

S4 waterbulletin

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WATER RESEARCH

WRC solves water problems for local authorities

AQUACULTURE

Fishfarms set to feed black homeland

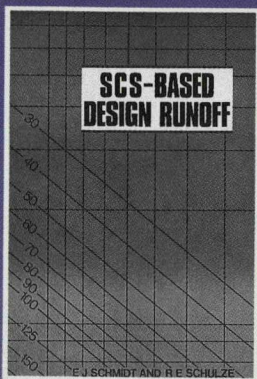
WEATHER

Researchers develop climate model for SA

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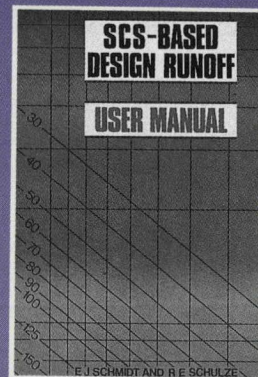
There is a need in southern Africa for hydrological information which will assist engineers and hydrologists responsible for the planning of hydraulic structures, in making economic and safe design decisions.

Three new reports, emanating from a WRC project, now offer an up-to-date guide on the application of SCS-based techniques in design hydrology for small catchments.



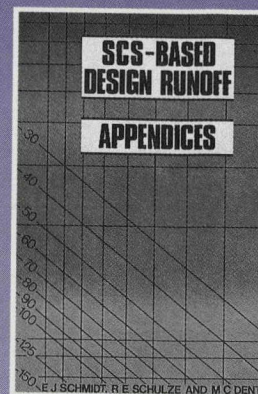
Report TT 31/87 Flood volume and peak discharge from small catchments in southern Africa, based on the SCS technique

This report is basically a design manual. In Part 1 detailed background information and theory is given for the professional designer requiring a comprehensive guide to modelling assumptions and research findings. Part 2 outlines procedures for use of the SCS model in southern Africa, and provides a detailed breakdown of the steps required to determine runoff volume, peak discharge and hydrograph shape. Various alternatives to solutions are given and procedures to estimate design runoff depth accounting for the joint association of rainfall and antecedent moisture condition for southern Africa are included. Worked examples are also given in Part 2 of the document. These provide step by step solutions to a range of problems for which SCS-based methods are likely to be applied. Part 3 consists of tables, maps and nomographs for application of the SCS method in southern Africa.



Report TT 33/87 User manual for SCS-based design runoff estimation in southern Africa

A shorter and simpler report is presented as a design aid for use for less expensive structures. The report contains a minimum of theory (given in Parts 1 and 2) to provide the necessary background information to perform manual calculations. It focuses, by way of worked examples (Part 3), on the use of nomographs, tables and maps to provide quick (but thoroughly researched) estimates of runoff volume and peak discharge.



Report TT 32/87 Flood volume and peak discharge from small catchments in southern Africa, based on the SCS technique: Appendices

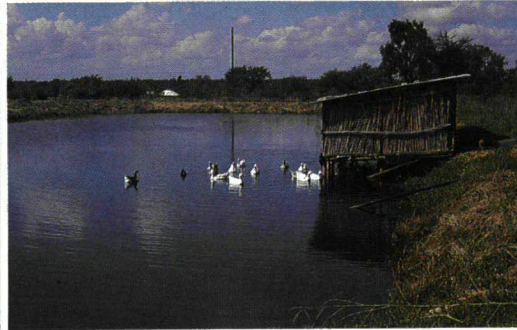
This document contains appendices relevant to reports TT 31/87 and TT 33/87. It consists of tables of hydrological information for each of the climatic zones in southern Africa as well as a computer program.

Reports
on flood
estimation
models
NOW
available

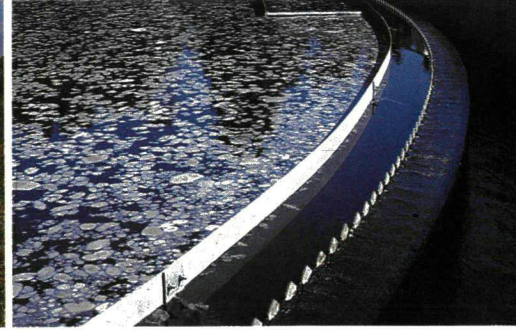
All three reports are available, free of charge, from the Water Research Commission, P O Box 824, Pretoria 0001. Tel: (012) 28-5461. To order, please complete the order card in this Bulletin.



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Cover: Current problems in SA water treatment technology were discussed at a WRC workshop. See report on page 4.

SA Waterbulletin is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organization established in 1971 by Act of Parliament.

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Intekening is gratis. Stof in dié publikasie weerspieël nie noodwendig die oorwoë menings van lede van die WNK nie, en mag hergebruik word met erkenning van die bron.

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A workshop on water treatment technology to discuss current problems, and research needs in water treatment in South Africa was held at the CSIR's conference centre on 24 May this year.

The workshop was organised by Dr Frik Schutte, Research Manager at the Water Research Commission. Speakers included Mr IK Reid, who discussed the results of an investigation by the University of Cape Town into the apparent problems in water treatment today, Dr FA van Duuren, who spoke on the possible underlying problems in design of water treatment plants, Mr G Offrenga, CSIR, who delivered a paper on flotation, Mr J Geldenhuis, Rand Water Board, who discussed activated carbon, and Miss A Toerien, Western Transvaal Regional Water Company, and Prof G v R Marais, University of Cape Town, who spoke on oxidation and water stabilization, respectively.

Mr Reid said in his presentation that the problems arising in the water supply industry in South Africa could be categorised as follows:



From left: Mr AR McClaren, Gold Fields Mining Co and Dr DF Toerien, Division of Water Technology, CSIR.

- Technology is available but often is not disseminated adequately and there are questions of its appropriateness to South African conditions.
- There is a need for effective evaluation of existing technology and transfer of such technology per design, operation and controls by means of manuals of practice oriented to designers, chemists and operators respectively.
- There is a need for an investigation into comprehensive environmental control of individual catchment areas.

Mr Reid said the Water Research Commission had requested the University of Cape Town to survey problems associated with treatment of potable water as regards water quality, design operation and control of water treatment works, and on corrosion and aggression in reticulation systems.

It was decided that in the first part of the survey attention should be focussed initially on the larger water supply authorities. It was also agreed that the survey should be carried out by way of discussions with officials of these authorities and by visits to a number of the larger treatment works. Although the orientation of the survey was towards the larger authorities, the problems of smaller authorities were also addressed.

WORKSHOP HIGHLIGHTS PROBLEMS IN SA WATER SUPPLY INDUSTRY

To initiate an exchange of views the discussions were conducted under the following broad headings:

- Treatment problems experienced.
- Control and management difficulties.
- Difficulties foreseen in the future.

The second part of the survey, into corrosion and aggression in reticulation systems, was carried out by way of a questionnaire sent to all municipalities in South Africa treating daily flows in excess of 5 Ml/d or serving populations greater than 5000. The questionnaire was designed to elicit information on treated water quality with respect to corrosion and aggression, and problems experienced in the reticulation system.

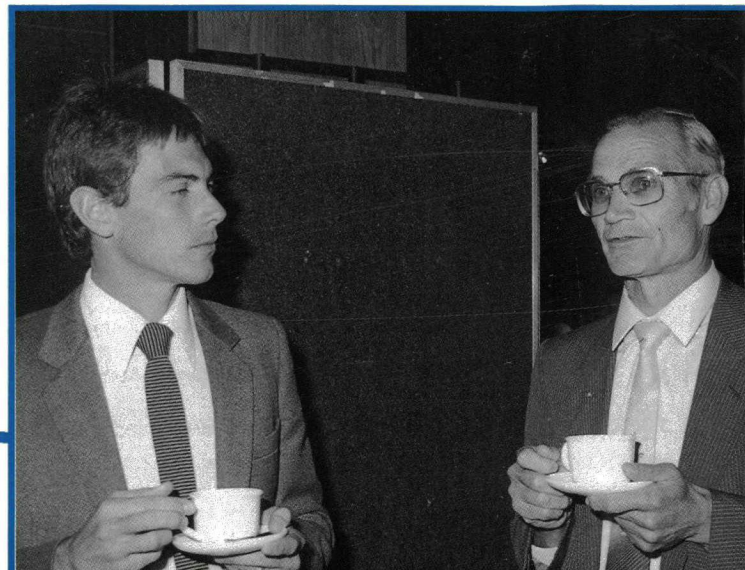
Mr Reid summarised apparent problems as follows:

Inadequacies in treatment works design

In general the larger plants appear to be well designed. Difficulties that have arisen, as a result of design features, are more commonly found in smaller installations. Difficulties observed were:

- Inadequate provision for the number of dosing chemicals and associated rapid mix requirements.

From left: Mr L Aucamp and Mr AJ Husselmann both from the Rand Water Board.



- Inadequate provision for flocculation to suit the type of sedimentation tank installed.
 - In the smaller water works the majority of designs make no provision for stabilization of the water before discharge to the distribution system.
 - Inadequate provision in the design to cope with variations in raw water quality either seasonally or over the design period.
- These situations appear to arise from the following:
- Inadequate appreciation of the function of the different unit processes and of the parameters controlling their performance.
 - Inadequate information on the raw water quality, its seasonal variation and future trends. This situation may be exacerbated where there is an urgent need to complete the project.

Although there is extensive literature on all aspects of water treatment and unit process design, the information is not readily accessible to designers and its relevance to South African conditions is not clear.

It seems that there is a need for manuals of practice setting out the design considerations, process requirements, applica-



From left: Dr J Haarhoff, Geustyn, Forsyth and Joubert, and Prof G v R Marais, UCT.

bility of each type of unit process, preliminary testing requirements and design techniques all within the South African context; such manuals would help to avoid many of the pitfalls now commonly encountered.

High rate sedimentation

It is general South African practice to use conservative loading rates in the range 0,8 to 1,5 m³/m²/h for sedimentation tanks. There are some exceptions where loadings two to ten times greater are used - some authorities voiced an interest in the application of these high rate units - they were particularly interested in (1) possible financial benefits and, (2) their application in uprating existing treatment works. Definitive guidance is lacking regarding the use of high rate sedimentation units under local conditions, particularly with regard to:

- The characteristics of raw waters most suitable for high rate treatment.
- Rapid mix and flocculation requirements related to raw

water type and coagulants.

- Types of coagulants and their effects on subsequent units in the process chain.
- Comparative costs.

Algae removal

Although the coastal rivers of South Africa are comparatively nutrient free, the inland waters are receiving an increasing nutrient load from municipal and industrial waste discharges and agricultural run off. Algae was present in the influents to a



From left: Mr IK Reid, Ninham Shand and Mr P Polasek, Separa (Pty)Ltd.

number of treatment works; most treatment works visited showed evidence of algal growth within the treatment units; in some there was also visual evidence of algae in the filtered water.

The causes for algal growth in the treatment units probably are due to the following factors:

- (i) The presence of nutrients in the raw water, persisting even in the final stages of treatment, albeit in minute concentrations, and
- (ii) The countrywide high incidence of solar radiation and high seasonal temperatures.

- Present methods for controlling algal growth are:

Covering the units to reduce the light intensity: However this is likely to reduce the problem but unlikely to eliminate it as some algae require very low light intensity for growth particularly if the water temperatures are relatively high.

- Chlorination of the raw water. Chlorination presents a problem in THM formation. One authority has changed to ozonation, instead of chlorination, and there are others that contemplate using chlorine dioxide. However it seems that there is little quantitative information on the effectiveness of these procedures in controlling after growth of algae in conditions of high solar radiation and high temperatures.

Present methods of removing algae include flotation, for example dissolved air flotation (DAF). However the potential, efficiency and technical details for design and operation of these systems are not readily available.

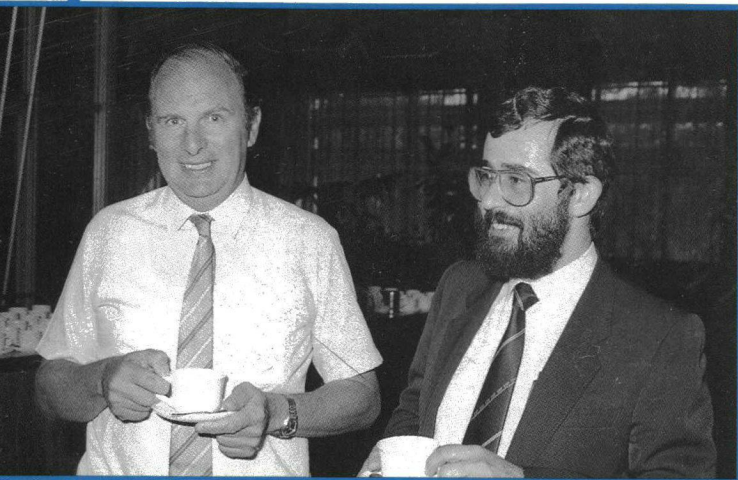
From these observations it would seem that research is required into:

- Removal of algae in the raw water itself.
- Factors controlling algal growth in the treatment system, and

- Development of chemical, physical and operational measures that may counter such growth.
- Guidelines for the design and operation of DAF systems in water treatment.

Tastes and odours originating from algae or bacterial growth

Over the past year, two of the treatment authorities visited have experienced odour in the treated water. The odour was traced to the chlorination of certain algal species. In both cases the problem was of relatively short duration. Other water supply authorities have experienced taste and odour prob-



Mr JS van Rooyen and Mr A Rousouw, both from the Department of Water Affairs.

lems as a result of bacterial growths in the reticulation system. One authority traced the problem to the use of a particular flocculant. Virtually every authority expects that these problems will increase in the future.

Information on the causes that lead to odour development in the treated water is meagre particularly under South African conditions. There appears to be justification for research into

- the causes, and methods of control, of odour development in the treatment process and the reticulation system under South African conditions.

Manganese in association with organic colour

Organic colour is coagulated with aluminium salts at a pH below 7; in contrast manganese removal requires the oxidation of the divalent metal Mn^{2+} to Mn^{3+} and its precipitation at a pH 8,5. Consequently the removal of colour and manganese in a single sedimentation unit gives rise to difficulties in operation. This problem has been found with certain dams when the water level is low or where water is drawn off from the hypolimnion.

Although the problem is not of frequent occurrence and tends to be of short duration, it is troublesome and merits study to optimize the removal of both.

Organic colour removal

Humic acids are the usual cause of organic colour in waters from the Table Mountain sandstone region. The quantities of humic acid can vary significantly between locations and also vary seasonably at a location. Usually flocculation is achieved by alum at a low pH, sometimes with polyelectrolyte addition. Traditionally horizontal flow sedimentation tanks are installed. One authority has installed an upflow (sludge blanket) system for the removal of organic colour in association with turbidity. Operational experience with this system using a cationic polyelectrolyte as coagulant aid has indicated that the mean alum dosage can be reduced and need only be applied intermittently.

It would appear that knowledge of the treatment of organic coloured waters is still empirically based, there is very little real understanding of the chemistry of these waters, the possible influence, for example, of the colourless fulvic acid on the chemical response of these waters to coagulants. Only one authority traces the removal of the fulvic acid in addition to the humic acids.

- Research into the influence of fulvic and humic acids on the coagulation process is indicated.

Sludge dewatering and disposal

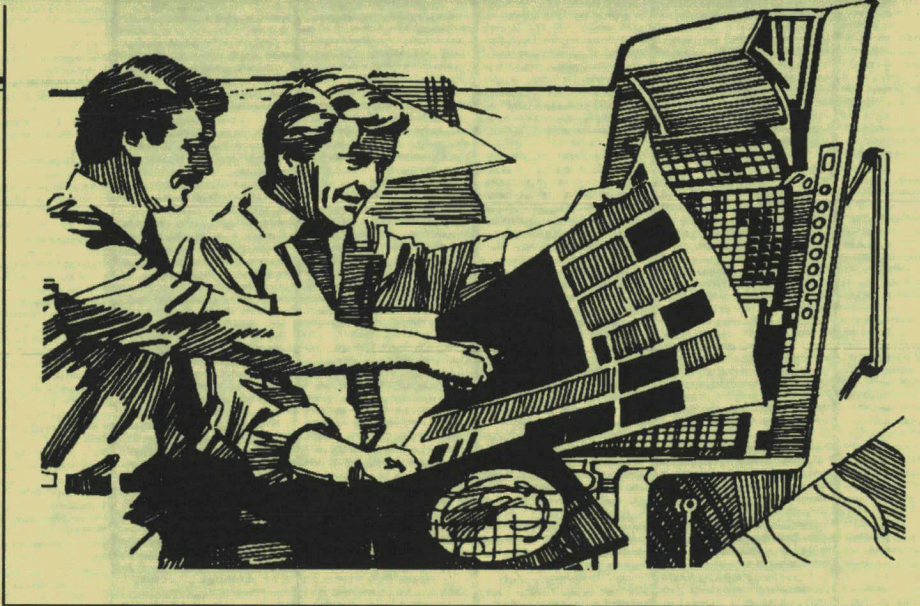
The conventional water treatment process produces a sludge waste stream in the range 1 to 3 per cent of the water production. The sludge varies in concentration from 0,5 per cent to 1,5 per cent dry solids. Present methods of sludge disposal include lagooning, sludge drying beds, vacuum assisted sludge drying beds (RSDS), centrifuges, filter presses, and others. In areas where land is plentiful lagooning appears to be the method favoured.



From left: Dr CF Schutte, WRC, Mr AJ Husselmann, RWB and Mr D Kerdachi, Umgeni Water Board.

However all authorities expressed concern that as sludge quantities increase and shortage of land becomes critical there will be an urgent need for the use of alternate disposal methods.

Various water treatment authorities and research organizations are investigating the problem of sludge disposal. Central coordination of their investigations and orderly dissemination of the findings would be to the benefit of the whole water industry.



ENQUIRIES AND INFORMATION

Please address all enquiries and requests for further information to:

Division of Water Technology

CSIR

P O Box 395

Pretoria

0001

Telephone: (012) 841-2231 Mr P Coombs

Telex: 3-21312 SA

Telefax: (012) 841-4785

REPLY FORM

SYMPOSIUM ON SLUDGE HANDLING

S 501

15 November 1988

Geological Survey, Pretoria Road, Silverton

1. NAME (Prof/Dr/Mr/Mrs/Miss/Ms) _____

ORGANIZATION _____

ADDRESS _____

Postal Code _____ Tel No. _____

2. I wish to attend the above symposium and my registration fee of R _____ is enclosed.

I am a full-time student at _____ University.

Signature _____ Date _____

PLEASE NOTE: Cheques should be made payable to Division of Water Technology S 501 and returned with this form to:

Phil Coombs, Liaison Officer

Division of Water Technology

CSIR, P O Box 395, Pretoria 0001

Supplement to SA Waterbulletin June/July 1988

SYMPOSIUM ON SLUDGE HANDLING GEOLOGICAL SURVEY 15 NOVEMBER 1988 S 501

The symposium is organized by the Division of Water Technology (DWT) of the CSIR in conjunction with the Water Institute of Southern Africa, the Water Research Commission and the Department of Water Affairs. Secretarial services will be provided by the Marketing Programme of the DWT.

WHERE AND WHEN

The symposium will be held at the Geological Survey, Pretoria Road, Silverton on Tuesday 15 November 1988.

THEME

The theme of this symposium is the handling, treatment, utilization and disposal of sludge.

WHO SHOULD ATTEND

Engineers, scientists, entrepreneurs and all students of water and wastewater treatment technology.

SOCIAL FUNCTION

Delegates are invited to attend a cocktail party at the conclusion of the technical programme.

FEES

Registration fee for delegates R120

Registration fee for bona fide students R60,00

The registration fee includes:

- Symposium programme
- Complete set of symposium papers
- Lunches, tea/coffee at the Geological Survey
- Cocktail party

REGISTRATION

Delegates who register before 21 October will receive their papers through the post. Other delegates will receive their papers at registration.

PROVISIONAL PROGRAMME

08h00 - 08h50	Registration
09h00	Session 1
08h50 - 09h00	Welcome by Chairman and President of WISA - Mr PGJ Meiring
09h00 - 09h30	Upgrading of municipal anaerobic digesters through the use of crossflow filtration - Prof CA Buckley, University of Natal.
09h30 - 10h00	Guidelines for the use of sewage sludge on land - Dr PJ Aucamp and Mr FS Vivier, Department of National Health and Population Development.
10h00 - 10h30	Sludge utilization in the production of instant lawn - Mr Koos Richards, City Engineer, Krugersdorp.
10h30 - 11h00	TEA
11h00	Session 2. Chairman Dr DF Toerien, Director, DWT.
11h00 - 11h30	Composting - Mr JH Nell, DWT, Bellville.
11h30 - 12h00	Odour problems - Mr AJ du Toit, DWT, Bellville.
12h00 - 12h30	Dual digestion - Mr HA de Villiers, DWT, Bellville.
12h30 - 12h45	Discussion Forum.
12h45 - 14h00	LUNCH
14h00	Session 3. Chairman Mr PE Odendaal, Executive Director, WRC.
14h00 - 14h30	Sludge utilization in the manufacture of bricks - Mr J Slim, City Chemist, Port Elizabeth.
14h30 - 15h00	Sludge dewatering - Mrs M Smollen, DWT, Bellville.
15h00 - 15h30	TEA
15h30	Session 4. Chairman Mr HJ Best, Department of Water Affairs.
15h30 - 16h00	Flotation of activated sludge - Dr A Wood, DWT.
16h00 - 16h30	A new rapid sludge dewatering system - Mr R Heilbron, Babcock.
16h30 - 16h45	Discussion Forum and Closure.
17h00	COCKTAIL PARTY

Appropriate technology

In the past the surface waters in South Africa have been relatively unpolluted and a conventional five stage water treatment process has been employed generally. Some treatment authorities however are experiencing problems arising from the presence of algae and have noted an increase in organics in the raw water. This problem is likely to increase and become more widespread in the future.

Overseas experience indicates that a seven stage treatment process may be appropriate; this would have financial and operational implications; there appears to be room for:

- development of technologies appropriate to the South African milieu.

CONTROL AND MANAGEMENT PROBLEMS

- Control of the total water environments

Operation of sewage treatment works normally is vested in the local authority in whose area the effluent originates. These authorities are required to comply with legislation governing the qualifications of staff in control of the sewage works and the standard of effluent discharged to rivers. River water quality monitoring and policing of the regulations is done by the Department of Water Affairs. Water treatment works situated downstream frequently are under the control of different authorities. Some water treatment works situated downstream report that they have to cope with rapid deterioration in raw water quality possibly caused by illegal effluent discharges.

A number of the authorities visited considered that it would be advantageous if the treatment of sewage and water, and control of discharge to the river as well as the task of river quality monitoring for each river system or catchment were vested in a single authority. One authority envisaged a system of total water management of a catchment similar to that employed in the United Kingdom.

- Guidance Standards on maximum allowable THM in treated water

Some overseas countries have formulated standards regarding the concentration of THM in potable water. In South Africa no such standards or guidance exist. Some of the treatment authorities drawing water from the Vaal River voiced a desire for guidance in this regard.

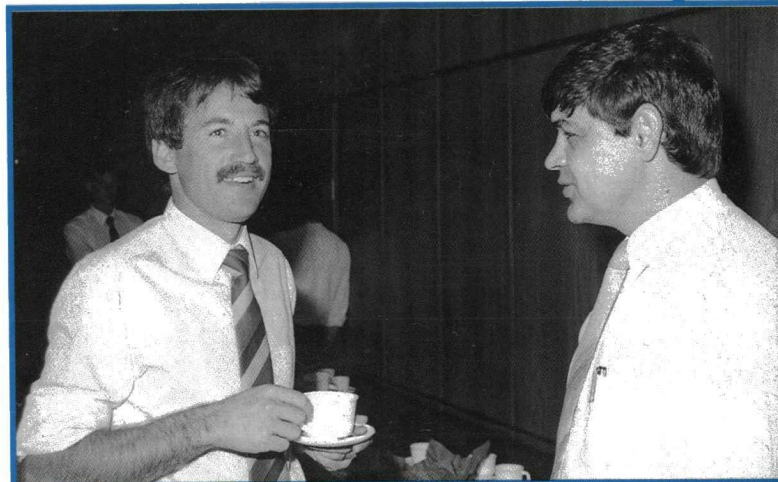
- Rapid changes in raw water quality

Some treatment works experience control problems when sudden changes in raw water quality occur. This problem most commonly occurs on treatment works which draw raw water from rivers that receive a high level of treated effluent or during storm periods. Often the first intimation the treatment works operators have, that the influent quality has deteriorated, is several hours later, when the quality of the treated water itself deteriorates. To overcome this time delay, where waters are subject to rapid change, some treatment works have devised schemes where the

floc quality is examined at regular intervals, in one instance, every twenty minutes. Some treatment authorities believe that there is a need for some formal type of testing procedure to forecast the occurrence of this type of problem.

- Laboratory analysis of low pH, low alkalinity waters

In the "brown" soft waters containing humic or fulvic acids the alkalinity due to the carbonate system (H_2CO_3 alkalinity) cannot be measured by the normal titration methods. The



From left: Mr L Fouche, Langenegger Otto and Part., and Mr J Lottering, OFS Gold Fields Water Board.

"alkalinity" contribution of these acids can lead to gross overestimates of the H_2CO_3 alkalinity and thus give rise to errors in chemical dosing estimation. A method of characterizing these waters should be sought.

- Measurement of algal concentrations

One authority stated that current methods of determining algal concentrations and identifying the types of algae are cumbersome and time consuming and suggested that attention should be given to developing simplified practical techniques.

In summarizing the day's proceedings Dr Schutte indicated that, based on the discussions, a document will be compiled containing:

- a list of the water treatment problems as discussed
- research needs to address these problems
- requirements regarding information and technology transfer
- a list of current projects and projects in the pipeline on water treatment
- other relevant aspects discussed

This document will be circulated to participants of the workshop as well as others in the field who will be requested to add problems or research needs that are not in the list and to indicate a priority rating to the needs and problems.

Feedback will be incorporated in a final document which will then be made available as a guide plan for research on water treatment in South Africa.

The Water Research Commission (WRC) is sponsoring wide-ranging research activities which bear directly on the interest and the needs of South African local authorities. These activities vary from research into municipal wastewater treatment to the management of sewage sludge, the marine disposal of effluents and water reclamation.

In this article some of the highlights of this work are reviewed. The article has been compiled from a paper by PE Odendaal, HC Chapman and JE McGlashan of the WRC, presented at the 58th conference of the Institution of Municipal Engineers of South Africa, held in East London during May this year.

Local authorities of necessity play a major role in dealing with the problems of water supply and pollution control and have established a proud record in this regard. As the pressures on available water supplies increase, these problems will become more complex and greater demands will be placed on the skills and knowledge available to local authorities. In fact, new knowledge and technology must be generated on a continuing basis to deal with the problems of the future, and this requires a sustained water research effort.

MUNICIPAL WASTEWATER TREATMENT

Biological phosphate removal

The phosphate content of treated domestic and industrial waste water discharges is the main contributor to the eutrophication problems experienced in many of South Africa's impoundments.

Phosphate can be removed from sewage either biologically or chemically. The biological route can only be followed in the case

of the activated sludge process. This requires a modification to the traditional activated sludge process, a modification invented by Dr JL Barnard whilst working for the then National Institute for Water Research (NIWR)*. Further development of the process required extensive research which was heavily supported by the WRC and the NIWR, the University of Cape Town and the Municipality of Johannesburg.

Many publications issued from the work, and culminated in the monograph Theory, design and operation of nutrient removal activated sludge processes, published in 1984.

Since then, research has continued and it is intended to consolidate the progress made in an updated monograph, probably in 1990.

Today some 40 nutrient removal activated sludge plants are operating in South Africa. The process generated much interest overseas, leading to research projects and plants in many countries.

Chemical augmentation of biological phosphate removal

In most cases biological phosphate removal cannot consistently meet the phosphate limit of 1 mg/l. Chemical phosphate removal as a supplementary process then becomes necessary.

Johannesburg Municipality is now investigating the in-plant addition of chemicals. This has the advantage over chemicals being added prior to or after activated sludge treatment in that it utilises existing plant, allows biological removal to take place simultaneously and, through recycling, reduces chemical requirements. Tests are being conducted at full scale on plants with different influent characteristics. In the same project, phosphate precipitation from the supernatant liquor of anaerobic digesters at various Johannesburg nutrient removal plants is also being investigated. This will be achieved by creating suitable conditions for the precipitation of struvite (magnesium ammonium phosphate) so as to minimize chemical requirements. The problem with anaerobic digestion of sludge from biological nutrient removal plants, is that phosphate in the sludge can be re-released into the system.

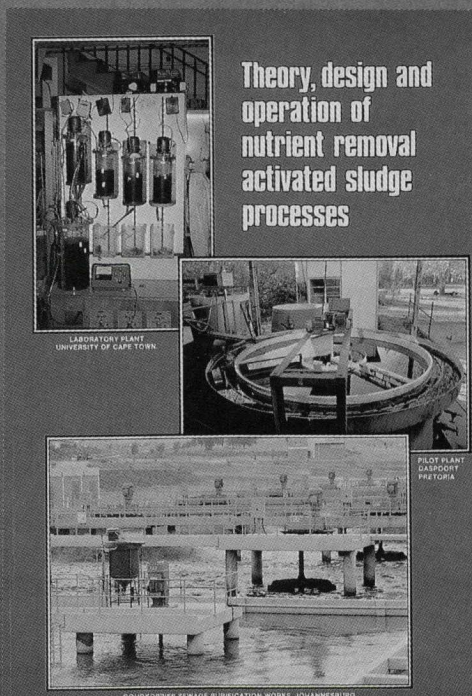
Phosphate crystallisation

This project is related to the previous one, in aiming at the chemical removal of phosphate in the anaerobic basins of nutrient removal activated sludge plants. The technology is different, however, in that phosphate is removed in the form of calcium phosphate, crystallised out on small grains of sand. This work is carried out by the Division of Water Technology (DWT) of the CSIR.

Controlled struvite formation

This project by the DWT, is investigating controlled struvite formation, but within the activated sludge process itself (as opposed to the supernatant liquors of anaerobic digesters). By achieving immobilisation of part of the phosphate released by the microbial biomass in the anaerobic stage of the plant, lower phosphate concentrations should be obtained more consistently in the final effluent. Additional advantages would be the removal of an equiva-

*The National Institute for Water Research of the CSIR has become the Division of Water Technology as from 1 April 1988.



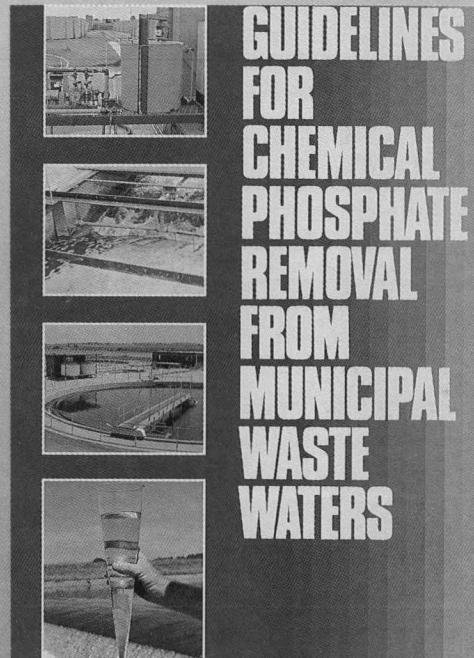
WRC PROJECTS HELP LOCAL AUTHORITIES TO SOLVE WATER PROBLEMS

lent mass of ammonia from the effluent, the production of a crystalline residue that is more readily removed than conventional sludge, the ability to upgrade the performance of existing activated sludge plants, and the elimination of uncontrolled struvite precipitation on heat exchanger surfaces and in pipe networks associated with anaerobic digestion.

Chemical phosphate removal

Biological phosphate removal is not currently possible in biological filter wastewater treatment processes. For these processes it would appear that chemical treatment is at present the only cost-effective and practical means of removing phosphates. Since approximately half of the volume of sewage treated in the sensitive catchments affected by the phosphate standard is treated by biological filter plants, appropriate technology for phosphate removal in these systems is of the utmost importance. As a result all available information on chemical phosphate removal was synthesized by the WRC in 1979 in the form of a review publication and disseminated to interested parties in the

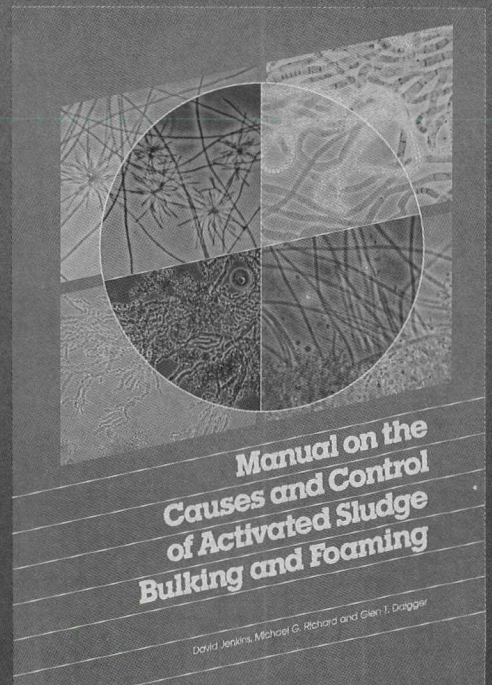
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RSA. In addition, the WRC also launched a research programme to evaluate, optimise and further refine chemical phosphate removal techniques at full-scale biological filter plants under local conditions. This programme was carried out under contract by the City Council of Pretoria and the NIWR in collaboration with the Town Council of Boksburg. The results of this programme were published in 1987 as Guidelines for chemical phosphate removal from municipal waste waters. Since then the Commission funded further research with the Town Council of Boksburg and a firm of consulting engineers. This work concentrated on procedures to optimize chemical phosphate removal and to quantify sludge production. The results will be used in updating the guidelines mentioned above.

Sludge bulking

Sludge bulking is a serious and common operational problem



David Jenkins, Michael G. Richard and Glen T. Dragger

in activated sludge plants in South Africa — particularly in nutrient removal plants - and results in the carry-over of suspended solids into the final effluent discharged from the sewage works.

The WRC attends to the problem through the funding of a project at the University of Cape Town. The project aims at remedial and preventative methods for sludge bulking with a view to developing appropriate design guidelines and operational procedures.

As an interim measure the Commission contracted an overseas consultant to draw up a Manual on the causes and control of activated sludge bulking and foaming, based on existing information. The manual, published in 1986, is being marketed successfully in the USA.

Current findings of the project have proved that selectors, which are short retention period reactors incorporated in an activated sludge plant, control bulking only for three specific types of bacteria. These bacteria do not occur very often in South African activated sludge plants with their relatively long sludge ages.

From research conducted at Cape Town it appears that some of the more dominant filamentous organisms found in South African plants thrive in periods or regions of low dissolved oxygen concentrations and elimination of these regions by improving oxygen input and mixing may ameliorate the bulking problem. This direction is being pursued.

a technology transfer document for the design and control of equalisation tanks in wastewater treatment plant applications. A user-friendly design and analysis computer program for use on a personal computer will accompany the document. This follows a project during the period 1979 to 1982 in which the role of equalisation tanks in wastewater treatment was evaluated. The study showed that equalisation can confer significant benefits in simplifying plant operation and effect cost savings, while a rational procedure for the sizing and design of equalisation tanks was established. The results of this study was subsequently confirmed at full-scale.

Settling tank design

The University of Cape Town has been charged to draw up a document on the design and operation of secondary settling tanks. The document will focus on upgrading currently used empirical design criteria in South Africa by making available the design procedures and full scale experience (approximately modified where required) from other countries.

Modelling of activated sludge systems

For a number of years the University of Cape Town wastewater treatment research group has worked on the development of mathematical models for describing the response of the activated sludge process. This has led to the recognition of a 'UCT model' internationally. Although the UCT model has found application in design, operation and control of plants, the only available version of the program is set up to run on mainframe computers which are often not readily accessible to potential users. The University has now been contracted to develop an interactive user-friendly computer program for simulating activated sludge behaviour which can be handled by a PC-type computer.

SEWAGE SLUDGE

In South Africa, sludge utilisation in agriculture and horticulture is practised on a much smaller scale than in certain countries abroad. The reason for this is the potential threat of the spread of disease to man and beast due to the particular climatic conditions of the country and the nature of the diseases endemic to South Africa. In order to overcome this potential threat, the research effort funded and co-ordinated by the Commission has focused on ways and means of treating the sludge in such a way as to enable the agricultural and horticultural utilisation options to become more freely available. Attention has, therefore, focused on sludge disinfection processes and combined sludge disinfection and stabilisation processes.

Forced aeration composting of sewage sludge

The Commission was instrumental in importing, evaluating and improving the forced aeration composting process for the stabilisation and disinfection of dewatered sewage sludge originally developed by the United States Department of Agriculture. The Commission financed a prototype study at the National Institute for Water Research (NIWR) in Bellville over a period of four years and the process has been shown to successfully disinfect and stabilise dewatered sewage sludge under the

Biological foam

The formation of biological foam on tank surfaces in the activated sludge process gives rise to a number of difficult operational problems, particularly at biological nutrient removal plants, and results in a poorer quality final effluent due to a carry-over of suspended solids, increases running costs of a plant and is generally unsightly.

In a study undertaken by the University of Pretoria, it was found that the accumulation of biological scum was due to the dominant presence of the bacteria, Nocardia sp. or Microthrix

parvicella. The particular phy-siological characteristics of these bacteria, which include resistance to starvation and high substrate affinity, present them with an advantage over other bacteria in conditions where there is a low substrate level.

The technique developed to control biological scum formation is to selectively float the scum bacteria from the system at a rate faster than that at which they multiply. The method was tested successfully on a pilot-scale and thereafter on full-scale at the Daspoort (Pretoria) sewage treatment plant.

Equalisation tanks

The University of Cape Town has been contracted to prepare

CJP LAUBSCHER
WA PRETORIUS

BIOLOGIESESKUMBEHEER
MET SELEKTIEWE
FLOTTASIE IN DIE
GEAKTIVEERDESLYKPROSES

Verslag aan die
WATERNAVORSINGSKOMMISSIE
deur die
UNIVERSITEIT VAN PRETORIA

WNK Verslag Nr 147/1/88

favourable experimental conditions at the Bellville Sewage Works. An opportunity presented itself for the rapid application of the research results with the decision by the Stellenbosch Town Council to build a forced aeration composting facility at their sewage works. Once operational, the facility may be used for demonstration to other local authorities, consultants, government departments, industry and any other interested party.

Dual digestion of sludge

Dual digestion is a process developed to overcome a number of disadvantages associated with conventional anaerobic digestion and with autothermal aerobic digestion on sludge. It is a combination of these two processes offering both disinfection of the sludge and stabilisation in one.

The aerobic first step of the process is aerated with oxygen to provide autothermal heating enabling thermophilic temperatures to be achieved for disinfection purposes. Due to the high rate of metabolism at these temperatures, stable treatment can be sustained at very high loading rates and short retention times. At this retention time only a small proportion of the organic matter in sludge is oxidised and only partial stabilisation is achieved. The stabilisation of the sludge is then completed in a second stage anaerobic digester which, due to the conditioning effect on the first step, may be operated at a very short retention time of around eight to ten days.

The findings of pilot scale research, undertaken for the Commission by the Johannesburg City Council into the autothermal aerobic part of the process, were sufficiently promising to warrant a study at larger scale of the whole process. This work is now being done, under contract with the Milnerton Municipality and the DWT of the CSIR, at Milnerton's Potsdam Wastewater Treatment Works. The research facility treats 45 m³/d of primary and humus sludge from the normal daily production of about 100 m³/d.

Sludge pasteurisation

In collaboration with the WRC, the Cape Town City Engineer's Department carried out an investigation to determine the disinfection characteristics of a full-scale continuously operated wastewater sludge pasteuriser. The pasteuriser was monitored over a three year period and it was found that a temperature of 53°C for 30 minutes was sufficient to inactivate *Ascaris Lumbricoides* ova. Copies of the final project report are available from the WRC.

Sludge dewatering

Under contract with the WRC, the City of Port Elizabeth evaluated several alternative ways to dewater sludge under South African conditions. The processes investigated were a rotary drum vacuum filter, a filter belt press, a filter plate press and two types of centrifuge. The investigations were done with both Zimpro thermally conditioned (heat-treated) and non-heat-treated sewage sludges, with and without the addition of a polyelectrolyte conditioning agent. Copies of the project report are available from the WRC.

Chemical characterisation of sewage sludges

The DWT is conducting a survey of the occurrence of inorganic chemical contaminants and nutrients in South African sewage sludges. In the process the most suitable methods for analysis of these contaminants are being established. The results will be used, together with information derived from other DWT studies and from overseas, to prepare guidelines for the application of sewage sludge to agricultural land.

MARINE DISPOSAL OF EFFLUENTS

The favourable geographical location of the country and ocean currents around

I R MORRISON

THE PASTEURISATION OF SLUDGE

Report to the
WATER RESEARCH COMMISSION
by the
CITY ENGINEER'S DEPARTMENT
CAPE TOWN

WRC Report No 86/1/86

M SMOLLEN
J M FOURIE
W R ROSS

SLUDGE CHARACTERISATION AND DEWATERING

Report to the
WATER RESEARCH COMMISSION
by the
COUNCIL FOR SCIENTIFIC AND
INDUSTRIAL RESEARCH
NATIONAL INSTITUTE FOR WATER RESEARCH

WRC Report No. 89/1/85
CSIR-NIWR Report No. 620/9846/2

the South African coastline have enabled the disposal of a variety of effluents to the marine environment. Present marine disposal methods vary widely from surf-zone discharges to discharges through deep, well-designed sea outfall sewers.

The WRC has been involved in sponsoring research into the marine disposal of effluents since 1980.

Disposal of sludge to sea

In a project jointly sponsored by the WRC and Durban Corporation, with participation by the NIWR and the National Research Institute for Oceanology (NRIO), an experiment was conducted to re-introduce sludge into Durban's two sea outfall sewers which have been discharging settled sewage since 1968.

An intensive monitoring programme showed that there was no pollution of the beaches, no deleterious effect on the quality of the sea-water or on marine fauna, and no bacteriological and chemical pollution at any of the measuring points along the coastline and at sea. Based on the findings, Durban Corporation was granted a permit to continue the sludge discharge (to be reviewed every five years).

The importance of the successful completion of this project is reflected in the attitude of the controlling authorities which are now much more ready to accept the marine disposal option for a wider range of discharges, provided that it can be shown that the marine environment can absorb and properly disperse the discharges.

A guide to the marine disposal of wastewaters

The WRC contracted NRIO to develop a guide for the marine disposal of effluents. The preparatory work involved inter alia field measurements of the initial dilution of effluents discharged to sea through the Camps Bay outfall sewer, and more controlled measurements from a single diffuser port installed at Hout Bay. Results from verification exercises at both sites confirmed that the actual dilution achieved is considerably greater than that predicted theoretically.

The guide is expected to be available by the end of 1988.

Marine disposal practice in South Africa

On behalf of the WRC, NRIO is compiling a comprehensive publication which will document descriptive and technical details of known marine discharges in South Africa. Details will be documented in such a way that prospective dischargers can review the successes and failure of present practice to ensure safe and circumspect design and operation procedures in the future.

Items to be covered in the document will include the degree of pretreatment of the effluent discharged; physical design aspects such as port design; problems experienced with operation of the pipeline such as pipe movement and fracture; water hammer problems and clogging or cleaning of diffusers.

WATER TREATMENT

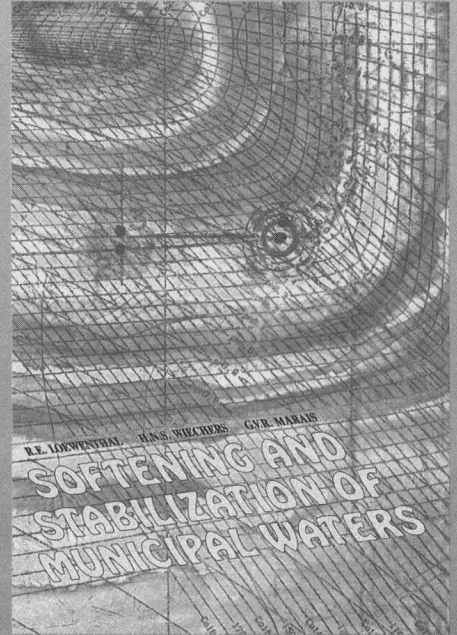
Softening and stabilisation of municipal waters

Unstable water can be corrosive, aggressive and scale-forming. This can lead to a deterioration in water quality (e.g. the dissolution of metals such as lead, cadmium, copper, zinc and iron), turbidity, tastes and odours, loss in conduit carrying capacity, drop in pressure, leaks, pump replacement and increased maintenance costs.

For these reasons the WRC initiated research on water softening and stabilisation with the Public Health Engineering Division of the Department of Civil Engineering at the University of Cape Town. A major advance resulting from the work was

the development of graphically aided procedures to determine the characteristics of water and the chemical dosing requirements. This was published in the monograph Softening and Stabilization of Municipal Waters.

In order to enable easy access to and application of these



procedures, the work was followed up by the development of a user friendly IBM compatible computer program, titled STASOFT, aimed at chemists, engineers and plant operators.

The program is available free of charge to South African users and can be ordered from the WRC.

Water works sludges

Water works sludges cause serious pollution problems and, therefore, create a need for new and economical methods for dewatering sludges to facilitate acceptable disposal. A novel sludge dewatering process has now been developed by the Pollution Research Group of the Department of Chemical Engineering, University of Natal, under a WRC funded project.

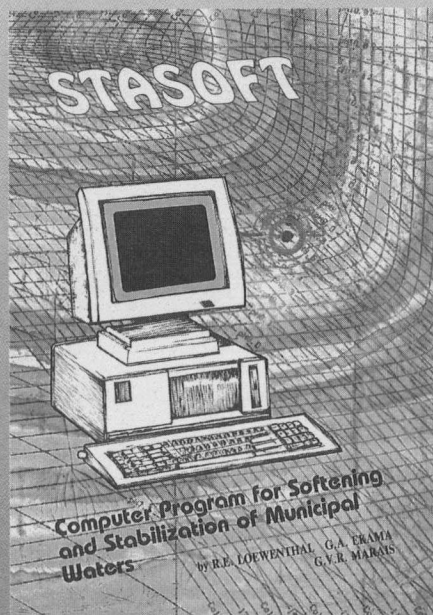
The process is called the "tubular filter press", and a prototype was installed at the Umgeni Water Board's HD Hill Water Treatment Plant in Pietermaritzburg. The Umgeni Water Board provided the capital for the prototype while engineers of the Board were also responsible for the design and construction of the plant.

The tubular filter press can be used to dewater a wide variety of inorganic and organic sludges.

Dissolved air flotation as pretreatment for algal waters

The project, carried out by the DWT, aims at the optimisation of the flotation process for the removal of algae and of compounds which react with chlorine to form undesirable chlorinated organics in drinking water.

In a separate project the combined use of flotation and powder activated carbon is investigated for the removal of tastes and odours and of precursors for chlorinated organics.



A comparative study of water disinfectants

The use of chlorine for water disinfection can lead to the formation of chlorinated compounds which could possibly have adverse health effects. The formation of these compounds can be avoided through the use of alternative disinfectants such as chlorine dioxide and ozone. The technical and economic feasibility of using these alternative disinfectants, are being investigated in a study involving the Western Transvaal Regional Water Company, the DWT and the firm Floccotan.

Effectiveness of potable water treatment in South Africa

The Department of Civil Engineering, University of Cape Town is conducting an exploratory study on the effectiveness of potable water treatment processes used in South Africa, and to identify problem areas in the design and operation of plants which may require further research.

Microbiological growths in water distribution systems

In spite of adequate disinfection at the point of distribution, it is possible that certain micro-organisms can accumulate and form biofilms in water distribution networks. This can lead to unpleasant tastes and odours and even have health implications. In the form of biofilms, these organisms have a high resistance to disinfection. In a new project, being funded with the CSIR's Division for Water Technology (DWT), the problem will be investigated as well as the extent of its occurrence in South Africa.

increasing as, under the South African Water Act of 1956, all effluents must be purified to a General Standard and returned to the stream of origin.

(ii) In coastal areas where indirect reuse options are limited, direct potable reuse is a distinct possibility before the turn of the century, due to growing water demands.

Indirect potable reuse has gradually increased in many of our inland areas - to the extent that research which traditionally addressed direct potable reuse, has now become of equal relevance to conventional water supply.

The main research thrusts during the eighties addressed the following issues:

Epidemiology

A ten year epidemiological study in Windhoek by the SA Institute for Medical Research, concluded that no negative effects on consumers of reclaimed water could be observed.

An epidemiological study in the Cape Town metropolitan area, carried out by the University of Cape Town, established valuable baseline data which are now being used in comparative epidemiological studies between areas where raw water supplies are polluted (such as the PWV region) and areas with fairly pristine sources (such as the Cape Peninsula).

Physical-chemical technology

Following the inauguration of the Windhoek plant, the further development and evaluation of physical-chemical technology for potable reclamation continued at the 4,500 m³/d Stander demonstration plant in Pretoria, the Athlone experimental plant (300 m³/d) in Cape Town, the Cape Flats demonstration plant (4,500 m³/d) and at the Windhoek plant itself. The state of the art was drawn together in guidelines published by the Water Research Commission in 1982. This was followed by a series of studies by the NIWR on the effective and economic utilisation of active carbon in water reclamation and water treatment.

Reverse osmosis

A 400 m³/d tubular cellulose acetate reverse osmosis plant has recently been commissioned in Port Elizabeth to investigate the production of potable quality water from activated sludge secondary effluent. Rapid sand filtration and chlorination is the only pretreatment.

The project which is jointly funded by the WRC and the Port Elizabeth Municipality was prompted by an earlier experiment by the Municipality with a 40 m³/d plant. This plant operated successfully for 21 months without any serious decrease in performance. The results indicated that with sufficient attention to membrane cleaning potable water could be produced consistently with little pretreatment.

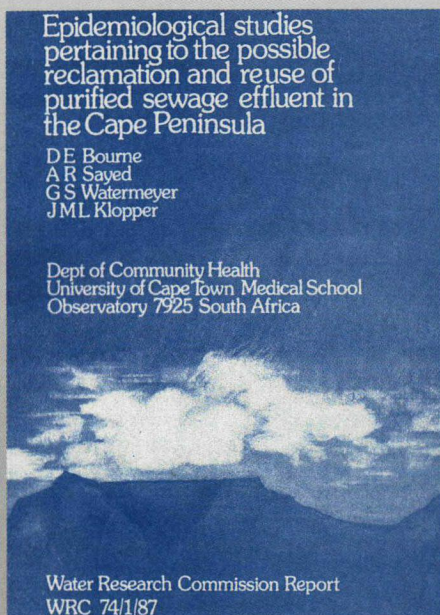
The occurrence and fate of micro-pollutants

An investigation into the incidence and concentration of trihalomethanes (THM) and their precursors in South African drinking waters is being undertaken in terms of a project carried out by the DWT. Trihalomethanes are halogenated organic compounds which are formed as a result of the disinfection of water with chlorine. Trihalomethanes, which develop in small concentrations, have received considerable world-wide attention in

WATER RECLAMATION

Since the commissioning of the water reclamation plant at Windhoek in 1969, there has been no need for further direct potable reuse facilities in South Africa, due to the continued availability of alternative fresh water supplies. The WRC has, however, continued the funding of research in this area for two main reasons:

(i) The indirect potable reuse of purified effluents is steadily



recent years, mainly as a result of allegations that the intake of the substances over a long period of time could constitute a health risk for the consumer. The information generated from this project will contribute towards the establishment of quality criteria for THM in potable water if these are considered necessary. Furthermore, the research could have an influence on the technological input required to remove these compounds and their precursors from the water.

The Commission also contributes to a second project by the DWT dealing with the development of a portable toxicity detector for water. It is hoped that this instrument will meet the need for a fast and reliable biological surveillance testing method.

Infiltration studies

The Atlantis sandy aquifer in the South Western Cape is used to infiltrate surface run-off plus treated waste water of mainly domestic origin. In a joint project by the Institute for Ground Water Studies (UOFS), the DWT and the University of Cape Town, the quifer is studied to develop models for its hydrological management and to monitor the chemical, bacteriological and virological quality.

Bacteriological analyses indicate that the abstracted water conforms to potable standards. The study has also shown that surface run-off is of poorer quality than the treated sewage effluents and for this reason run-off is separately infiltrated to limit salt water intrusion from the ocean.

WATER ECONOMY IN URBAN AREAS

Water economy in the home

In terms of a five year agreement with the then National Building Research Institute (NBRI) of the CSIR, spanning the years 1979 to 1984, many aspects of water economy were investigated, concentrating primarily on water economy in the home. Perhaps the most notable benefit flowing from this work was the drafting of National Water Supply Regulations by the SABS. Provision has been made in Government Gazette No 10941 of 25 September 1987 for these Regulations to be

incorporated into the Water Act.

Cape Town, Port Elizabeth, Durban, Pretoria and Johannesburg are already working on incorporating the regulations into their municipal By-laws prior to publication under the Act.

Other benefits of the Water Economy Project were the formation of the Joint Acceptance Scheme for Water Installation Components (JASWIC) which endeavours to unify decisions regarding common water supply problems, especially with regard to the suitability of fittings. A list of acceptable fittings is available from the Secretary for JASWIC at the Cape Town City Engineer's Department.

To provide a similar forum in the private sector, the Plumbing and Sanitaryware Manufacturers Association (PLASMA) was also formed. The formation of these two bodies has resulted in the removal of a large measure of risk when decisions have to be taken regarding the introduction of new products. Through PLASMA, many of the results of the research undertaken by the NBRI have been incorporated by the manufacturers of fittings, including toilet cisterns. Notable publications which issued from this project were:

- How to save water.
- A guideline for local authorities on water economy measures.
- A preliminary list of plants for water conservation gardening in South Africa.

Individual metering of flats

Following on the water economy project, the NBRI undertook a project to determine the impact of metering on flats.

The investigations showed that very few existing apartment buildings were suitable for the retrofitting of meters. Any requirements in this regard should, therefore, concentrate on new developments and even if meters are not actually installed at the construction stage, the plumbing design should be such as to facilitate the fitting of meters at a later stage.

Although water savings in the order of 30 per cent were achieved through the mere expedient of fitting meters, by far the greatest benefit was being able to identify water wasters.

Leak detection and water loss control

A major problem that had been identified is a reticence by local authority engineers to accept that major leakage problems could exist out of sight. It would be wise policy to at least look at a sample by measuring the midnight flow into a few blocks in some of the older areas.

The final report of the recently concluded project with Castle Brass and the Johannesburg City Council should be available for distribution by mid 1988. The technology for water loss control and analysis in this country is now equal to that to be found anywhere else in the world.

Areas that may need some attention in the future are the evaluation of the condition of municipal distribution systems through sophisticated computer models and monitoring systems which can monitor automatically the rate of deterioration of a distribution network, predict areas where renovation will be needed most urgently and indicate the type of pipe material most suited to a given set of conditions. Such models should also provide answers to the many "what if" questions which arise during urban renewal planning.

The effect of reduce sewer flows

During times of drought consumers are requested to "place a brick in the toilet cistern". When severe restrictions are imposed as in Durban and other Natal towns recently and to a lesser degree in the PWV regions, the normal flow of water in sewers is drastically reduced to the point where toilet solids are no longer waterborne and the incidence of blockages increases dramatically.

At the request of JASWIC a project to investigate the effects of reduced flows in sewers has been initiated with the NBRI. This project is scheduled to run to the middle of 1990.

Corrosion studies

The Commission has recently entered into an agreement with the CSIR's Division of Materials Science and Technology to investigate the impact of changing water quality on the corrosion effects of metallic pipes. This project is of particular importance in view of the steadily expanding problem of salt pollution which is facing a number of areas in the country.

Data logging

For planning purposes it is important to know when the peak drawoffs occur, what the ratio of mean to peak drawoff is and to what extent inaccurate domestic water meters contribute to the unaccounted-for water.

The Pretoria University, the CSIR's Division of Building Technology and the Pretoria City Council are working jointly on a project to quantify the above unknowns using data logging equipment developed through the efforts of the CSIR. The research team hopes to gather sufficient conclusive evidence to convince the assize authorities to amend current water meter assize requirements. For this purpose a number of continental water meters, which do not meet South African assize requirements, will be tested in parallel with meters manufactured locally. This project is being carried out in close cooperation with other local authorities and the SABS.

The role of private boreholes in urban areas

The extent to which the sinking of boreholes in residential areas should be controlled depends largely on alternative uses for the groundwaters. Towns which depend on groundwater for their domestic water supplies will have a different outlook to those who depend on, for example, the Rand Water Board for their domestic supplies.

In the latter case, civil defence and emergency planning are the chief motivations for keeping a log of all the boreholes within the municipal areas. In Pretoria, a large amount of background data is being gathered by the CSIR in an endeavour to try and identify areas of possible concern and to establish a probable maximum capacity of the groundwater reservoir.

of concentration.

The focus of future urban hydrology research might shift however. In the light of the recent devastating floods in all four provinces and considering the extensive damage caused by such flooding events, perhaps the time has arrived to re-evaluate the risk criteria for major structures and developments. Just one catastrophic flood can make a mockery of any economic analysis based on a 1:25 or 1:50 return period event.

SOCIO-ECONOMIC STUDIES

Socio-economic effects of water restrictions

The WRC initiated an investigation into the socio-economic effects of water restrictions which were imposed as a result of the drought in Natal, the Vaal River system and the Riet River and Vaalharts Government Water Schemes. The research was done by the Institute for Social and Economic Research of the UOFS, the Bureau for Market Research of the University of South Africa and the Centre for Applied Social Sciences of the University of Natal. The total estimated effect of the restrictions over the period March 1983 to March 1985 was R468 million. A large part of the amount, approximately 44 per cent was, however, the result of expenses for permanent improvements to properties, such as boreholes and paving.

The economic effects of salination

The WRC engaged the services of a specialist consultant - Mr JJ Heynicke - to undertake a desk study to estimate the cost to various categories of consumers, mainly in the PWV area, if the average salt content in the water supplied should increase from the present average of about 300 mg/l to 800 mg/l.

He estimated the total additional costs per year (1983 prices) at R252 million. Adjusted for an average inflation rate of 15 per cent per year, this figure would have been R440 million in 1987. Private households would bear 53 per cent of the costs and industry 38 per cent.

This work updated a previous study completed in 1981.

CONCLUSION

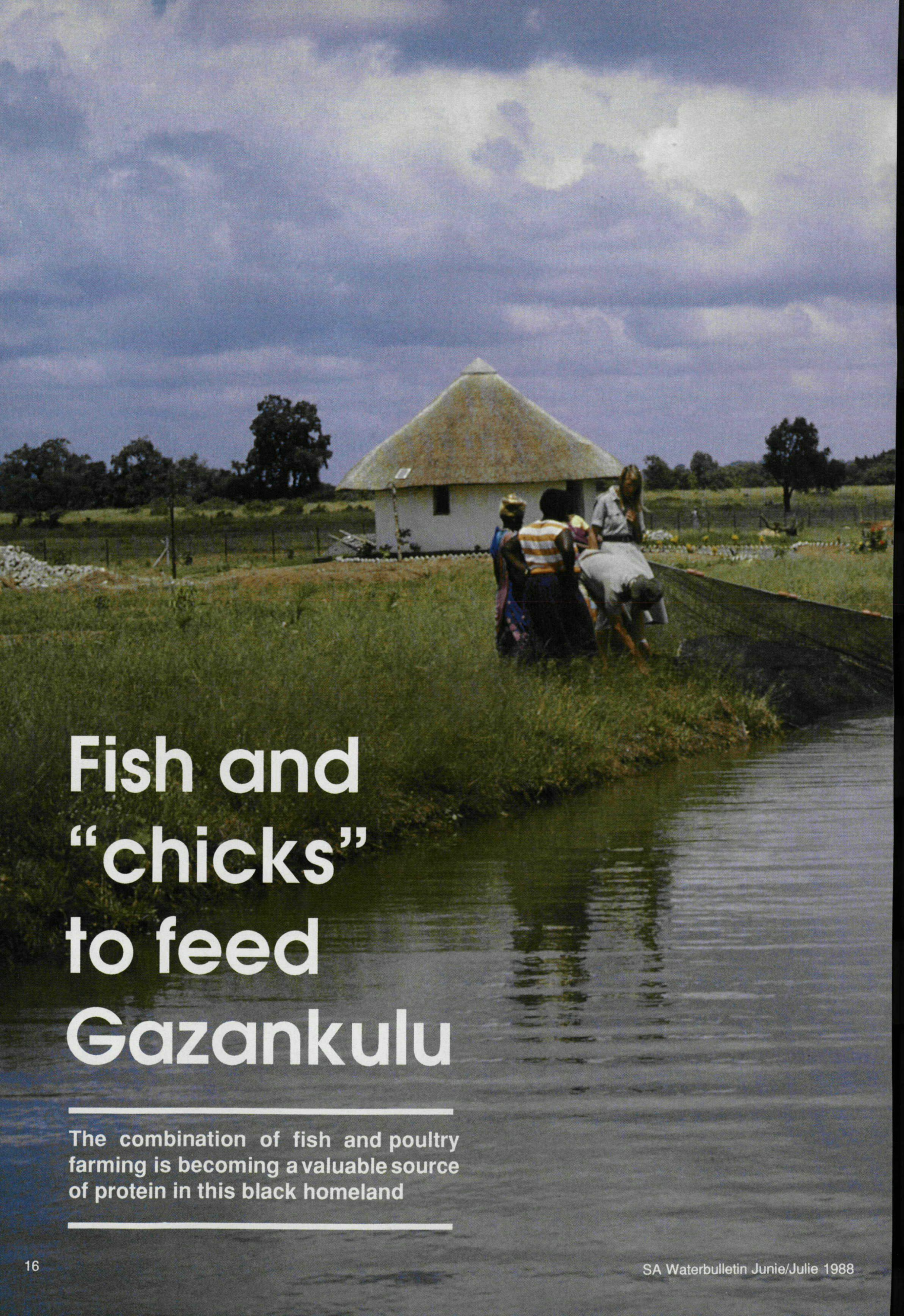
The WRC would like to thank the many local authorities who have participated in WRC projects, served on WRC steering committees and coordinating committees, commented on draft reports and manuals and made facilities available for demonstration events. Through such participation, local authorities have made valuable contributions towards the dissemination and application of research findings.

The WRC will certainly continue to solicit the assistance of local authorities in the type of activities mentioned above. In addition, the Commission would, at any time, welcome comments and suggestions from local authorities on research needs or improved information and technology transfer procedures.

Finally, local authorities are welcome to approach the WRC for further information on any of the work reported here. The Commission can either supply them with published information, arrange personal interviews, or put them in direct contact with the researchers involved.

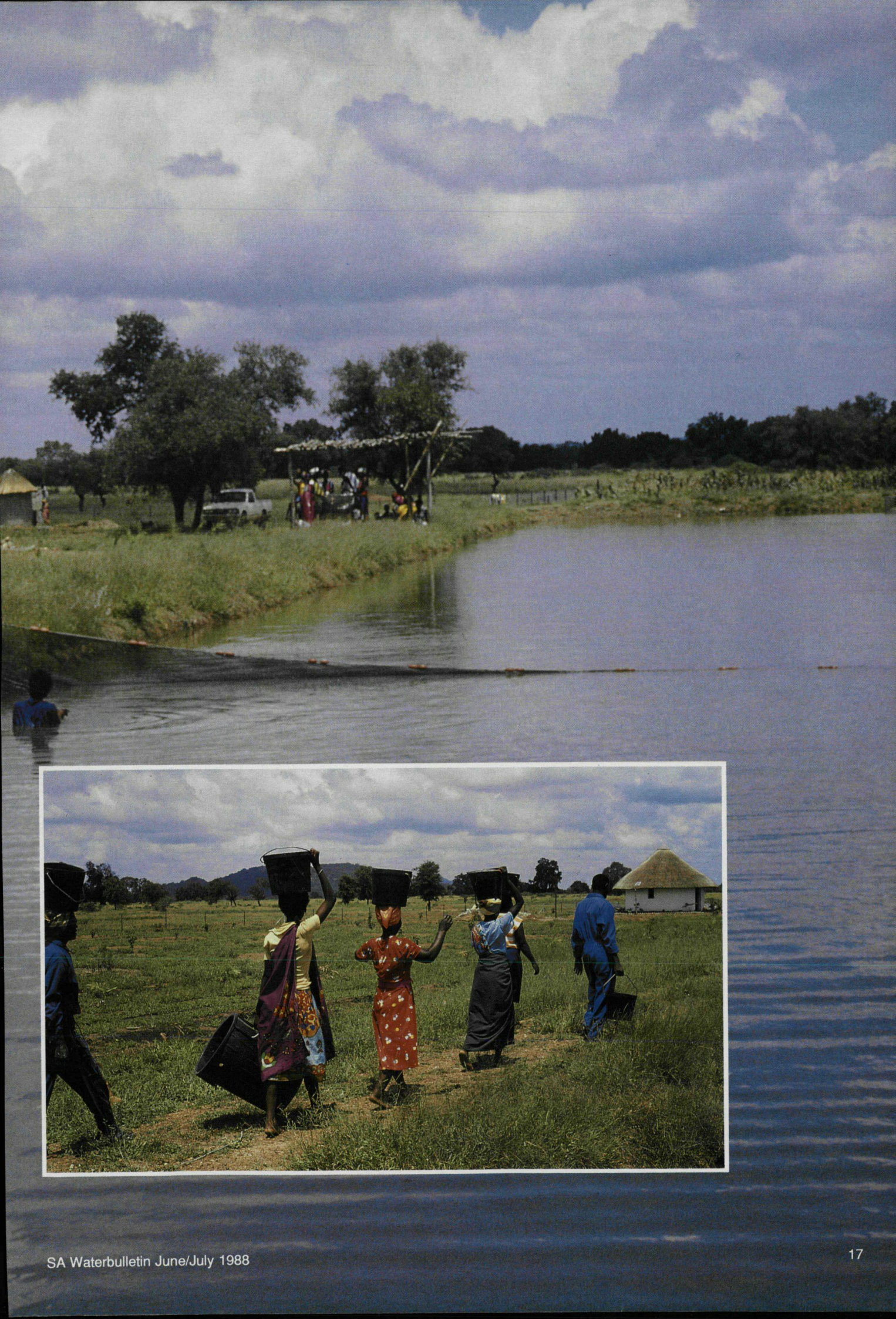
URBAN HYDROLOGY

The University of the Witwatersrand is researching various aspects of urban hydrology including the effects of urbanization on peak discharge, the volume of the discharge and the time



Fish and “chicks” to feed Gazankulu

The combination of fish and poultry farming is becoming a valuable source of protein in this black homeland



Gazankulu is the home of the Shangaan people. About 0,75 million Shangaans live in this homeland which lies in patches along the border of the Kruger National Park from Punda Malia to Skukuza. Red meat is very expensive in the region and because the Shangaans originally came from the coast of Mozambique and are very fond of fish, fish farms are being developed to provide the people with an alternate and inexpensive source of protein.



Labourers assist Mr and Mrs Hughes-Games in harvesting Tilapia.

The farms are based on the Chinese principle of aquaculture where animals such as chickens are housed over the pond containing fish, in this case Tilapia. This method of aquaculture has been practised in China for more than 5 000 years. The Chinese have used a variety of animals like pigs, cows, silk worms and other domestic animals to provide manure for enriching the pondwater.

In Gazankulu, due to the diligence of Mr William Hughes-Games, a Canadian marine biologist, fish farms have been constructed at Mhinga, Mnisi, Jongilanga and Siyandhani. The farm at Siyandhani is close to the capital, Giyani, and is being used by the Fisheries Division of the Gazankulu Government as demonstration farm.

Money for the construction of the farms is provided by the South African Government but the tribe who requested a fishfarm and on whose land the farm is developed, is responsible for the construction of the unit under close technical supervision by Mr Hughes-Games. The local people also undertake the production and marketing of the fish and chickens on the farm.

LAYOUT

The farms consist of four hectares of land. The four ponds on each farm, cover an area of one hectare. Around the ponds another two and a half hectares of land remains which is used for agriculture.

Over the ponds, four cages are built, capable of housing 200 chickens each. The floors of the cages are constructed of 25 mm creosoted droppers spaced about 15 cm apart to allow the chicken droppings to fall into the ponds.

The chickens are sold at the age of eight weeks. They then weigh about two kilograms and sell at five rand a piece.

HARVESTING

The fishponds are 30 metres wide and 80 metres long to simplify harvesting the fish. So far, six weeks after starting the

operation at Siyandhani, 364 kilograms of fish has been harvested in two ponds. On this basis an average of 6,3 tons of fish per hectare per year can be anticipated. At present only 100 chickens are grown at a time in each cage while the pond manager is still being trained. Once the full 200 chickens are being grown in each cage, the supply of manure will increase which will increase the fish yields significantly.

The ponds have a deep end of two metres and a shallow end of one metre. A sein net is pulled across the shallow end, cutting



Duck farming combined with aquaculture has been practised in Taiwan for centuries.

off one fifth of the pond's fish population. The harvesting is repeated once a week to ensure that the remaining fish in the pond have enough room to grow in. The fish breeds freely in the ponds so once stocked, the ponds need never be supplied with fish again.

MARKETING

The fish is sold alive on the premises and includes Tilapia of all sizes. Members of the local population bring along buckets and plastic bags, fill them with fish and have them weighed.

This marketing method is very successful in a Third World

environment where no electricity is available for refrigerating or deep freezing products.

This method of fish farming is possible because the local people eat all sizes of fish unlike Westerners who prefer large portions of fish fillets for example. The Shangaan people cook the smaller fish in a sauce with tomatoes and onions as a protein rich gravy over their porridge or fry the fish in oil with lots of salt until they have a chiplike texture.

WATER

The water for the ponds comes from different sources.

At Mnisi water is pumped from a nearby dam using a solar pump. At Jongilanga a syphon system is used to bring water from a nearby dam which is above the farm and the farm at Mhinga is dependant on water from a borehole. At Siyandhani water



comes from a canal that runs between the Middle Letaba and the Hudson Ntsanwisi dam. The ponds are situated below the canal making it possible for the water to reach the ponds without using a pump for this purpose.

The dams are self cleaning as all the nutrients are taken up by the fish. Top up water is needed only to compensate for evaporation, as the soil contains a lot of clay which limits seepage.

FOOD SOURCE

The Tilapia in the pond do not eat the manure which falls into the water as it does not contain any energy. The manure provides nutrients for the food chain in the pond.

Two different food chains exist in the pond providing the needs of the fish:

The photosynthetic cycle

Phytoplankton absorbs the nutrients that are dissolved in the water and which come from the chicken manure. Using the energy of the sun, the nitrates and phosphates and other nutrients in the water are converted into the carbohydrates and proteins of the algal cells.

The fish eat the photoplankton cells, trapping the algae in their mucus and then swallowing it. The ability of the Tilapia Mosambicus, used in Gazankulu, to feed on the bottom of the food chain as well as higher up, makes it ideal for use in this way.

The detritus cycle

When the chickens in the cages are still small, their feet could go through the gaps between poles which form the cage floor.

To prevent them injuring themselves, a layer of grass is put down initially. As the chickens grow, the grass falls through the bars little by little and into the pond until there is nothing left. The chickens are large enough by that time to move safely in the cage.

The grass falling into the pond consists mainly of cellulose and the bacteria in the water use the energy from the cellulose molecules to take nutrients and build them into food.

The fish can then digest the protein rich bacteria, returning what remains of the grass particle back into the water with added nutrients from the gut of the fish, which is again colonized by bacteria. This is a very similar process to that which occurs in a cow's rumen and indeed some scientists refer to a fish pond as a "sunlit rumen".

AGRICULTURE

The remaining area around the ponds, is used for

- Cultivating fruit trees such as mango's, avocado's litchies and paw-paws;

- A vegetable garden containing maize, spinach, potatoes and other vegetables which are sold to the local people;

- Each labourer on the fish farm is allotted a vegetable patch which can be cultivated for an hour each day and the vegetables are for their personal use. Compost and water for these little gardens are supplied by the Government.

The main aim of these fish farms is to educate the people into providing food for themselves in a way that is suited to Third World



Die mobiele besproeiingsevalueerseenheid in aksie.

Die aankoop van 'n doeltreffende besproeiingstelsel het al vir menige boer hoofbrekens besorg. Besproeiingsboere kan egter nou gebruik maak van die professionele diens wat die Direkoraat Besproeiingsingenieurswese van die Hoofdirekoraat Landbou-ingenieurswese en Watervoorsiening by die Departement Landbou en Watervoorsiening, bied.

Nuttige navorsing bevorder besproeiing

Die Direkoraat Besproeiingsingenieurswese bestaan uit die volgende subdirekorate:

□ Besproeiingsingenieurswese-navorsing wat navorsing, ontwikkeling, beplanning en tegnologie-oordrag aan firmas, streekskantore en boere in verband met besproeiingstoerusting en stelsels hanteer;

□ Besproeiingsrade wat die stigting van besproeiingsrade hanteer en skakel met raadgewende ingenieurs in verband met die ontwerp van besproeiingstelsels vir besproeiingsrade; en

□ Streeksdienste wat

- ontwerpe van besproeiingstelsels kontroleer vir subsidieoelendes;

- behulpsaam is met die stigting van besproeiingsrade en skakeling met raadgewende ingenieurs wat ontwerpe vir boere en besproeiingsrade onderneem en

- die ontwerp van werke vir besproeiingsrade wat om lenings aansoek doen, kontroleer

"Tans gebruik die besproeiingssektor nagenoeg 70 tot 75 persent van die totale beskikbare water in die Republiek," sê mnr Felix Reinders, waarnemende adjunk-hoofingenieur by Besproeiingsnavorsing.

Volgens mnr Reinders moet besproeiingspraktyke en -tegnieke gedurig aangepas en verbeter word deur evaluering en navorsing. Verder is die praktiese implementering van hierdie resultate nodig sodat 'n goed

ontwerpte en aangepaste ontwerp daargestel kan word om sodoende die verlangde besproeiingstandaard te handhaaf.

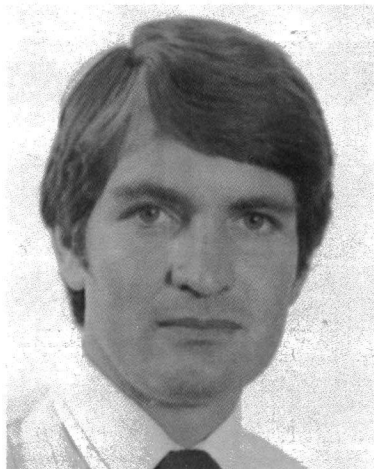
By die Direkoraat se hoofkantoor in Silverton word besproeiingstoerusting in 'n goed toegeruste laboratorium geëvalueer. Gesofistikeerde elektroniese meetinstrumente met 'n hoë akkuraatheid en betroubaarheid word gebruik om die metings te doen. Sommige van die evalueringe word dan ook met behulp van rekenaars, ten volle outomaties, gedoen. Hierdie

evalueringsmetode stel die navorsingspan in staat om 24 uur per dag evalueringe uit te voer. Die evaluering van sprinkelaars, druppers, mikrospruite, filters en hidrouliese kleppe word op 'n deurlopende basis uitgevoer. Werkverrigtingsverslae word dan hieruit voorberei en tegniese data kan verskaf word aan ontwerpers en firmas sodat die regte aanwending van toerusting kan geskied.

Die Direkoraat beskik verder ook oor 'n mobiele besproeiingsevalueringseenheid wat volledig toegerus is met die nodige meetapparaat. Die ingenieurs kan dus, deur hiervan gebruik te maak, enige besproeiingstelsel besoek en kan vanaf die waterbron tot by die laaste toediener meet hoe doeltreffend die water aangewend word. Dit is 'n hulpmiddel om water, energie en geld vir die boer te bespaar. Behalwe werkverrigtingstoetse, probleemondersoeke en statistieke hiervan word hierdie evalueringseenheid as 'n opleidings- en bewusmakingsprogram vir ontwerpers, firmas en boere gebruik.

Boere studiegroepe is ook 'n effektiewe medium vir die uitruil van inligting en die navorsingspan kan deur so 'n groep genooi word om 'n boer se stelsel te ondersoek en aanpassings voor te stel. In die verskillende landboustreke is die streeksingenieur die aangewese persoon om kontak met besproeiingsboere te bewerkstellig. Behalwe die professionele ingenieursdienste wat hulle lewer, word probleme so geïdentifiseer en terugverwys na die navorsingspan by hoofkantoor wat die probleme dan ondersoek.

So byvoorbeeld het die ingenieurs van die Direkoraat 'n draagbare infiltrasiemeter nagevors en ontwikkel. Afloop van water het voorgekom onder spilpunte met gevolglike grondverspoeling en vermorsing van water. Om dit te verhoed word die infiltra-



Mnr Felix Reinders, waarnemende adjunk-hoofingenieur by besproeiingsnavorsing.



Links: 'n Infiltrasiemeter meet die grond se infiltrasievermoë en die spilpuntontwerp word daarby aangepas

siemeter nou gebruik om vas te stel wat die grond se infiltrasievermoë is en die spilpuntontwerp kan hierby aangepas word.

'n Boer wat voornemens is om 'n besproeiingstelsel aan te koop, kan die landbou-ingenieurs raadpleeg wat sy behoeftes sal bepaal en hom dan kan adviseer. Die boer moet dan gebruik maak van die dienste van 'n private ontwerper waarna die ontwerp weer voorgelê kan word aan die streeksingenieur wat dit tegnies en landboukundig kontroleer vir subsidiedoeleindes.

Navorsingsresultate wat by die laboratorium te Silverton behaal word, word opgeneem in lesings by die verskillende Landbou-kolleges in die land sodat voornemende boere kennis neem van doeltreffende toerusting en ontwerpe.

Verskeie publikasies word beskikbaar gestel aan boere en ontwerpers in die besproeiingsbedryf wat insluit 'n tegniese bulletin, werkverrigtingsverslae, handleidings, asook die Landbou-ingenieurswese en Watervoorsiening se blaadjie "Agring".

Besproeiingsingenieurswese maak ook insette en bydraes by die Suid-Afrikaanse Besproeiingsinstituut (SABI) om kennis oor te dra. SABI se lede bestaan onder meer uit beplanners, ontwerpers en verkopers van besproeiingstoerusting en die vereniging se doelwitte is: beter aanwending van water, doeltreffende stelselontwerp en goeie interaksie tussen die verskillende partye binne die besproeiingsgemeenskap.

Die besproeiingsingenieurswese navorsingsgroep by Silverton bestaan uit landbou-, siviele- en elektroniese ingenieurs asook tegnici. Projekte wat hierdie jaar aandag sal geniet, is onder meer:

Evaluering van sprinkelaars, druppers, filters, mikrospruite en hidrouliese krane;

Die ontwikkeling van 'n rekenaarprogram vir die tegniese evaluering van besproeiingsontwerpe volgens vasgestelde norme;

'n Onderzoek na pulsbesproeiing onder Suid-Afrikaanse toestande;

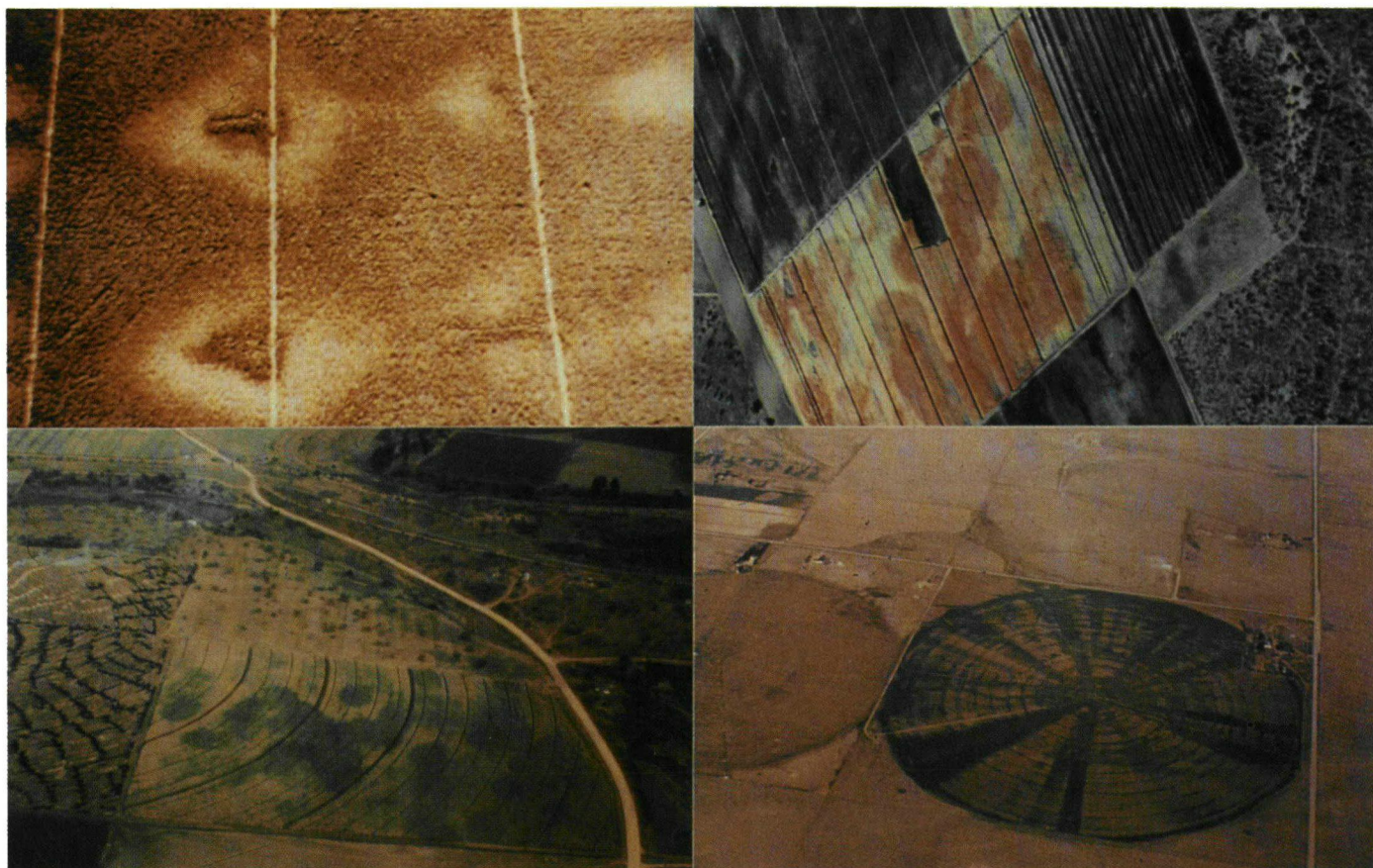
Drupbesproeiing van kontantgewasse;

'n Onderzoek na en gebruik van besproeiingsrekenaars vir die beheer en bedryf van besproeiingstelsels;

'n Onderzoek en evalueringsprogram van kruipspuite waar funksionele werkverrigting gemeet en geëvalueer sal word, sodat 'n vergelykende oorsig van tegniese spesifikasies opgestel kan word.

Volgens mnr Reinders is daar ook 'n groot behoefte by firmas en boere om kennis te dra van watter diens die verskillende verskaffers lewer. Hiervoor is 'n adreslys van alle firmas met hulle aktiwiteite op rekenaar geplaas en saamgevat in 'n publikasie "Irrinfo". Die eerste uitgawe is met groot belangstelling in Aprilmaand ontvang en opdatering sal op 'n gereelde basis geskied. So kan 'n boer byvoorbeeld 'n volledige lys van spilpunt-verskaffers naslaan.

Mnr Reinders is baie positief ten opsigte van die rol wat besproeiingsingenieurs-wese navorsing in die landbou speel en sê: "Om ingelig te wees en kennis toepas, beteken vooruitgang en deur navorsing en opleiding word mense juis ingelig om ons skaars hulpbron, water, doelgerig en effektief aan te wend."



Hierdie lugfoto toon duidelik die resultaat van oneweredige waterverspreiding as gevolg van 'n foutiewe besproeiingstelsel

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Insert to *SA Waterbulletin* June/July 1988.

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Climate is a critical factor in determining the variety and abundance of vegetation and animal life in a region, and imposes limits on the range of agricultural and other economic activities. It is therefore not surprising that various aspects of climate such as precipitation, temperature, solar radiation, humidity, wind speed and many others are recorded regularly throughout the world.

The purpose of taking these measurements is to extend our knowledge about the behaviour patterns of climate and thereby, among other things, to determine which activities are feasible and how these can effectively be carried out. Statistical models provide an efficient means of synthesising the information contained in large sets of data such as climate records. They are capable of describing both the systematic patterns in climate and the nature of random variations from these patterns.

There is an extensive literature on the modelling of daily rainfall sequences, but apart from Richardson (1981), very little work has been reported on models for daily climate sequences, that is models which simultaneously describe several components of climate.

In order to address this issue a research project has been initiated under the sponsorship of the Water Research Commission. The main objective of the project is to develop a stochastic daily climate model for South African conditions. The variables to be included in the model are rainfall, maximum and minimum temperature, humidity, evaporation, wind speed and solar radiation.

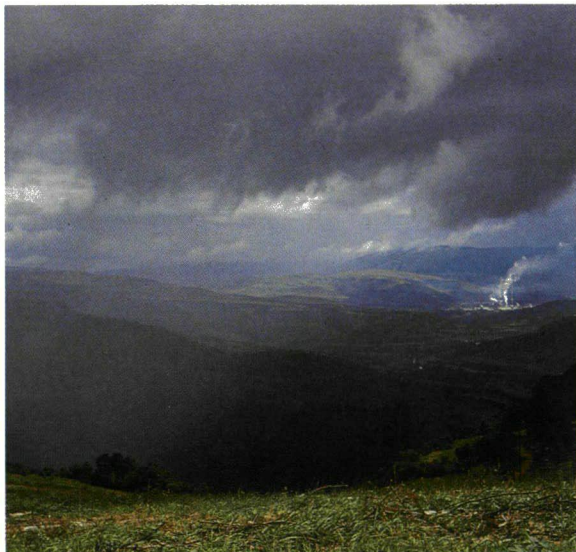
The model should provide a concise description of the patterns that exist in the different components of climate. The parameters of the model should be estimable from relatively short historical records. In addition the model should be capable of conveniently generating artificial climate sequences which preserve the typical patterns and variability of real daily climate sequences, that is the artificial sequences should be essentially indistinguishable from the real sequences.

Among other things, artificial climate sequences are useful as "inputs" to crop growth models which can then be used to determine the distribution of yield, the probability of crop failure due to adverse climate, optimal planting dates and so on. For such purposes artificial climate sequences generated by a good stochastic model are more often useful than the original historical record. Firstly they are free of the typical imperfections which are especially prevalent in historical

climate records, for example incorrect recordings and missing observations. Secondly, the historical records available in South Africa are mostly quite short and therefore only reflect a small fraction of the different climate sequences which could occur.

The development of a daily climate model for South Africa

by Walter Zucchini and Anabela Brandao, Department of Mathematical Statistics, University of Cape Town



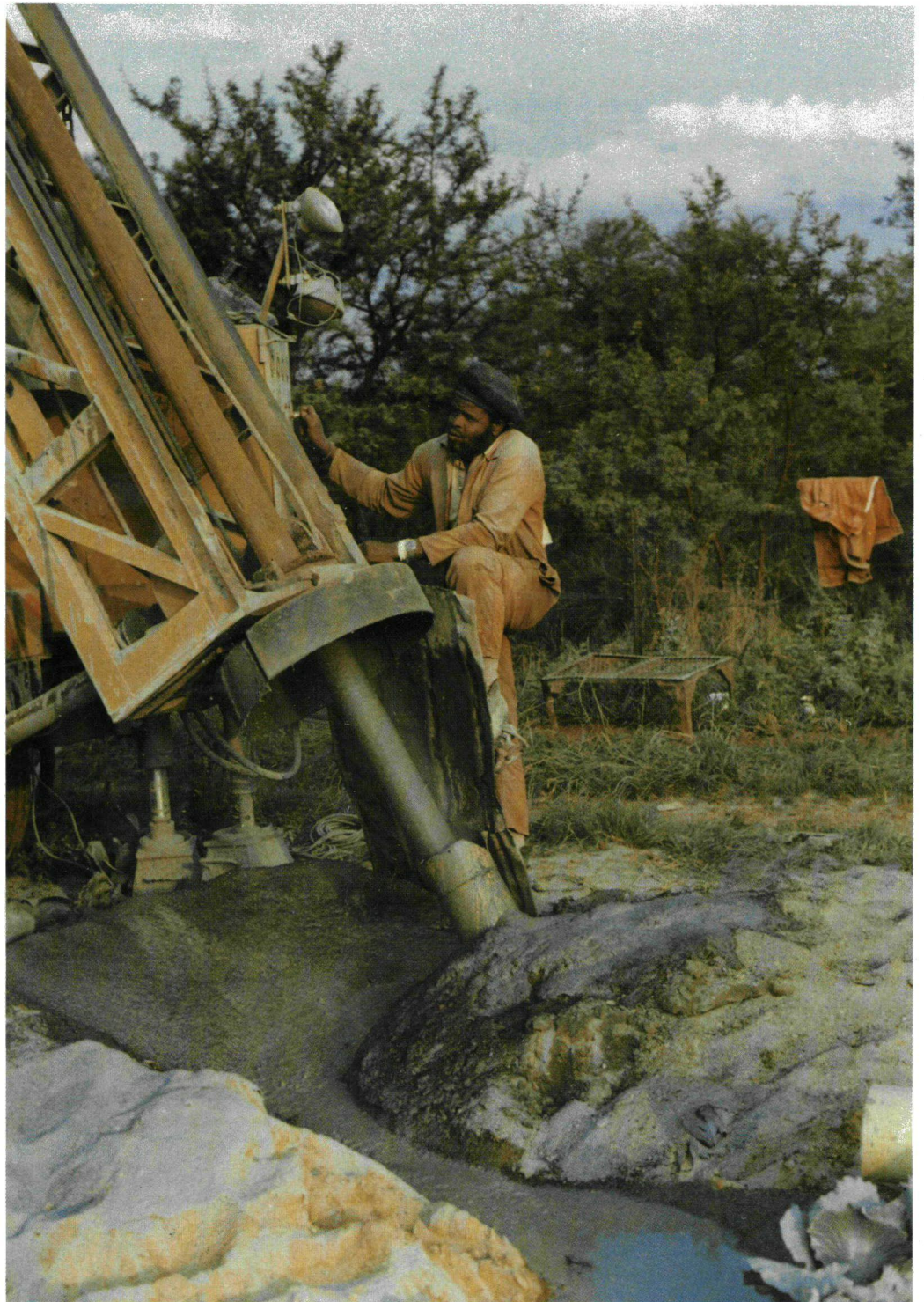
It is sometimes argued that artificial sequences generated by a stochastic model constitute no more than complicated extrapolations of the historical record. However a model contains more than the information that can be extracted from a single historical record. It contains our knowledge (in the form of model assumptions) about the behaviour of climate derived from theory and from observations at other locations. For example, it is reasonable to assume that certain average properties of climate variables vary smoothly with time. Such assumptions give the model a structure which may not be evident in a single short historical record.

The details relating to the construction of a daily climate model are lengthy and technical, and so we will not even attempt to describe these here. Instead we will discuss some of the properties of climate sequences which the model is required to mimic.

Firstly, the individual climate variables exhibit seasonal fluctuations which, on average, are approximately shaped like sine curves. This suggests that the mean function of each variable can be parsimoniously modelled by means of a truncated Fourier expansion of the true (but unknown) mean function. Secondly the individual variables are serially correlated, for example the temperature today is (stochastically) related to the temperature yesterday. Thus the observations on each variable

constitute a time series and have to be modelled as such. Thirdly the different variables are cross-correlated, for example, the humidity is high on rainy days. Thus the variables cannot be modelled separately, they must be modelled jointly. In statistical terminology we are modelling a multivariate time series. Finally, since practically all historical records have some observations missing, the parameter estimation procedures must be capable of dealing with missing values. As the variables are both serially- and cross-correlated this last requirement leads to quite difficult technical problems.

The project has been in progress since January 1987 and is due to be completed by the end of 1989. So far we have investigated three models. One of these has been developed in sufficient detail to demonstrate that it is possible to construct a daily climate model suitable for South African conditions.



Whilst inclined percussion and diamond core drilling are accepted techniques for the exploration of steeply inclined ore bodies, inclined boreholes are rarely used in the exploration and development of aquifers associated with subvertical faults and fracture zones.

The exploration of very limited groundwater occurrences at

Inclined percussion drilling for groundwater exploration and development

by HP Formanek, Seismic Survey (Pty) Ltd* and PL Bezuidenhout, Zandrivier Besproeiing**

* Seismic Survey (Pty) Ltd, P O Box 2760, Randburg 2125, Tel (011) 787-6047

** Zandrivier Besproeiing, P O Box 3151, Pietersburg 0700, Tel (01521) 89222

Eersteling Gold Mine, located near Pietersburg, Northern Transvaal, demonstrated the well-known difficulty of locating narrow, steeply inclined water-bearing fissures by means of vertical boreholes. Boreholes inclined at -60° proved to be successful in intersecting multiple fracture zones of substantial yield.

Few problems were encountered in the drilling of inclined percussion boreholes provided some standard precautions were adhered to.

Several inclined boreholes were developed with perforated casing and equipped with submersible and shaft-driven pumps.

These pumps have operated for extended periods successfully.

In the case of Eersteling Gold Mine and other groundwater development projects, inclined water drilling produced a substantially higher rate of successful boreholes than vertical percussion drilling. A comparison of the total cost of exploration, drilling and installation of vertical versus inclined water wells indicated that inclined water drilling may reduce the total development cost by 30 per cent to 50 per cent in some situations.

The Eersteling project demonstrated clearly that inclined percussion drilling should be used to far greater extent than is presently the case, for the exploration of aquifers associated with narrow subvertical faults or dolerite dykes.

A large number of unconfined aquifers occur in a geological environment similar to that of certain hydrothermal mineral deposits associated with vertical or subvertical faults or fracture zones, along lithological contacts or with some dolerite dykes.

The target areas are frequently narrow shear zones with particular fractured lithologies. They are difficult to locate as testified by the large number of dry boreholes drilled every year throughout southern Africa.

In mineral exploration, "deposits" of this nature are invariably explored by means of inclined percussion or core drilling so as to improve the odds of intersecting one or multiple ore bodies and to obtain representative samples.

Similar considerations should apply to the exploration of aquifers associated with subvertical structural features or lithologies. Yet the total number of inclined water boreholes is unlikely to exceed a few dozen or fewer than 0,1 per cent of water boreholes drilled annually.

THE EERSTELING CASE HISTORY

The Eersteling Gold Mine is located between Pietersburg and Potgietersrus. The area is underlain mostly by dense and impermeable amphibolites and serpentinites with zero groundwater storativity.

Very limited groundwater resources occur within open tension fractures and shear zones with gold-bearing quartz/carbonate mineralization. The prime target for groundwater exploration presented a major north/south trending fault zone infilled by a Karoo dolerite dyke.

Geophysical investigations, comprising magnetic and seismic refraction profiling, followed by resistivity depth soundings, confirmed the shallow degree of weathering and dense character of the geological formations.

Three vertical boreholes of 165 mm diameter were drilled as shown in Figure 1. Of these boreholes, two were considered successful with a blowout yield of approximately 10 m³ and 5 m³ respectively. Yield testing showed no drawdown of the adjoining borehole even though lo-

cated only 12,5 m from each other. This confirmed the isolated nature of the water-bearing fracture zones.

At this point several boreholes were drilled inclined at -60° towards the fault zone and the Karoo dyke. Two of the three inclined boreholes intersected multiple fracture zones varying in width from 0,5 m to 2,0 m. Each of these fracture zones contributed to the borehole yield exceeding the combined yield of the vertical boreholes.

Encouraged by this successful experiment, all subsequent boreholes were drilled inclined at Eersteling Gold Mine.

INCLINED PERCUSSION DRILLING

The inclined drilling was carried out with a standard Rockgiant airdrill with an 18 bar compressor.

In the over 20 inclined percussion boreholes drilled or supervised by the authors, no serious drilling problems were encountered provided some basic procedures were adhered to.

Deviation from borehole alignment is likely to occur at the base of weathering. Furthermore, caving of the unconsolidated overburden may arise when water is intersected. It is, therefore, advisable to insert steel casing of suitable wall thickness when solid bedrock is reached.

Drilling will generally proceed normally in hard formations at little decrease in the penetration rate until the intersection of a fracture zone. The possibility of loose rock fragments lodging behind the hammer must be guarded against when major cavities or open fracture zones are encountered. Attention to detail and proper drilling techniques will generally avoid blockage of the equipment.

The cost of inclined 165 mm percussion drilling will generally not exceed the cost of vertical drilling by more than 20 per cent to 25 per cent.

BOREHOLE DEVELOPMENT AND PUMP INSTALLATION

At the Eersteling Gold Mine, four inclined boreholes were equipped with perforated PVC casing with 140 mm ID.

Matra submersible pumps, Model DX 15-23, with 7,5 HP motors were installed in two boreholes. These pumps delivered initially 17 m³ water per hour.

Two other inclined boreholes were equipped with Mono pumps, Model BP 16 M with a 65 mm pipe string and 19 mm drive shaft. The pumps were operated with 6 kw Lister Engine and electric motor respectively delivering 8,5 m³ water at peak.

The submersible and shaft-driven pumps have performed without breakdown and with minimal maintenance for 24 hour duty periods for several months although borehole yields have decreased considerably since commencement of water abstraction.

COST COMPARISON OF VERTICAL AND INCLINED PRODUCTION BOREHOLES AT EERSTELING GOLD MINE

The situation of Figure 1 at Eersteling is taken as a cost model. Actual costs will vary depending on the amount and cost of drilling conducted and the type of pump installation and power supply.

Vertical Boreholes

Three boreholes with a total of 180 m of drilling resulting in two production boreholes with nominal yields of 8,5 m³ and 4,5 m³ per hour.

Vertical boreholes

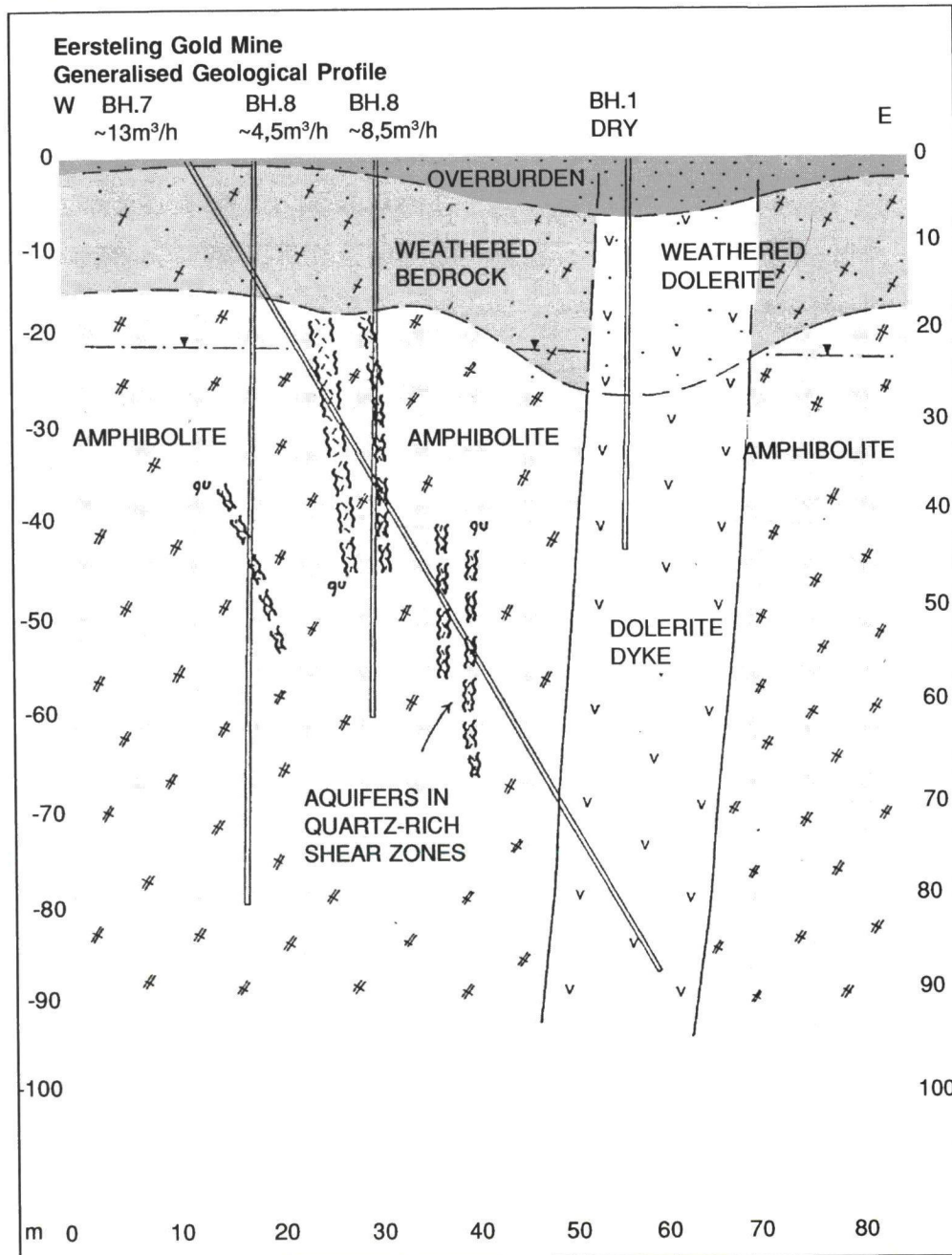
Drilling costs:	180 m @ R25,00	R 4 500
Casing to bedrock:	30 m @ R28,00	840
Installation of 2 pumps and motors, inclusive, delivering a total of 13 m ³ per hour		11 000
Total provisional cost:		<u>R16 340</u>

Inclined Borehole

One borehole drilled to depth of 100 m, fully cased to 80 m, delivering a nominal yield of 13 m³ per hour.

Inclined boreholes

Drilling costs:	100 m	@ R30,00	R 3 000
Casing to bedrock:	30 m	@ R28,00	840
Perforated casing to	80 m depth	@ R26,00/m	2 080
Installation of submersible pump plus motor			6 730
Total provisional cost			R12 650



CONCLUSIONS

Our experience at the Eersteling Gold Mine and at other groundwater exploration projects demonstrated the merit of inclined percussion drilling in situations where groundwater occurs within narrow, steeply inclined fissures and fracture zones. The cost advantages of this drilling technique are pronounced in areas with scarce groundwater resources. Inclined percussion drilling will frequently make the difference between an unsuccessful borehole and a producing well.

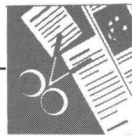
Few difficulties have been experienced in the drilling of inclined water wells provided that good drilling techniques and certain precautions are adhered to.

Submersible and even shaft-driven borehole pumps have performed well for extended durations in boreholes adequately constructed.

The cost comparison between fully equipped inclined and vertical boreholes demonstrates that inclined water well drilling has the potential of reducing the very high cost of groundwater exploration and development quite significantly in many areas with scarce water resources.

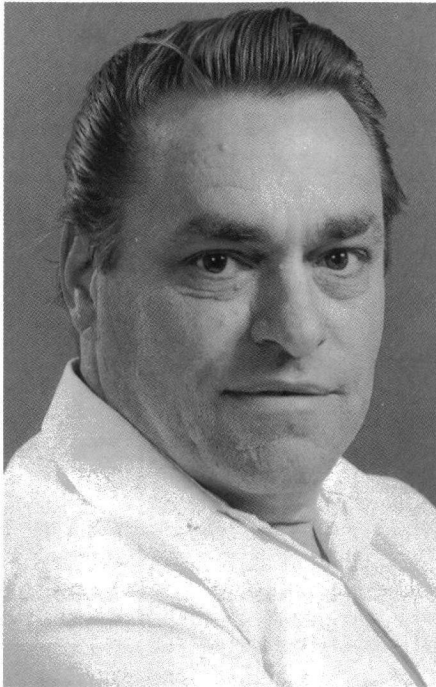
ACKNOWLEDGEMENT

Thanks should go to Eric Smith, Mine Manager, and to Charles Byron, Chief Geologist of Eersteling Gold Mine for supporting an approach to groundwater exploration that comes naturally to exploration people; to Phil Bezuidenhout acknowledgment for persisting with inclined water drilling in the face of reluctance by many clients; recognition must go to Peter Mony, Waterways, for the successful installation of submersible pumps; and finally an award should go to John Minter, pump installer at Pietersburg for the demonstration that Mono pumps also work in inclined water boreholes.



WATER SCIENTIST WINS AWARD

Dr Ron van Steenderen, senior scientist attached to the Division of Water Technology, CSIR, received a prestigious Industrial Award at the National Inventiveness Award Ceremony held at the Transvaal Automobile Club, Johannesburg.



The occasion was sponsored by the First National Industrial Bank, LTA Industrial Building Systems Ltd and Middleburg Steel and Alloys.

The award was for the development of a Dissolved Organic Carbon Analyser used in the assessment of water quality control and in various industrial applications. The instrument is especially used to monitor the absorptive capacity of organic material onto granular activated carbon (GAC), a material used as a process in drinking water reclamation and in the mining industry for the recovery of gold from 'spent' mine dumps. The instrument has until now allowed at least one industry to make substantial savings on its effluent discharge bill by being able to exercise more adequate internal domestic control.

A marketable DOC analyser named the RF12 dissolved organic carbon analyser will, be marketed overseas. One of these promotions will be launched at the 14th IAWPRC Biennial Conference in Brighton, England in July 1988.

Dr van Steenderen obtained his D.Sc. degree in 1980 at the University of Pretoria through part-time studies on a topic very much associated with innovation and inventiveness i.e. Automated Procedures for determining dissolved organic carbon and halogenated organic compound concentrations in surface waters.

Thea Lap DWT (CSIR)

COUSENS RESIGNS

Mr Dave Cousens, previously Senior Adviser to the Water Research Commission, took up the post of Agricultural Services Manager at the Noodsberg Company of CG Smith Sugar Ltd near Pietermaritzburg on 1 June 1988.



Mr Cousens joined the WRC in 1981 as Adviser and was responsible for research in the field of Surface Hydrology.

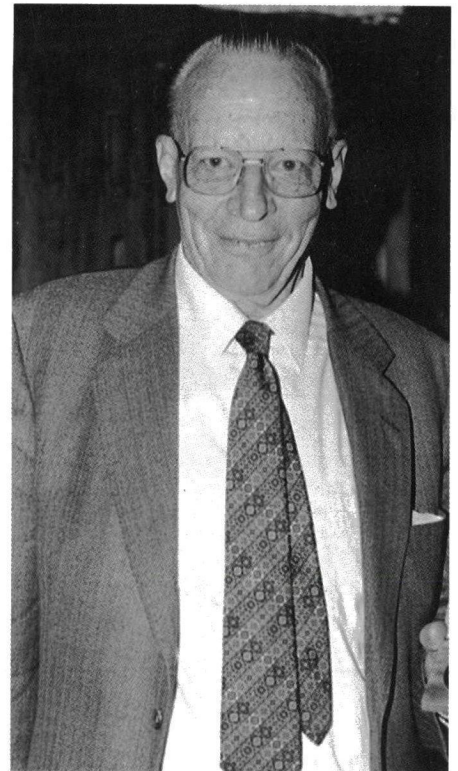
His main achievements at the WRC were inter alia the establishment of the Computing Centre for Water Research based at the University of Natal, the development of a master plan for hydrological research in South Africa and the progress made on modelling, flood studies as well as the organisation of the country's hydrological data into a comprehensive Hydrological Information System together with the Department of Water Affairs.

Mr Cousens also recently completed the MBL degree through UNISA.

VEGTER RECEIVES MEDAL

Mr JR Vegter, Director: Geohydrology at the Department of Water Affairs, recently became the first recipient of the Groundwater Division of the Geological Society of South Africa's (GSSA) new Groundwater Medal.

The medal was presented to Mr Vegter at a ceremony in Johannesburg for his contribution towards the science of groundwater in South Africa.

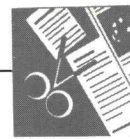


This medal was specially struck and will be presented periodically to groundwater practitioners of particular merit. Mr Vegter was also awarded honorary life membership of the Groundwater Division of the GSSA.

Professor B Th Verhagen who presented the medal said in his speech that it was hardly surprising that Mr Vegter was unanimously and immediately chosen as the first recipient of the award.

"Mr Vegter has become a household name in the field of groundwater in South Africa. He has established for himself a leadership role and scientific reputation both nationally and internationally, and it will be generally agreed that his most abiding attribute can be summed up in one word: SERVICE," Professor Verhagen said.

Erna Snyman: Water

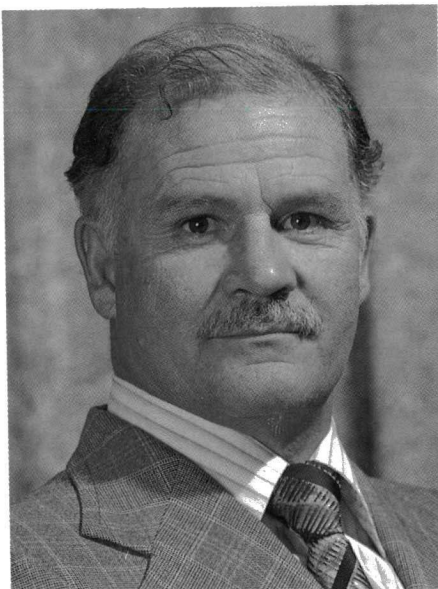


BARNARD ONTVANG INTERNASIONALE TOEKENNING

Dr James L Barnard van die firma Meiring en Vennote in Pretoria is genomineer as die eerste ontvanger van die IAWPRC se Karl Imhoff-Pierre Koch-medalje. Die toekenning word aan dr Barnard gemaak vir sy internasionale, praktiese bydrae op die gebied van watergehaltebeheer. Die medalje sal tydens die tweejaarlikse kongres van die IAWPRC in Brighton,

DR IMMELMAN VEREER

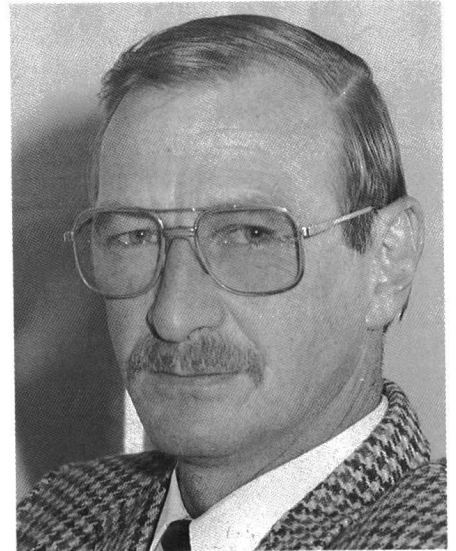
Dr DW Immelman, lid van die Watervorsingskommissie, aan wie onlangs twee belangrike eerbewyse toegeken is, naamlik, die Misstofvereniging van Suid-Afrika se goue medalje vir buitengewone diens aan die landbou en die erelidmaatskap van die Suid-Afrikaanse Instituut vir Landbouvoorsorging.



HONOUR FOR SA SCIENTIST

Dr Gerrie Stander, often referred to as the Father of Water Research in South Africa, added another award to his career at the end of last year. The World Cultural Council, Mexico, awarded him its diploma for his numerous scientific achievements. The award is coupled to the annual Albert Einstein World Award of Science. Dr Stander was the first director of the Council for Scientific and Industrial Research's National Institute for Water Research and later Chief executive officer and chairman of the Water Research Commission. He was also president of the International Association on Water Pollution Research and Control for eight consecutive years.

SA Digest



University of the Orange Free State.

Dr Reid previously worked in the Department of Water Affairs where he was concerned with hydrology and research on all aspects relating to irrigation project water use efficiency, concentrating on avoidable and unavoidable losses from canal systems.

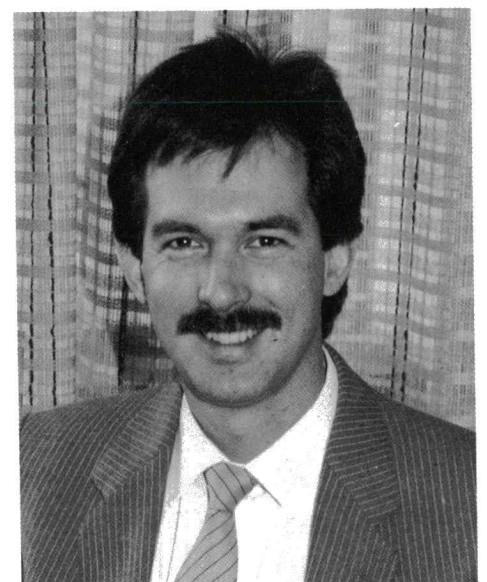
Mr Anthony Reynders was born in Queenstown on 31 July 1959. He matriculated in 1977 from Queen's College in Queenstown after which he obtained a B.Sc. and a B.Sc (Hons) from Rhodes University. In 1984 he also obtained his M.Sc from Rhodes with his thesis entitled: An investigation of the groundwater seepage and irrigation return flow of the Middleton area of the Great Fish River.

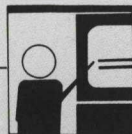
Mr Reynders joined the Directorate Geohydrology of the Department of Water Affairs in 1982 where he worked on coastal sand aquifers of the Eastern Cape and the dolomitic aquifers South of Johannesburg.

NEW FACES AT WRC

The Water Research Commission has announced the appointment of two new scientific managers. They are Dr PCM Reid, Research Manager, responsible for irrigation research projects and Mr A Reynders, Assistant Research Manager, responsible for groundwater research.

Dr Peter Reid was born in Pretoria on 3 March 1946. He matriculated in 1963 from Pretoria Boys High School after which he obtained a B.Sc. from Pretoria University. In 1976 he also obtained his M.Sc (Agric) (Meteorology) from the University of Natal and in 1981 his Ph.D. from the





NAVORSING

'n Konferensie getiteld Mense vir navorsing en ontwikkeling 1988, sal op 23 en 24 Augustus 1988 by die WNNR in Pretoria aangebied word.

Navrae: Die Konferensiekoördineerders, S.446 (aandag: mev Meyer), Posbus 395, Pretoria 0001. Tel: (012) 841-4412.

ARTIFICIAL RECHARGE

The American society of Civil Engineers is planning an International Symposium on Artificial Recharge of Ground Water from 23 to 27 August 1988 in Anaheim, California.

Enquiries: Ivan Johnson, 7474 Upham Court, Arvada, CO 80003.

MARINE POLLUTION

A marine pollution Symposium will be held at the Muizenberg Pavilion, Muizenberg, Cape Town, on 8 September 1988. Topics will include: Marine pollution research in South Africa, Discharges to the marine environment, Treatment of sewage for sea disposal, environmental effects of discharges, Pathogenic organisms, health effects and epidemiology as well as oil pollution.

Enquiries: Miss Hannekie Botha, FRD, P O Box 395, Pretoria 0001. Tel: (012) 841-3726 or Mrs Lesley Shackleton, New Botany Building, University of Cape Town, Rondebosch, Cape Town. Tel: (021) 686-4663.

GROUNDWATER

An expert meeting on new developments in groundwater modelling will be held from 14 to 16 September 1988 in Delft, the Netherlands.

Enquiries: International Institute for Hydraulic and Environmental Engineering, Oude Delft 95, P O Box 3015, 2601 DA Delft, The Netherlands.

SEWAGE SLUDGE

A conference on sewage sludge treatment and use will be held in Amsterdam, the Netherlands, from 19 to 23 September 1988.

Enquiries: Industrial Presentations (Europe) BV, Europaplein 8, 1087 GZ Amsterdam, Netherlands.

IWEM

The Institution of Water and Environmental Management (IWEM) will hold its '88 conference and exhibition with the theme maintaining a balance in water and environmental management in Eastbourne, UK, from 27 to 29 September 1988.

Enquiries: IWEM, 15 John Street, London WC 1 2EB, England.

OZONE

A conference on ozone in water quality management will be held in London, UK, from 18 to 20 October 1988.

Enquiries: Professor R Perry, Public Health and Water Resource Engineering, Department of Civil Engineering, Imperial College, London SW 7 2 BU.

MICRO-IRRIGATION

The fourth international micro-irrigation congress will be held in Albury-Wodonga, Australia, from 23 to 28 October 1988.

Enquiries: Congress Secretariat, P O Box 29, Parkville, Victoria 3052, Australia.

WATER MODELLING

A conference on water modelling and measurement will be held in Harrogate, UK, from 7 to 9 November 1988.

Enquiries: Dorothy Thompson/Lynne Staples, BHRA, Fluid Engineering Centre, Cranfield, Bedford, MK 43 OAJ, UK.

DAMONTWERP

'n Kursus getiteld Damontwerp '88 word vanaf 7 tot 10 November 1988 deur die Departement Siviele Ingenieurswese aan die Universiteit van Pretoria aangebied. Die klem sal hoofsaaklik op die nie-hidrologiese aspekte van damontwerp vir kleiner damme val.

Navrae: Prof A Rooseboom, Departement Siviele Ingenieurswese, Universiteit van Pretoria, Pretoria 0002. Sluitingsdatum 30 September 1988.

HYDROLOGY

A conference on the advances in groundwater hydrology will be held in Tampa, Florida, USA from 16 to 18 November 1988.

Enquiries: AH 3416 University Ave SE, Ste 200, Minneapolis, MN 55414, USA.

SAND FILTRATION

A conference on the advances in slow sand filtration will be held in London, UK, from 23 to 24 November 1988.

Enquiries: Dr N Graham, Public Health & Water Resource Engineering, Department of Civil Engineering, Imperial College, London SW7 2BU.

POLMET 88

An international conference on pollution in the metropolitan and urban environment will be held in Hong Kong from 28 November to 2 December 1988. Papers are invited for the technical sessions which will include: Environmental management practice, Industry and environment, Air Quality management.

Enquiries: Polmet 88 Secretariat, c/o Hong Kong Institution of Engineers, 9/F Island Centre, No 1 Great George Street, Causeway Bay, Hong Kong.

WATER POLLUTION

The thirtieth Convention of the SA Chemical Institute will be held on 15 to 20 January 1989 at the Johannesburg Sun. The Convention will accommodate a number of themes including "Environmental Protection" which will incorporate Water Pollution.

Enquiries: Prof J Boeyens, University of the Witwatersrand, Department of Chemistry. Tel: (011) 716-2076.

MEMBRANES

An international technical conference on membrane separation processes will be held in Brighton, England, from 24 to 26 May 1989.

Enquiries: Lorraine Grove, Conference Organiser, Membrane Separation, BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK 43 OA, UK.

RIVER BASINS

The 5th river basin management conference will be held in Rovaniemi, Finland, from 31 July to 4 August 1989.

Enquiries: The Secretary, Ms Anja Holmsten, P O Box 250, SF-00101 Helsinki, Finland.

TECHNOLOGY TRANSFER SYMPOSIUM: ADVANCES IN BIOLOGICAL PHOSPHORUS REMOVAL BY THE ACTIVATED SLUDGE PROCESS

27 October 1988

Recent findings of WRC funded research at Johannesburg and the University of Cape Town

ORGANIZERS AND OBJECTIVES

In August 1983 the Water Research Commission entered into an agreement with the City Council of Johannesburg to study the enhancement of biological phosphate removal from sewage by altering process feed composition. During a three year period the Council undertook a number of plant scale investigations, as well as fundamental studies to unlock the secrets of biological phosphorus removal that have eluded researchers for so long.

Results of this research were reported at a Technology Transfer Symposium held in Johannesburg on 30 October 1986.

During this research a number of problems were identified, which have been investigated during 1987 and 1988. These include elutriation of volatile fatty acids and denitrification of return sludge.

At the same time the University of Cape Town, amongst others, has been engaged in research into other aspects of biological phosphate removal. Both parties have made positive contributions to the understanding and application of biological phosphate removal, during the past two years.

To ensure technology transfer, the Water Research Commission in collaboration with the City Council of Johannesburg and the University of Cape Town has organized this symposium to present and discuss the results obtained during the contract period. The symposium is intended to serve as a discussion forum for all who are interested in biological removal of phosphorus from wastewater.

A number of papers will be presented and ample time will be provided for discussion. Certain aspects will be expanded on in a poster display.

VENUE

Indaba Hotel and Conference Center
Sandton, Johannesburg, 27 October
1988.

DOCUMENTATION

A complete set of papers to be presented will be provided for each delegate.

REGISTRATION FEE

Registration fee R60,00
(Includes luncheon, tea and all documentation).

A late registration fee of R10,00 will be levied on all registrations received after 10 September 1988.

Cheques should be made payable to:
City Treasurer.

As the venue will only accommodate 200 people it is advisable to register early to avoid disappointment.

REGISTRATION CARD

Please complete and return the registration card in this Bulletin together with your payment by 10 September 1988.

ENQUIRIES

Dr L Lötter, City Health Department, P O
Box 1477, JOHANNESBURG 2000. Tel:
(011) 728-7373.

PROGRAMME

08h30 - 09h00	Registration
09h00 - 09h15	Opening Address
09h15 - 10h15	Full Scale experimentation: Production of volatile acids. On-line monitoring. HA Nicholls, Johannesburg City Health Department
10h15 - 10h45	TEA
10h45 - 11h15	Full scale experimentation: Comparison of different process configurations HA Nicholls, Johannesburg City Health Department
11h15 - 11h45	Design considerations in nutrient removal activated sludge plants AR Pitman, Johannesburg City Engineer's Department
11h45 - 12h30	Some fundamental aspects of nutrient removal and their relevance to plant operation LH Lötter, Johannesburg City Health Department
12h30 - 13h00	Poster viewing
13h00 - 14h00	LUNCH
14h00 - 15h00	Kinetics of biological phosphorus removal MC Wentzel, Department of Civil Engineering, University of Cape Town
15h00 - 15h30	Steady-state design for biological nutrient removal Prof G v R Marais, Department of Civil Engineering, University of Cape Town
15h30 - 16h00	TEA
16h00 - 17h00	Bulking in nutrient removal plants Prof G Ekama, Department of Civil Engineering, University of Cape Town
	COCKTAIL PARTY



KRY WATERINLIGTING GRATIS EN GOU KONTAK WATERLIT

Waterlit is 'n gerekenariseerde databasis met wêreldwye inligting oor water.

Meer as 105 000 verwysings na artikels, verslae, boeke, patente, tesse en konferensie-mededelings oor water is tans tot jou beskikking in die Waterlit-rekenaar.

En die aantal verwysings styg steeds.

'n Span indekseerders fynkam gereeld sowat 600 wetenskaplike en tegniese tydskrifte en voer elke maand oor 'n duisend nuwe verwysings na inligtingsbronne oor water in die databasis in.

Waterlit hou jou op die hoogte.

Vir meer besonderhede skakel die Suid-Afrikaanse Inligtingsentrum Vir Water by (012) 86-9211 X 3083 of 2048.



WATERLIT

Inligting van die eerste water.