysis, statistics and data interpretation, environmental engineering, legal aspects, waste management and health considerations. Practical work and field excursions will form an im-

portant part of the course. A research project on an approved topic will be conducted under supervision, with completion of a dissertation by mid-December 1995. A part-time option over two years may be allowed under special circumstances and individual modules may be taken as short courses by arrangement.

Further details and application forms may be obtained from Dr MV Fey, telephone (021) 650 2903/2931.

New IAWQ specialist group on odours

The establishment of an IAWQ specialist group on "Volatile Atmospheric Emissions from Wastewater Systems" has been proposed.

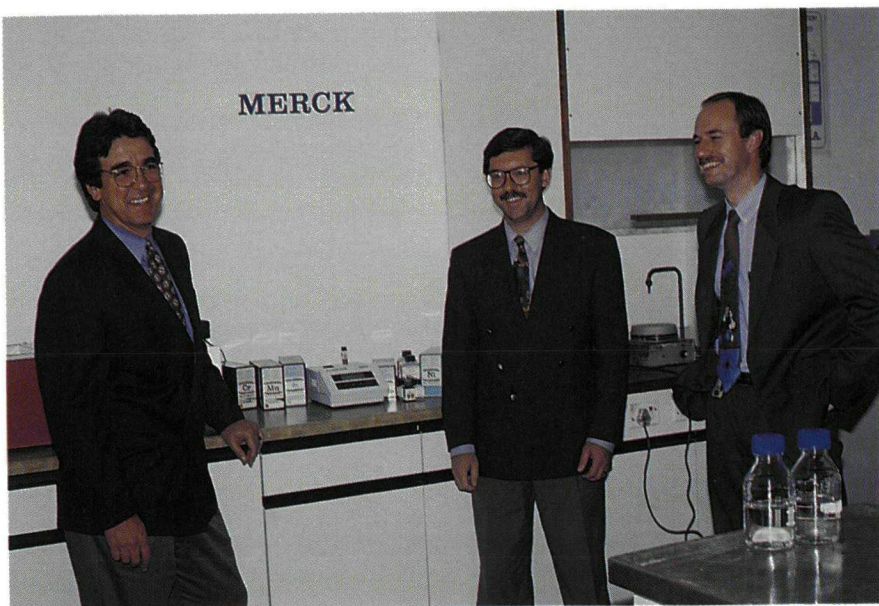
The aim of the group will be to promote international cooperation in research on adverse odours and emissions due to both inorganic and organic volatile compounds, sensory and chemical measurement techniques, emission rates from liquid surfaces under a variety of conditions, modelling of the transport of the compounds and the management and control of the emissions by physical, chemical and biological treatment methods to meet regulatory licence conditions.

Anybody interested in further information can contact Mr Terry Schultz, Manager: Centre for Wastewater Treatment, University of New South Wales, New South Wales 2052, Australia. Tel: 61 2385 5047. Fax: 61 2313 8624.

MERCK sponsors application laboratory at UP

MERCK SA has recently decided to sponsor a mobile water analysis applications research and development laboratory in the Department of Microbiology and Plant Pathology at the University of Pretoria. The Department was chosen due to the extensive research done in the field of industrial and wastewater treatment systems and the concomitant expertise which exists within the Department.

The applications laboratory will operate along the same lines as that at Merck in Germany and will research and develop new applications and methods for mobile water analysis systems. Major industries in South Africa are already using this technology. Conditions in South Africa are, however, often unique and this has created the need for research and development into new applications of this exciting new technology. The ultimate goal would be to offer the South African water industry mobile water analysis techniques, tailor-made for virtually any application.



Discussing Merck's sponsorship of a water analysis laboratory at the University of Pretoria are from left: Mr D Vos (Director, Merck), Professor TE Cloete (Head: Department Microbiology and Plant Pathology) and Mr D Jeans (Merck).

Department initiates groundwater management strategy

The Department of Water Affairs and Forestry has initiated a project designed to culminate in a strategy for managing the country's scarce groundwater resources.

This strategy which will embody a policy as well as a management plan to ensure its practical implementation, will be drafted in consultation with representatives of all the country's water users.

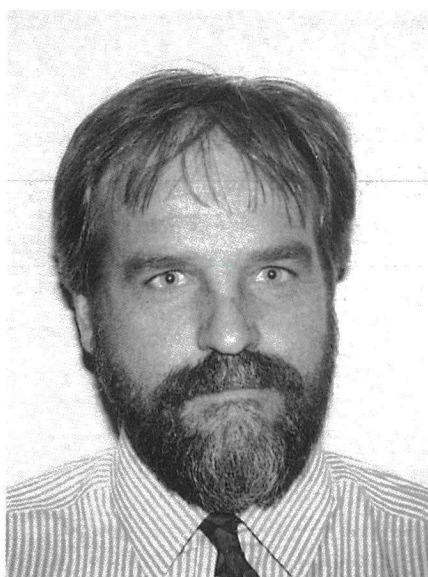
Announcing the launch of the project in Pretoria, Mr Andrew Brown, Deputy Chief Engineer of the Department, said there was an urgent need to manage South Africa's groundwater resources effectively.

"During the droughts of the past 20 years, water users had to tap heavily into groundwater resources to meet their needs, because the surface water supply was inadequate. Many borehole owners saw their groundwater supplies diminishing. This has made it more necessary than ever to arrive at a practically implementable policy to safeguard groundwater resources and yet to gain optimum use from them."

Mr Brown pointed out that a large portion of the South African public was dependent on groundwater resources. "However, because groundwater is a localised resource and classed as private in the Water Act, it has received sparse attention with respect to policy in the past. Except in some specially declared subterranean government water control areas, the abstraction of private water is not subject to control. Currently, the Water Act provides no protection to a user against overpumping by a neighbour. We need to address this as a matter of priority."

PROJECT

The project, which is expected to be completed in 18 months time, will address both the quantity and quality of groundwater. Unlike with surface water, the effects of pollution of groundwater can take years to be detected. "It is then very difficult and expensive to clean up," Mr Brown said. "The policy must therefore ensure that pollution is addressed at its source. It must also be fully supported by the communities that rely on the resource, so that these communities can take their own



Mr Andrew Brown

steps to safeguard their groundwater against pollution and other abuse."

The involvement of all interested and affected water users, including representatives of political groups, government officials, non-government organisations (NGOs), environmental groups and even small community groups, is vital to the success of the project and is being actively encouraged. The policy project will objectively address the concerns and suggestions voiced by representatives of water users, he added.

INFORMATION

According to Mr Eberhard Braune, Director of Geohydrology at the Department, much information was already available on the effects of mining and solid waste disposal on groundwater. "But we know very little about diffuse resources of pollution from agricultural land and informal residential settlements. Water users can assist us in obtaining this information. We will treat all information collected from private boreholes as confidential."

One of the first tasks of the project will be to classify South Africa's groundwater resources in order to set priorities. "For example," Mr Braune says, "urgent attention may be required now to protect groundwater resources on which some Karoo towns are totally dependent. Similarly, there may be a need to implement procedures to protect the shallow aquifers which many coastal towns use for their drinking water supplies."

The Department will shortly start contracting representatives of water users country-wide to seek their involvement in the project. The Department has also appointed the consulting firm, Wates, Meiring and Barnard Inc, to coordinate the project over the next 24 months. Any enquiries or concerns are most welcome and can be directed to either Greg Wells or John Wates at telephone (011) 315 0316.

Catfish can feed Southern Africa

The aquaculture of catfishes, one of the most diverse groups of freshwater fishes in the world, could become an important food source in Africa, says Professor Mike Bruton, Director of the JLB Smith Institute of Ichthyology at Rhodes University, Grahamstown.

"There are over 2 500 species of catfishes distributed throughout the world with more than half of the species occurring in South America. They are an important aquaculture and aquarist species in Africa, North and South America and Asia. Their culture was previously based on a few species, but is now diversifying," Professor Bruton said.

He has returned from an international conference on the aquaculture of catfishes held in Montpellier, France, where he presented a paper on catfishes, entitled "The life-history strategies of siluriformes" during the opening session of the conference.

His paper reviewed the ecomorphological and reproductive characteristics of catfish and made recommendations on how these can be manipulated to improve aquaculture production. He also introduced the concepts of breeding guilds and the different breeding and lifestyle strategies used by catfishes and cautioned on the hazards posed by the introduction of catfishes into alien environments.

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
Faks: (012) 331-2565

Gids:

- Een SA Watergeleentheid vir hierdie dae.
 - 'n Tweede SA Watergeleentheid gereël vir dié datums.
 - ✕ 'n Derde SA Watergeleentheid gereël vir dié datums.
- Sien Konferensies- en Simposiumbladsy vir aangeduide geleenthede.

1994

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SOUTHERN AFRICA 1994

AQUACULTURE

SEPTEMBER 21 - 23

The third congress of the Aquaculture Association of Southern Africa entitled Aquaculture '94, will be held at Berg en Dal Rest Camp, Kruger National Park.

Enquiries: Mrs Suzette van Wyngaardt, Blyde River Aquaculture, PO Box 408, Hoedspruit 1380. Tel & Fax: 01528-35250. E-mail address: ihth@hippo.ru.ac.za.

WASTECON '94

SEPTEMBER 27 - 29

A conference on waste management will be held in Somerset West, Western Cape.

Enquiries: WASTECON '94, PO Box 1303, Cape Town 8000. Tel (021) 400 2423 Fax (021) 25 3848.

ENVIRONMENTAL MANAGEMENT

OCTOBER 18 - 21

The 2nd Southern African international conference on environmental management will be held at Victoria Falls in Zimbabwe.

Enquiries: SAICEM 2 Secretariat, c/o PO Box BW 294, Borrowdale, Harare, Zimbabwe. Tel (263) 4 739 822. Fax (263) 4739 820.

WATER MICROBIOLOGY

OCTOBER 18 - 21

Introductory course: See advertisement on page 2.

WISA

OCTOBER 26

Technical Division for Water Distribution: One day seminar. See advertisement on page 31.

ICOLD

NOVEMBER 1 - 5

The 62nd executive meeting of ICOLD will be held at the Elan-

geni Hotel in Durban.

Enquiries: Mrs Ginny Eslick, ICOLD 1994 Organising Committee, PO Stamford Hill, 4025 Durban. Tel (031) 233 494 Fax (031) 232 405.

ICOLD

NOVEMBER 6 - 11

The 18th ICOLD congress will be held at the Durban Exhibition and Conference Centre.

Enquiries: Mrs Ginny Eslick, ICOLD 1994 Organising Committee, PO Stamford Hill, 4025 Durban. Tel (031) 233 494 Fax (031) 232 405.

ANALYTICA '94

DECEMBER

The second national symposium on analytical science will be held early in December 1994 in the Western Cape. Theme: "Toward the Welfare of Man and his Environment".

Enquiries: Dr IM Moodie, ANALYTICA '94, c/o PO Box 19070, Tygerberg 7505. Fax (021) 932-4575.

1995

WATER MICROBIOLOGY

FEBRUARY 14 - 17

Introductory course: See advertisement on page 2.

GROUNDWATER

APRIL 3 - 7

The Centennial Conference of the Geological Society of South Africa will be held in Johannesburg.

Enquiries: Tel & Fax (012) 47 3398.

SAICE

APRIL 11 - 13

Call for papers. See advert on page 32.

RIVER MANAGEMENT

MAY 14 - 19 1995

The IAWQ conference on river basin management will be held in the Kruger National Park.

Enquiries: Dr Ben van Vliet,

Watertech, CSIR. Tel (012) 841-2237 Fax (012) 841-4785.

RESOURCE MODELLING

JULY 5 - 10

The '95 world conference on natural resource modelling will be held at the University of Natal in Pietermaritzburg.

Enquiries: Professor John Hearne, Department of Applied Mathematics, University of Natal, Private Bag X01, Pietermaritzburg 3209. Fax: (0331) 260 5599 Tel: (0331) 260 5626.

HYDROLOGY

SEPTEMBER 4 - 6

The 7th national southern African hydrological symposium will be held in Grahamstown.

Enquiries: Prof Denis Hughes, Institute for Water Research, Rhodes University, Grahamstown 6140. Tel (0461) 24014 Fax (0461) 25049. E-mail: Denis@iwr.ru.ac.za.

IWSA

SEPTEMBER 9 - 15

The 20th biennial congress and exhibition of IWSA will be held in Durban.

Enquiries: Mrs Ginny Eslick, Congress International, 18 Rapsion Road, Morningside, Durban 4001. Tel (031) 233 494. Fax (031) 232 405.

OVERSEAS 1994

RIVER BASIN

SEPTEMBER 13 - 16

An international conference on Integrated River Basin Development will be held in the UK.

Enquiries: Ms Jacqueline Watts, HR Wallingford Ltd, Wallingford, Oxfordshire OX10 8BA, UK. Tel +44-491-(8)-35381 Fax +44-491-(8)-26703.

HYDROINFORMATICS

SEPTEMBER 19 - 23

The first international conference on hydroinformatics will be held in Delft, the Netherlands.

Enquiries: Organising Committee, Attn Adri Verwey, IHE, PO

Box 3015, 2601 DA Delft, the Netherlands. Tel +31-15-151 814/811 Fax +31-15-122 921

MINE WATER

SEPTEMBER 19 - 24

The 5th international mine water congress will be held in Nottingham, UK. Theme: Mine water and the environment.

Enquiries: The Secretary, IMWA Conference, c/o Department of Mineral Resources Engineering, University of Nottingham, University Park, Nottingham NG7 2RD, United Kingdom. Tel (0602) 514076 Fax (0602) 678494.

ENVIRONMENTAL CONTAMINATION

SEPTEMBER 20 - 23

The second international symposium and exhibition on environmental contamination in Central and Eastern Europe will be held in Budapest, Hungary.

Enquiries: Roy C. Herndon, Symposium Co-Chairman, Florida State University/CHAERSE, 2035 East Paul Dirac Drive, 226 HMB, Tallahassee, Florida 32310-3700, USA Tel (904) 644-5524 Fax (904) 574-6704. E-Mail: buda94@chaerse.fsu.edu

IRRIGATION

SEPTEMBER 20 - 24

An international conference on irrigation management transfer will be held at Wuhan University in Wuhan, China.

Enquiries: Dr Sam H Johnson, PO Box 2075, Colombo 1, Sri Lanka. Fax: 94-1-866854. Tel 94-1-867404. E-mail: IIMI 157:CGI29.

PARASITES & WATER

SEPTEMBER 26 - 28

A conference on Protozoan Parasites and Water will be held at the University of York, UK

Enquiries: IFAB Communications, Institute of Applied Biology, University of York, York YO1 5DD. Tel 44 (0)904 432940. Fax 44 (0)904 432917.

Please see more conferences and symposia on page 30.

NUTRIENT REMOVAL

OCTOBER 4 - 6

The second Australian conference on biological nutrient removal from wastewater will be held in Albury, NSW, Australia. Enquiries: AWWA - BNR2 Secretariat, Albury - Wodonga Convention Bureau, PO Box 323, Albury, NSW, Australia 2640. Attention: Mr WGC Raper. Fax (intl) 613 542 2386. Tel (intl) 613 542 2387.

FISH ASIA '94

OCTOBER 26 - 29

The second Asian aquaculture and fisheries exhibition and conference will be held at the World Trade Centre in Singapore. Enquiries: ITP Services Pte Ltd., 2 Jurong East St 21#05-19/22 IMM Building, Singapore 2260. Fax +65 296 5384.

SOIL SCIENCE

NOVEMBER 13 - 18

The annual meeting of the Soil Science Society of America will be held in Seattle, Washington, USA. Enquiries: SSSA, 667 South Segoe Road, Madison, WI 53711-1086. Tel 608-273-8080. Fax 608-273-2021.

ANAEROBIC PROCESSES

NOVEMBER 23 - 25

An international meeting on "Anaerobic processes for bioenergy and environment" will be held in Copenhagen, Denmark. Enquiries: Mia Clausen, Department of Environmental Engineering, Technical University of Denmark, Building 115, DK-2800 Lyngby, Denmark. Tel +45 45 399308. Fax +45 45 932850.

DESALINATION

DECEMBER 1 - 2

An international conference on desalination and water reuse will be held at Murdoch University, Perth, Western Australia. Enquiries: Dr K Mathew, Remote Area Developments Group, Institute for Environmental Science, Murdoch University, Murdoch WA 6150, Western Australia. Tel: 61-9-332 2896 Fax: 61-9-310 4997.

doch WA 6150, Western Australia. Tel: 61-9-332 2896 Fax: 61-9-310 4997.

OVERSEAS

1995

WASTE MANAGEMENT

FEBRUARY 1995

The third conference on appropriate waste management technologies for developing countries will be held in Nagpur, India. Enquiries: Professor P Khanna, Indian Association for Environmental Management, NEERI, Nehru Marg, Nagpur 440020, India.

HYDRO-SCIENCE

MARCH 22 - 26

The second international conference on hydro-science and engineering will be held Beijing, People's Republic of China. Enquiries: Mr Tan Ying, ICHE '95, IRTCES, PO Box 336, Beijing 100044, People's Republic of China.

AWWA

APRIL 2 - 6

The Australian Water and Wastewater Association's 16th Federal Convention will be held in the Convention Centre at Darling Harbour, Sydney, Australia. Enquiries: The Secretariat, PO Box 388, Artarmon, NSW 2064, Australia. Tel +61 2 413 1288. Fax +61 2 413 1047.

MICRO-IRRIGATION

APRIL 2 - 6

An international micro-irrigation congress entitled "Micro-irrigation for a changing world: conserving resources; preserving the environment" will be held in Orlando, Florida, USA. Enquiries: Allen Samajstria, University of Florida, Agr. Eng. Department, Gainesville FL 32611, USA. Tel (904) 392-9295. Fax (904) 392-4092.

WATER TREATMENT

MAY 15 - 17

An IWSA specialised conference on advanced water treatment and integrated water system management into the 21st century will be held in Osaka, Japan. Enquiries: Water Osaka '95, c/o Osaka Municipal Water Works Bureau, 6-28 Minami-ogimachi, Kita-ku, Osaka 530, Japan. Tel 06 (363) 7301. Fax 06 (363) 7362.

GROUNDWATER

MAY 15 - 18

An international conference on groundwater quality: remediation and protection (GQ 95) will be held in Prague, Czech Republic. Enquiries: Conference Secretariat GQ 95, c/o Guarant, Opletalova 15, 110 00 Prague 1, Czech Republic. Tel +42 2 2421 0650 or 2421 0735 Fax +42 2 260 130.

OZONE

MAY 15 - 19

The 12th Ozone World congress will be held in Lille, France. Enquiries: Mme Michele Rizet, IOA International Coordinator, c/o Societe des Eaux du Nord, 217 blvd. de la Liberte Lille, B.P. 329, 59020 Lille CEDEX, France. Tel 33-2049 4000. Fax 33-2049 4052.

COASTAL ENVIRONMENT

JUNE 13 - 15

The Black Sea regional conference on "Environment protection technologies for coastal areas" will be held at the International House of Scientists, St Constantine Resort in Varna, Bulgaria. Enquiries: IAWQ - Bulgarian National Committee, c/o USB - Mrs TS Angelova, Oborishte St 35, Sofia 1504, Bulgaria. Tel (+359-2) 43 01 28, 44 11 57. Fax (+359-2) 44 15 90.

RAINWATER

JUNE 19 - 25

The 7th international conference of the International Rainwater

Catchment Systems Association will be held in Beijing, China.

Enquiries: Dr Mou Haisheng, Dept of Hydrology, Institute of Geography, CAS, Building 917, Datun Road, Anwai, Beijing 100101, PR China. Tel (86) 1 4914289. Fax (86) 1 4911844.

CONTAMINANTS IN WATER

JUNE 29 - 30

A conference on hazard assessment and control of environmental contaminants in water will be held in Copenhagen, Denmark. Enquiries: Dr Niels Nyholm, Laboratory of Environmental Sciences and Ecology, Building 224, Technical University of Denmark, DK-2800 Lyngby, Denmark.

RESOURCE MODELLING WASTEWATER RECLAMATION

OCTOBER 17 - 20 1995

The 2nd international symposium on wastewater reclamation and reuse will be held in Iraklio, Crete, Greece. Call for papers. Enquiries: Mrs T Furnaraki, Municipal Enterprise for Water Supply and Sewerage of Iraklio, 1 Vironos Str., 71202 Iraklio, Greece. Tel: +30-81-229913, 225833 Fax: +30-81-22 9991

WEFTEC '95

OCTOBER 21 - 25

The Water Environment Federation's 68th annual conference and exposition will be held in Miami Beach, Florida, USA. **Call for papers. Deadline for submissions December 16, 1994.** Enquiries: Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994 USA. Fax 1-908-885-6417.

LAKE MANAGEMENT

OCTOBER 23 - 27

The 6th international conference on the conservation and management of lakes will be held in Tsukuba and Tsuchiura, Japan. Enquiries: The Secretariat, Kasumigaura '95, 1-5-38 Sannomaru, Mito, Ibaraki 310, Japan. Tel +81-292-24-6905 Fax +81-292-33-2351.

Water Institute of Southern Africa

Technical Division for Water Distribution

One Day Seminar on 26 October 1994

The demands of the water supply engineering profession from the implementation of the reconstruction and development programme.

Meeting the objectives of the reconstruction and development programme (RDP) will require adaptations by the engineering community from both the professional and technical view points. This seminar will address the issues from various perspectives and will include prominent speakers from the PWV government, the Department of Water Affairs and Forestry, a community organisation, a water supply board, local government and the consulting engineer profession.

The morning will consist of the presentation of short papers, each followed by a brief question and answer session. Luncheon, sponsored by Kent Measurement, will be followed by a panel discussion.

WHO SHOULD ATTEND

This seminar will be of interest to all engineers involved in the supply of water to communities, non-government organisations (NGOs), decision-makers and consumers.

WHERE

Civic Centre, Kempton Park, c/o CR Swart Drive and Pretoria Avenue.

WHEN

26 October 1994 at 9:00 to approximately 15:00.

COST

R100 per person (includes teas and luncheon).

REGISTRATION FORM

Please send together with remittance of R100 to: *Ms Alta Engelbrecht, PO Box 3112, Johannesburg 2000.* Attendance is limited to the first 150 delegates.

Name:

Employer:

Address:

Tel no:

Fax no:

Further enquiries to Peter Coetzee at (011) 832 1861 or Mike Richardson at (011) 789 2229.

ENGINEERING OUR ENVIRONMENT

SIXTH ANNUAL CONGRESS

OF THE SOUTH AFRICAN INSTITUTION OF CIVIL ENGINEERS

11 to 13 April 1995

Port Elizabeth

SECOND CALL FOR PAPERS AND POSTER PRESENTATIONS

The 1995 SAICE Congress will be held in Port Elizabeth at the historic Feather Market Centre. International speakers are being invited to address Congress on large overseas projects, but within the context of the theme.

The first day of the Congress will be devoted to the impact of the new dispensation on the engineering environment with eminent speakers from political, funding and engineering organisations. The second and third days are set aside for sessions based on the following main topics.

□ THE SOCIAL ENVIRONMENT

This theme addresses the interaction between engineers and the communities they serve. The issues that need to be addressed here are *inter alia*:

- Community involvement/empowerment
- The provision of services in informal townships
- Labour based schemes
- Joint venture agreements/social compacts
- Public participation
- "One City" engineering management issues
- Educational aspects
- Impact of the RDP on the social environment

□ THE GREEN ENVIRONMENT

Here the impact of engineering on the natural environment will be looked at. There are many concerns that could be addressed here:

- The development/conservation dilemma
- Issues of increasing pollution
- Environmental ethics for engineers
- Waste management
- Resource management
- Environmental management
- Environmental education

□ THE INFORMATION ENVIRONMENT

The management of information to enhance the environment is the broad thrust of this theme. This includes our social and environmental challenges, e.g.

- Modelling of environmental processes
- Information management
- Information technology in education
- Socio-economic data
- GIS
- Engineering graphics
- Integrated systems

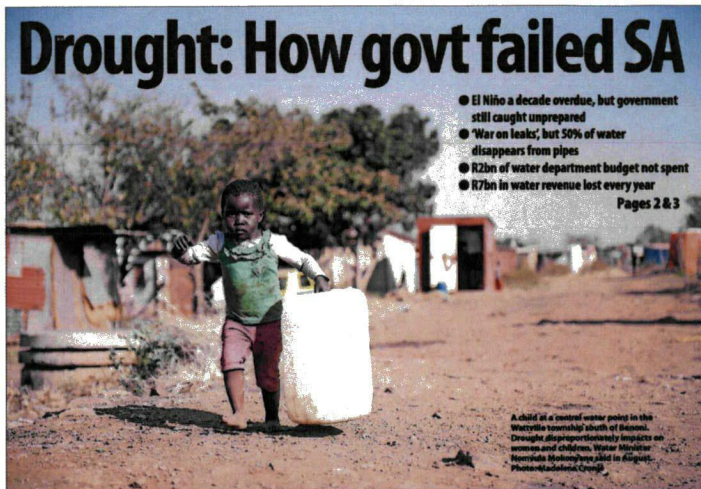
□ CALL FOR PAPERS

Prospective authors are invited to submit proposals for papers and posters by **30 September 1994**. Such proposals should not be longer than one typed page (about 300 words) and outline the proposed contents of the paper or poster. The proposals will then be considered and the authors of the selected proposals will be requested to prepare draft papers, which must be submitted by the end of December 1994, to allow sufficient time for reviewing. A time limit of 20 minutes will apply for the presentation of papers followed by 10 minutes for questions and discussions. A brief curriculum vitae of the author must be included with the proposal when it is submitted for approval.

□ INFORMATION

For further information contact Adriaan van Eeden at telephone (041) 55-8741 or Stan Long at telephone (041) 504 3297.

The address for paper and poster submissions is:
The Organising Committee,
PO Box 23903,
Port Elizabeth 6000.



Drought: How govt failed SA

- El Niño a decade overdue, but government still caught unprepared
- 'War on leaks', but 50% of water disappears from pipes
- R2bn of water department budget not spent
- R7bn in water revenue lost every year

Pages 2 & 3

It's simply too late to avert

Political meddling, too little planning and a loss of skills have left SA beyond drought repair

Alpha Kings

In the corridors of the offices of the department of water affairs in Pretoria the atmosphere is 'verging on panic', insiders say. The rains have failed for the first time since 1994, and the carefully laid plans for such a disaster have been implemented partially, where they were implemented at all.

The cost will be borne disproportionately by women and children, two groups the government believes particularly vulnerable to water issues.

At least a decade ago the department knew the rains would dry up. El Niño – a weather phenomenon that rapidly heats the Pacific and brings drought to the southern hemisphere – is a fairly regular occurrence. But the department has been crippled by a regular turnover of skilled staff – five acting and permanent director generals have come and gone in the past five years. It has also had to partner with other departments – forestry, sanitation and environment – which has seen a churn in skills.

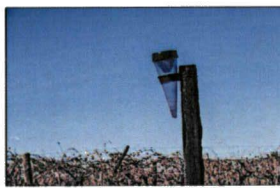
That turnover of politicians over technocrats has left the country responding to a water crisis, rather than preventing it.

If just 20mm of rain falls soon it would take the worst strain off the water system and get farmers planting, which should push the crisis back at least one more season. But even that seems too much to ask, according to the best available weather predictions. If those rains do not come, well, nobody likes to think about what happens then.

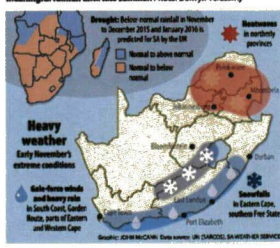
South Africa is an arid country. It receives an average of 460mm of rainfall each year, half the world average. In the past, droughts, though they hurt, were overcome through engineering on a heroic scale applied to a population smaller than that of today. This time around, however, entire provinces are in crisis because a skills shortage and lack of political continuity has left the country responding to the disaster with calls for prayer.

No amount of clever politics or good administration could have averted the drought, just about everyone agrees, but the effect of it could have been softened. Instead, it has been intensified.

To overcome the crisis, it must rain



Dust collector Weather forecasts suggest there won't be any meaningful rainfall until late summer. Photo: Delwyn Verschoor



In the next five weeks. But it won't. The cracks will widen as the earth crumbles further in the breadbasket provinces. Once green fields will complete their transformation to Karoo wilderness. People will run out of water and staple foods will become less affordable.

And there will be hard questions to ask before the next meaningful rain, now expected in March next year. With most of the country's rain falling in the east (thanks to the warm Indian Ocean), the water system is highly dependent on dams and pumping water uphill to get it to the interior. Lesotho was supposed to pump water into a dam for Gauteng's industry and irrigation in the Free State and Mpumalanga; the Komo Dam in that country is all that stands between Gauteng and water.

This system got South Africa through the last two devastating droughts, in 1982 and 1992, even though they crippled the economy

and agriculture. But those droughts were in a country of 30-million people and a much smaller industrial base. The number of people has grown by more than a third, but the quantity of available water has shrunk. Now each South African gets about 1000m³ of water a year – less than it takes to fill a swimming pool.

In the next five years, the 2030 Water Resources Group predicts, there will be a water shortfall of 17%. All of these facts are included in the government's long-term water roadmap.

"Regular drought and El Niño often are a fact in South Africa. You plan for them in your 100-year building plans," says a former department of water and sanitation official.

El Niño was overdue by a decade, which should have given planners breathing space, the official says. "The problem with plans is you have political upheaval and that brings a house. Everything shifts."

The natural process that would help fix this problem, such as wetlands, have been so heavily damaged that the rivers are firm, polluted.

This flows into the dams that store drinking water – such as the Vaal. More pollution makes the water harder to make drinkable; the last Blue Drop report says half the country's water treatment plants are not cleaning water properly – Alpha Kings

It's not a crisis, says ministry

● "There are not water cuts but they are water restrictions... so perhaps to call it a crisis at this stage will be putting the cart before the horse." – Water affairs spokesman Mmusile Mkhomo, in an ANC interview, November 2015

● "We will never ever have a situation of water shortage. It will never happen." – Water Minister Mmusile Mkhomo, in an ANC interview, November 2015

● "Let me remind you that we have a responsibility to serve water. All of us. When you see a leaking tap, close it. When you see a leaking pipe on the road, inform the authorities. Nobody should waste water. It is very scarce and we could find ourselves in difficulties if we do not act now to save water." – President Jacob Zuma, launching the War on Leaks Project, in August 2015

The water department was recently given its own minister after a period when it fell under the environment minister. It has consistently been given qualified audits, and in the last year underwent on its budget by R3-billion. Lack of capacity and skills have meant the department – and municipalities – do not spend the money they are given for development. Where there is development, it is top-down and caters to communities, so projects fall apart when government leaves.

Three officials working for the water department confirm that, although there were long-standing plans on how to mitigate the effect of a national drought, these did not get the attention they needed.

"We didn't ignore this or plan to fail, we just screwed up. We dropped the ball," says one of the three. "There should have been a much stronger campaign to stop leaks, stop people wasting water and to really work on industry and the agricultural sector to use water more efficiently."

This would have meant that more water was stored in South Africa's dams – particularly the five mega-dams that carry most of the country's water, they say. "What we did instead was pay lip service to water saving and only get serious when the crisis was too late to avert."

The water department has now written up to the need to push rapidly for people to conserve water, but only after the problem stopped being one in far-flung provinces and became urban. Last week Rand Water declared water restrictions in Gauteng.

Speaking during a media blitz this week, Minister Mmusile Mkhomo said: "The most important thing is for South Africans to understand that we are a water-scarce country." Her department has called for proper, and blamed a whole host of different sectors for not doing enough to conserve water, but it did not request the Most & Guardian's questions.

Rand Water's announcement of

The future is dry and hot

El Niño is a regular phenomenon – named after the Christ Child because it appears seasonally, around Christmas time – and has been identified as the cause of famine for centuries. In the 1700s it was linked to crop failures, which led to the circumstances that drove the French Revolution.

Nasa has warned that a warming world will make El Niño considerably worse, because the majority of warming is stored in the world's oceans.

Regardless of El Niño, South Africa's water scarcity will become more acute. Predictions outlined by the environmental department

show that by 2050 the interior will be on average 2°C hotter. By 2100, it will be 2°C hotter. This will mean less rain in the west and more in the east. But this rain will come in shorter and heavier cycles – damaging top soil and crops.

Whose water is it? By law, the department of water affairs owns all of South Africa's water, which it provides to municipalities and utilities such as Rand Water. These then pipe it to households. But so to half the water put into pipes is lost through leaks before it reaches the end user. At the other end of the water

system, average treatment plants work above their built capacity and, according to the last Green Drop report, often release raw sewage into dams and rivers.

The natural process that would help fix this problem, such as wetlands, have been so heavily damaged that the rivers are firm, polluted. This flows into the dams that store drinking water – such as the Vaal. More pollution makes the water harder to make drinkable; the last Blue Drop report says half the country's water treatment plants are not cleaning water properly – Alpha Kings

the water disaster



Running out: In Welkom in the Free State wells are drying up (above, right) and in KwaZulu-Natal (above, left) about 500 000 people face food shortages and 100 000 head of livestock have died. Cullinan (below) too is feeling the drought. Photos: Oupa Nkosi, Dethwyn Verasamy

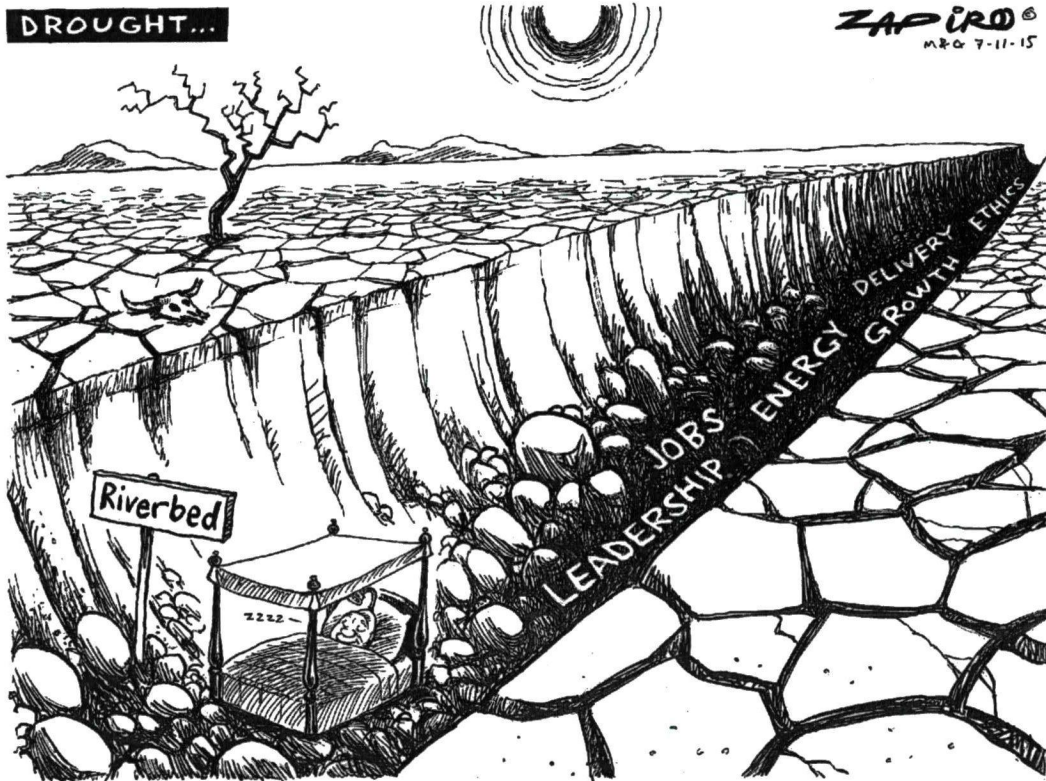
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the "unintended" consequences of the program. The program was designed to provide a "one-stop" service for the public, but it has resulted in a "one-stop" service for the public, and it has resulted in a "one-stop" service for the public. The program was designed to provide a "one-stop" service for the public, but it has resulted in a "one-stop" service for the public, and it has resulted in a "one-stop" service for the public.



DROUGHT...

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Politicking made SA's water crisis

Our water crisis — and make no mistake, it is a crisis — is the result of a comprehensive victory of political imperative over technocratic sense. South Africa is a water-scarce country. Water is the single biggest constraint on growth and improving livelihoods. But the department tasked with securing this precious resource fell prey to internecine politics of the worst kind. Skilled workers have either left or been forced out. Those who stay are ignored or silenced; nobody wants to stick their head above the office divider if that means their job suddenly becomes redundant.

Water affairs has been paralysed. It underspent its last budget by R2-billion and consistently receives qualified audits. The plans and projects that would secure our water future are behind schedule, or fail soon after completion. Tens of billions of rands have been wasted as trillions of litres of water leak out of our faulty systems. The falling is even more comprehensive at a municipal level. Outside of the metros, South Africa's water infrastructure is in a dire state. Children die from cholera and diarrhoea. Water projects that should stand for half a century collapse after half a decade.

Everyone knew this drought was coming. Everyone knew how desperate the water situation had become — and if they didn't, then reading this newspaper six months ago would have made it clear. But instead of going public and preparing people and response systems for this entirely anticipated crisis, water affairs was dealing with political upheaval.

A new minister and a new department, taken from the environment department and twinned with the consistently orphaned sanitation department, meant the department's focus was on transition and all that that brings. In that time the ball was dropped. Delayed construction of dams and ageing infrastructure mean our water systems cannot handle anything extraordinary, and that is what the future will be: extraordinary.

Climate change will make extremes of drought and flood commonplace, forcing us to make hard decisions about who gets water first — and who does not get water at all. Meanwhile, a political standoff with farmers has seen them largely left to their own devices: 40 000 head of cattle dying in KwaZulu-Natal and the price of white maize rising by more than 50% this year. Our water-agriculture nexus has been broken, just like its energy component was broken seven years ago by the same kind of political paralysis, and with the same result.

Politics dictates that little will change. Mines, often built as much on political connections as on ore-bearing seams, will continue to destroy wetlands and rivers. We will pick up the cost of cleaning up that water, and of looking after the people it makes sick. Our neighbours, also hard hit by the drought, will pick up the cost as dirty water flows across our borders, in contravention of our international commitments.

Countless things could have been done — and should have been done — to prevent a drought from turning into a water crisis. They were not. Many things can be done to soften the impact of that water crisis. This time there can be no mistakes.