AUSTRALASIAN HYDROGRAPHERS ASSOCIATION

Australasian Hydrographer

Your Editor attempting to extract a Land Cruiser en route to a Western Tasmania investigation site, early 1970's

November 2001
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Quote:

The mark of a successful man is one that has spent an entire day on the bank of a river without feeling guilty about it.

Chinese Philosopher

The **Australasian Hydrographer** is the Journal of the **Australasian Hydrographers' Association.** The Journal is distributed monthly, free of charge to Members.

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Editorial

Hello there, and welcome to our third Quarterly edition of our Newsletter.

As I begin to put this together, I have absolutely no idea what the final product will contain, and whether I have enough material to fill it up usefully! Thanks to those Members who have given me material. But, as you will see, we have roamed far and wide to find one article.

Our 20 questions this month is from one of our lady members, who initially wrote a short article about females in Hydrography, and then volunteered to do the 20 questions. Thanks Faye for your interest.

The sub-Committee organizing the next Conference has been beavering around in the background, and has settled on the dates, venue, and a general format. These details are on Page 10. The costs still have not been worked out, but this should be attended to very soon. Then, I suspect the really difficult work will begin!

Our new web site is up and running, and, as I seem to say on a regular basis, it's up to you what you want to put on it. All complaints will be ignored, and all constructive suggestions will be incorporated as much as possible. I'd like to receive your suggestions for the links page. We are now paying for this, so it might as well be useful!

The issue of affiliation with AWA is continuing, although I don't have any more up to date information since last month.

Some time ago, Alex Springall asked me to try to find an article from a Newsletter from years past. Unfortunately, I was unable to help him. However, I was thinking that it may be useful to have a "register" of old Newsletters. What do you think? I have quite a few of the old ones, but by no means the full collection. For now, at least, read on, and I hope you enjoy this issue. Les Marshall

20 Questions with Faye Edden

Faye completed Bachelor of Chemical Engineering at the University of Melbourne in 1998 after moving up to the 'Big Smoke' from her family's Dairy Farm near Phillip Island. Faye was an Hydrographer for a couple of years, before realising that there was such a word, when she began at WATER ECOscience in 2000. She has aspirations to be a big wig in the Water and Wastewater Industry for years to come and has worked as an Hydrographer for 5 years. She sees herself as a bit of an environmentalist which is why she chooses to work in this area rather than producing plastics and fuels that end up in landfill and the atmosphere.

What was your first job?
As a Casual (part time) Field Assistant at ADS Environmental Services in Melbourne in 1996.

Why did you pick it?
It was a part time job advertised at my Uni. I had decided it was time to get some sort of job in Melbourne while I was still studying to gain some experience rather than continue to travel home on weekends to milk cows for pocket money.

What drew you to your present position?
The opportunity to do different works other than solely flow monitoring in sewers, which I've done to death. Also the chance to be involved in every aspect of a project; including writing tenders, winning, managing and working on jobs through to completion. No awful salesman to underprice jobs, forget about passing on specifications or take all the credit for your hard work; that's what attracted me to my current job.

What is the favourite part of your current job?
Well I have lots of favourites, but mostly the variety of my job and the opportunity to meet many people working at different levels of the Water and Wastewater Industry.

What is the strangest thing you have been asked to do for or at work?
Some would say climbing 20 metres underground to stand in a 4 metre diameter pipe with sewerage flowing at 1-2 metres / second and 1 metre deep. However I would have to say saving a large Frill-necked Lizard from a particularly gassy sewer in Sydney. We grabbed him from the side of the pipe where he was clinging on and put him in the equipment bucket, pulling him out to freedom.

Pastimes and hobbies?
Keeping fit by riding my bike and going to the gym, being arty-farty by drawing, writing and sewing. Love going on holidays to different places which usually involves a road trip as I consider myself to be one of the original 'Road Sisters'. The next adventure is to South America over Christmas/New Years that includes a road trip through Chile to see Glaciers and Volcanoes.

What are you reading?
I've just started reading "Johnny got his gun" by Dalton Trumbo. It's an anti-war novel that is probably quite relevant at the moment.

Favourite music?
Mostly Australian bands; new and old. Also don't mind a bit of Fat Boy Slim and Moby; very easy to listen to.

Favourite website?
At the moment,
www.mmm.com.au/promotions/2001/escape_pentridge/polls/index.php
This is because one of my friends (Kym) is one of the Triple M radio contestants being locked in Pentridge for 3 weeks and we all want her to win!!

Where do you see our industry in say 5 years from now?
Authorities (environmental and water) are going to need more and more incoming data from people like Hydrographers for PC-based

Environmental Management Support System Models for use in managing water and soil quality across regions throughout Australia. So our services can only become more valuable and sought after.

How can participation of younger members be encouraged in our Association?
Annual meetings in all states (not just Canberra) would be a start. Perhaps giving it a seminar feel with the sharing of ideas would also go a long way towards encouraging younger members to be in attendance and to get involved.

If you could achieve one thing in your lifetime what would it be?
To build a model of a community practising sustainable living techniques (ie renewable energy generation and use, water recycling systems, organic food production). Hopefully this would demonstrate to both myself and to others that there is an alternative to our currently destructive lifestyle. Also to have fun doing it and maybe even make it profitable.

Name three people you would like to invite to dinner.
Patrick Rafter (seems like a good person and is very handsome), David Suzuki (environmentalist who would have a lot to say) and Margaret Thatcher (who could explain how she became so powerful). By the way, they would all be invited on separate nights since I'm not sure how well they would mix.

Your favourite beverage?
Have to say Boags Beer. Doesn't really matter which type, I just love the stuff!

Your ideal weekend consists of...
Catching up with friends and family (the ones I like that is). Enjoying good food and beverages with them in relaxed settings and doing adventurous stuff sometimes.

How do you balance you work and private lives?
Work to live; don't live to work. Often easier said than done, although I try not to let work dominate my life. It is also important to enjoy the time you are at work considering how much time spent there.

Your greatest asset?
My charming personality.

Your greatest liability?
Impatience. I don't like waiting for what I want.

What is the best thing about your job?
Feeling like a pioneer in the Wastewater Industry.

What is the worst thing about your job?
When I feel that my time is spent on repetitive work rather than learning new things.

Quote:

There is comfort in knowing that no matter what aspect my life takes on, this river will flow freely here, and that I might come to this place any time, in sadness or joy, alone or with someone I love. The waters will run smooth and fast, and though it will be a different river coming down out of the mountains it will also retain its constancy.

Jeff Wallach, *What the River Says*

The Barber's Pole

This month, we should leave The Barber alone. He tells me that his wife is becoming suspicious. However, he still thinks he has some sort of licence to defame others, and suggested we should tell the tale of Bill and Ben, two reprobates who used to haunt the South Australian outback.

Now, Bill and Ben were a bit of a worry, especially to their Supervisors. They used to think work was fun! Dear me. They even thought it was fun when Ben was thrown out of the back of a boat while trying to do a flood gauging. He emerged a fair way downstream, but no gauging sheet. Why bother to rescue that? They were having fun. But, I digress.

Bill and Ben pulled up in front of the pub at Marree late one afternoon, and immediately began to wash the dust off their tonsils. That was no real problem. Everyone does that. But then things seemed to get a bit out of hand. The dust rapidly turned to mud, but they pressed on.

Because they were nice, friendly fellows, they began talking to some other friendly travelers. These friendly travellers definitely weren't Hydrographers, as their antics will reveal. They wouldn't have lasted long as droggies when men were men, and they liked wimmen.

Eventually, Bill and Ben had had their fill of alcohol, and went to their room to rest up for a bit. I think passing out is a better description.

Some time afterwards, Ben awoke. In his stupor, he wondered how his wife had found him. He didn't care, a bit of cuddling and nibbling at his ear and neck. Suddenly, he realized that his wife had grown whiskers, and, oh no! It was one of their fellow travellers! Well, Ben used to be pretty good at judo when he was young, and somehow in that instant he designed a new throw. Two throws really. One was to throw up, and the other to throw off his new lover.

Well, this new lover wasn't all that silly. He was off and gone into the night.

Eventually, the excitement died down a bit, and Bill and Ben went off to sleep again.

Next thing they know, they wake up with smoke and flames billowing through their room. Bill and Ben, as starkers as the day they were born then set about dealing with this emergency. Fortunately they had help from the local CFS.

They tell us that their fellow traveller was probably a bit embarrassed about his little escapade, and sought to cover things up. OK.

All's well that ends well. But the Publican wasn't real happy with Bill's explanation of what happened. He said that they felt like a cuppa, and decided to boil the billy in the corner. Unfortunately the fire got away a bit.

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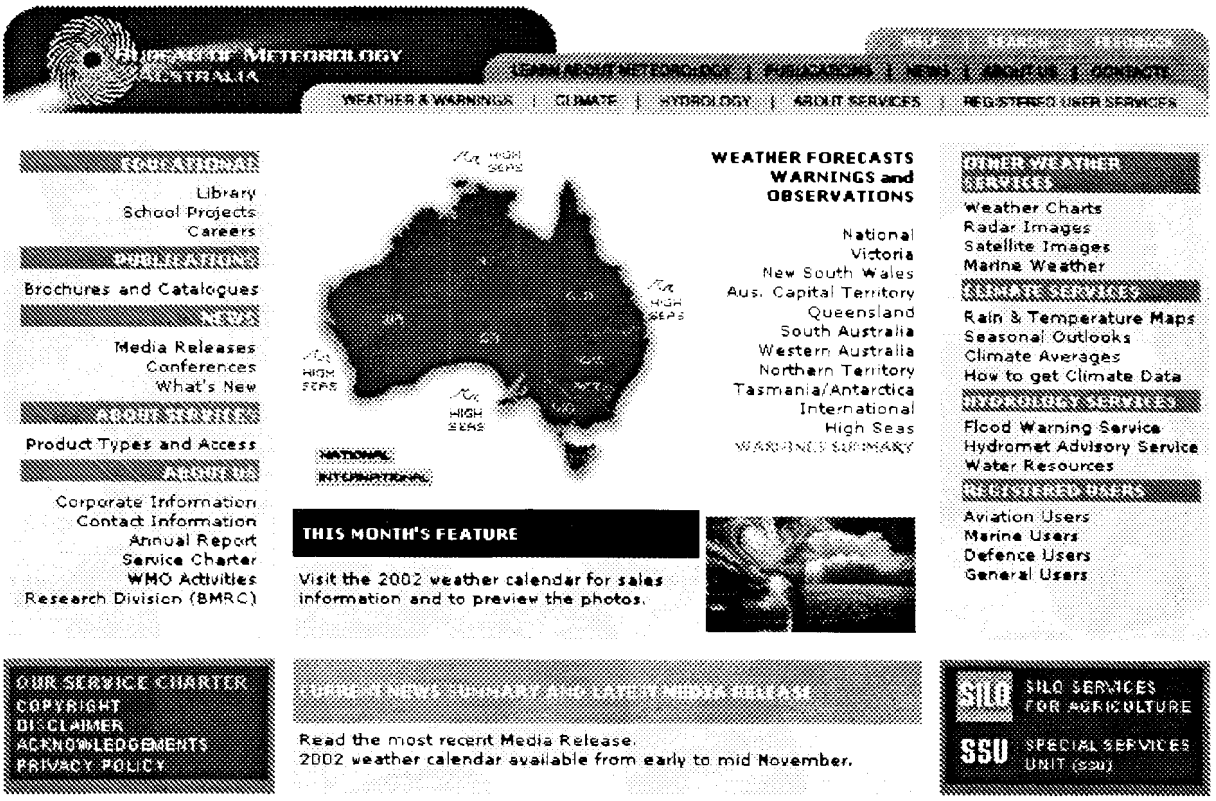

ACCESS THE BUREAU WEB SITE AT: www.bom.gov.au

A wide range of climate related data, information and products are available. Of particular interest to people in the water industry are:

- **Real time rainfall and river height data**
- **Climate averages in map and graph form**
- **National catalogue of river stations** www.bom.gov.au/hydro/wr/sgc
- **Drainage divisions and river basin boundaries**
- **National catalogue of rainfall stations** www.bom.gov.au/hydro/wr/rgc
- **National evapo-transpiration maps**

The Bureau of Meteorology's Hydrology Program would like to thank the hydrographic and data management groups in all State and Territory water agencies for their support over the years. Data and information have been provided for many projects, including:

- **Global Runoff Data Centre sponsored by WMO**
- **UNESCO Asian Pacific Friend Project**
- **Stream Gauging Information, Australia**
- **Flood warning system development and operation**
- **Rainman Streamflow Project**
- **Specialised rainfall analyses**

Cloud Seeding In Australia

*By **Ian L Searle**, Manager, Cloud Seeding Department, Hydro Tasmania*

Research by the Hydro-Electric Coporation of Tasmania (Hydro Tasmania) has raised the veil of scepticism from cloud seeding, with experimental evidence considered to be among the best in the world. New discoveries both in Australia and overseas are improving the prospects for cost effective enhancement of rainfall in many areas where cloud seeding was formerly considered to be non-viable.

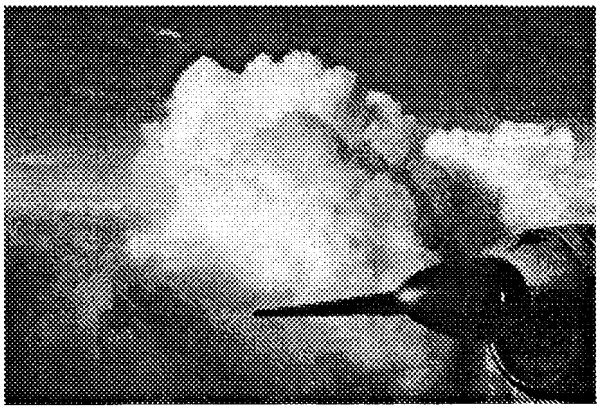

Figure 1. Large Cloud Suitable for Seeding

Hydro Tasmania entered the rain-making business with CSIRO in 1964 and its subsequent research has clarified the limitations of the process and the potential it has to assist other industries, including agriculture.

Hydro Tasmania has carried out thirteen years of experimental cloud seeding and eight years of operational seeding in Tasmania. Consistent increases in rainfall worth many millions of dollars have been achieved.

Recent advances in cloud seeding technology have removed much of the uncertainty surrounding cloud seeding and new discoveries are promising wider application. Essential cloud and atmospheric conditions can be sampled and recorded at frequent intervals, resulting in much greater confidence being placed on experimental results and cost/benefit analyses.

How it works

The air around us consists of several gases, including water vapour, and multitudes of tiny dust particles. When air cools on rising to higher altitudes, the water vapour condenses onto some of the dust particles to form a cloud of tiny liquid water droplets. A typical cloud droplet may be only one fiftieth of a millimetre in diameter and the dust particle on which it formed, known as a condensation nucleus, is thousands of times smaller.

It takes one million cloud droplets to make a single rain drop large enough to fall out of the cloud. Normally this is very difficult since the surface tension of each tiny cloud droplet makes it behave like a rubber ball, bouncing off its neighbours whenever they happen to collide. This explains why many clouds never rain, or produce far less rain than they are capable of.

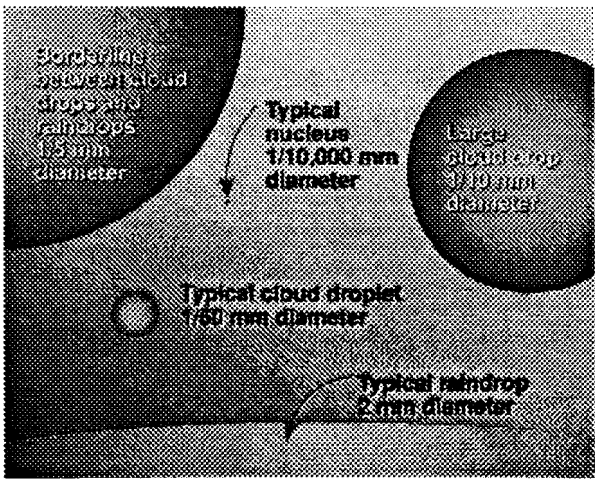

Figure 2. Cloud Particles, Comparative Sizes

In cooler climates the amalgamation of cloud droplets is often started by the formation of ice crystals. Cloud seeding imitates the natural process by introducing crystals of silver iodide or dry ice into the cloud. Silver iodide is the most commonly used seeding agent because it has a crystal structure almost

identical to that of ice and is effective in clouds at temperatures below -5°C. It is also easy to handle and economical since only about 500 grams per hour is used while seeding.

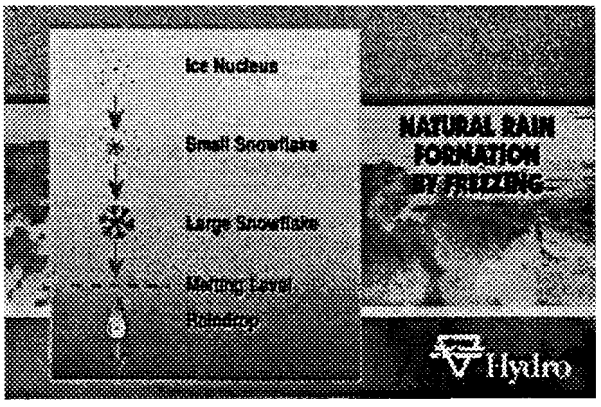

Figure 3. Rain Formation by Glaciation

Hydro Tasmania's Operations

Effective cloud seeding depends on effective weather forecasting and Hydro Tasmania uses Australian Bureau of Meteorology Internet based weather information, ie hourly satellite images in addition to a large range of other useful weather maps, charts and forecasts.

Hydro Tasmania's cloud seeders also use radar images at 10 minute intervals to routinely scan weather conditions upwind of their target area.

Not all clouds are suitable for seeding. It is important that the cloud seeder knows in advance details of cloud type, cloud top temperature, liquid water content and a range of other factors before seeding begins.

A specially equipped aircraft is based near the target area and remains on standby during daylights hours, seven days a week. It is launched whenever suitable clouds are expected in the target area.

Environmental Effects

Concern is sometimes expressed over the effect cloud seeding may have on the natural environment, particularly in relation to the pollution of water supplies with 'chemicals' such as silver iodide. The facts however, are rather reassuring. Silver iodide is a yellow salt, with exceedingly low water solubility, and a single tablespoon full (25g) is sufficient to seed a large cumulus cloud. This tiny quantity is capable of producing phenomenal numbers (10^{15}/g) of ice nuclei in the cloud tops where the temperature is colder than about -5°C.

If just 1% of the silver iodide is effective, producing raindrops averaging 2mm diameter, then about 40 megalitres of rain will have fallen, equivalent to about 10mm of rain over an area of 4 km^2. The traces of silver iodide reaching the earth in the rain will be quickly locked up in the soil. Silver iodide has been shown to be essentially non-toxic to plants, animals and even environment sensitive species such as rainbow trout.

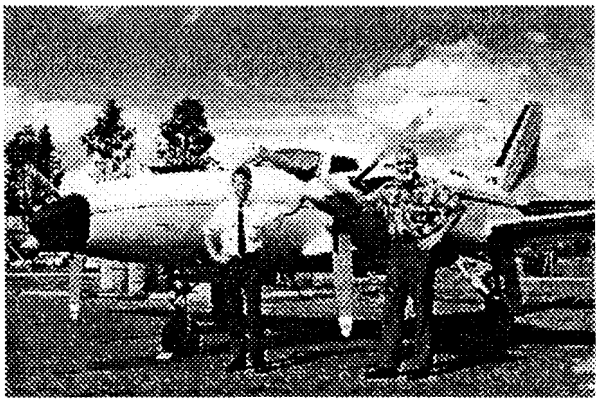

Figure 4. A Typical Cloud Seeding Aircraft

Persistent Effects

During the course of early CSIRO cloud seeding experiments it was suspected that silver iodide was affecting rainfall on days other than seeded days. This persistence effect seemed to influence experimental outcomes by confusing the statistical analysis so that large rainfall increases often obtained in the first year appeared to decline with time. Bigg (1985) discovered that silver iodide seeding was not only affecting rainfall on seeded days, but was also affecting target area rainfall for many days after seeding. Furthermore, the persistent effect was

spreading outward from the target area to affect control areas as well. The net effect was that the standard experimental designs and statistical methods were seriously underestimating the total seeding effect. Many of the early experiments thought to have been failures or only marginally successful, were in fact far more successful at increasing rainfall than at first thought.

Figure 5 shows enhanced rainfall in and around the designated cloud seeding target area. The size of the rainfall increase is far larger than can be accounted for by seeded day increases alone.

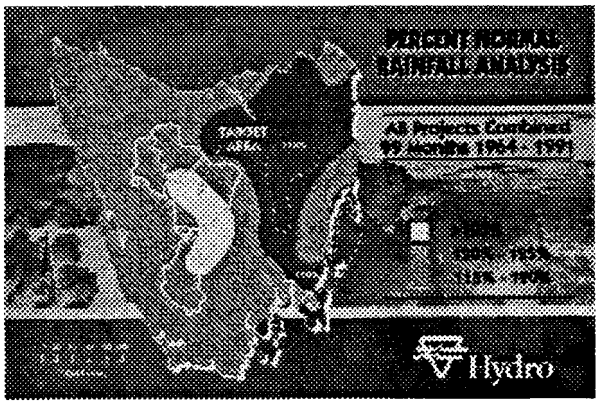

Figure 5. Combined Result of all Tasmanian Silver Iodide Cloud Seeding 1964 – 1991

Calculations indicate that the cost of extra energy in storage as a result of cloud seeding in Tasmania is about 0.2 cents per kilowatt hour.

The Way Ahead

The scientific principles behind cloud seeding are now well established, and the conditions required to produce results are fairly well known. Management of a cloud seeding project is however a little more complex than laboratory demonstrations may suggest, since it involves the co-operation of several government departments, weather forecasters, aviation industry specialists and scientists experienced in atmospheric physics. Australian authorities may now implement the modern technology of cloud seeding on a wider scale in areas where the climate is favourable and where high value economic production or environmental river flows depend on adequate supplies of clean, fresh water.

Ideally, new experiments utilising modern technology suited to both warm and cold clouds need to be conducted, in which the shortcomings of the previous experimental methods are overcome. The aircraft suited for cloud seeding, special seeding equipment, instruments for measuring cloud physical parameters and skilled technologists are all currently available.

There is water in abundance above the earth, and on a significant number of days each year, the atmospheric water becomes visible in the form of clouds. On some of those days, the cloud water is available for harvesting by means of cloud seeding.

Recent Projects

Three drought relief cloud seeding projects have been completed by Hydro Tasmania, two in eastern Tasmania in the spring months of 1994, 1995 and 2000 and one in northern New South Wales from November 1994 to February 1995. The latter project was classed as a trial only, and was not intended to provide data capable of statistical analysis. Given these limitations however, all indications are that it was an outstanding success.

Publications and References

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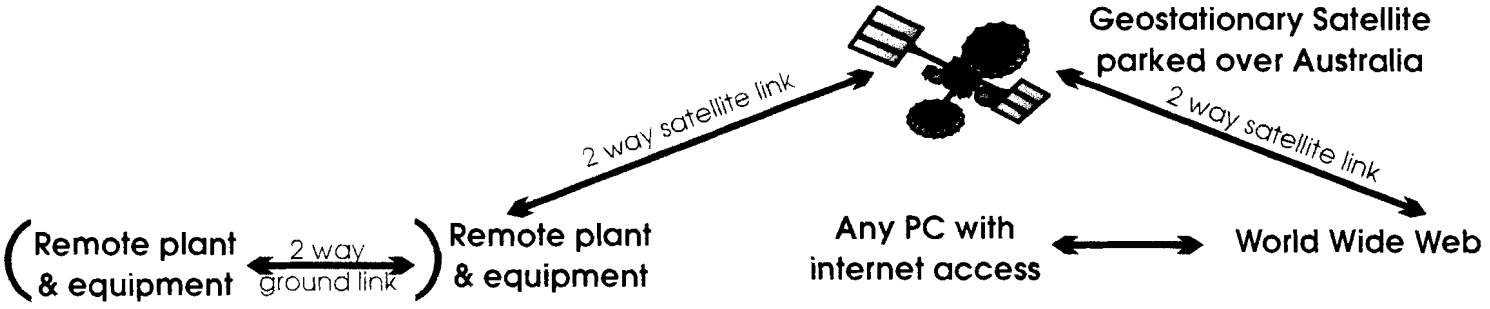
Satelemetry

Satelemetry is affordable satellite telemetry with starting prices from $9,000 & $60/month operating costs.

The Satelemetry terminal is tiny, about half the size of a VHS video casette, and has an inbuilt GPS receiver. The terminal is fully sealed including the internal antennas.

Satelemetry is a low data rate, low cost scada (supervisory control & data acquisition) system for tracking, monitoring & controlling remote plant & equipment.

In fixed plant applications the Satelemetry system can be interfaced to short haul terrestrial radio. These ground links can expand the reach of a single satellite terminal to anything within a 5 km radius.



Suitable applications for satelemetry are;

- River, pipeline & bore pump monitoring. Combined with 2 proximal, radio licence ground links, satellite terminals at 10 km intervals provide a cost effective wireless alternative to cabling

- Vehicle tracking, control & monitoring. Satelemetry is third generation mass produced technology that costs a fraction of traditional satellite based systems. The Satelemetry terminal can monitor refrigerated truck temperatures, check aircraft cabin pressurisation or vital engine parameters & can even provide limited messaging from an internet PC.

- Satelemetry is ideal for isolated environmental monitoring where cell phone or trunked radio services are unavailable.

What can't Satelemtry do? The system is unsuitable to any high data rate application making it inappropriate for web camera situations or any long term, real time demanding scada task (access plans vary from 40 to 720 messages per month)

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11TH AUSTRALASIAN HYDROGRAPHERS ASSOCIATION CONFERENCE
AND 2002 HYDSYS USER GROUP MEETING

Sydney 2000 Olympic Games Site Venue, July 10th to 13th 2002

INITIAL CALL FOR EXPRESSIONS OF INTEREST

The combined 11th Australasian Hydrographers Association Conference and annual HYDSYS User Group Meeting is to be held in Sydney from Wednesday July 10th to Saturday July 13th, 2002.
A field trip to several local sites of Hydrographic and Environmental interest will be included.

The conference theme will be **"INNOVATIVE ENVIRONMENTAL DATA COLLECTION"**.

Paper presentations will cover a wide range of topical issues in keeping with the theme. Submitted papers will be refereed and poster paper presentations will be accepted. Delegates attending the conference will represent many professional aspects of environmental data collection and publication.

The Conference and the annual HYDSYS User Group Meeting will be held in the Homebush Bay Novotel at Olympic Park.

Other events included in conference activities are, an extensive Trade Exhibition, Official Dinner and a Field inspection tour of several local sites of both Hydrographic and Environmental interest. A reunion dinner of retired Hydrographers will also be held at the conference venue.

Environmental Data Collection Trade representatives are invited to submit an expression of interest in presenting a three-day display of their products and services to a professional audience of national and international Delegates. Prices for all-inclusive trade participation packages and sponsorship arrangements are available on request. Approaches with both major and minor sponsorship proposals are encouraged.

The convenors have secured a window of accommodation at a special low rate at the function centre. As the Novotel complex offers accommodation within both the Novotel and Ibis wings, a broad range of tariffs is available. Quality accommodation is complemented by excellent venue dining facilities.

Note:(1) It is the responsibility of the participant to book and pay for his/her accommodation.
(2) Accommodation costs are separate from all conference fees.
(3) Availability of accommodation at conference secured rates will be limited closer to the event.

Delegate registration is available for full participation, day only participation and trade exhibition.
Registration fee's, accommodation rates and any additional information is available on request.

Electronic submission Deadline dates are:
Expressions of interest close on 17th December 2001.
Abstracts submissions close on 28th February 2002.
Final submission date for papers and registration will be 30th April 2002.

Please send electronic communications to:
j.tilley@unsw.edu.au Phone 0415 271722 or paul.langshaw@sydneywater.com.au Phone 0419 266299

Postal address is:
AHA Conference 2002, PO Box 112, REGENTS PARK, NSW 2143, Australia.

Jim Tilley, Michael Lysaght and Paul Langshaw,
AHA 2002 Joint Conference Convenors.

Alex Miller

We regretfully report the death of Mr Alex Miller, a long term AHA member, who passed away on Friday 5th October 2001.

After a brief stint as a hydrographer, with the Irrigation and Water Supply Commission of Queensland, Alex commenced his career with Sydney Water in August 1966 as a Technical Officer in the Gauging Sub-Branch.

After a number of years working in Sydney as an operational hydrographer, Alex was commissioned in 1976 to set up a district hydrographic office in the southern highlands. This office continues to serve as a base for hydrographic teams servicing hydrographic stations in the Shoalhaven, Warragamba and Nepean River Catchments.

In 1985 Alex assumed the management role of all operational hydrographic groups within the Gauging Sub-Branch and in 1990 was appointed Manager of the Hydrographic Services business. Alex spearheaded the commercialisation of this business (the first hydrographic department in Australia to do so) and as a result of his efforts the business enjoyed unqualified success, becoming a successful business enterprise within AWT.

In 1997, Alex was placed in a business development role in AWT and established the AWT office and laboratory in Brisbane. He retired from Sydney Water in 1999.

Alex's achievements in his career with Sydney Water and the AHA were many, despite ongoing battles with major health problems throughout his life.

Alex, in his position as the Chairman of the AHA, played a key role in the 'resurrection' of the organisation in late 2000. Largely through his determination and will, the AHA is now in a strong position with the groundwork laid for a promising future.

Alex was a popular member of the AHA and will be remembered for his dedication to our Association and its members.

He was an inspiration to all and will be sadly missed.

Water Affairs in South Africa

This article is reproduced from the SOUTH AFRICAN YEARBOOK, 2000 - 2001

South Africa is a water-stressed country where water planners and managers are faced with increasingly complex issues.

The country is largely semi-desert and prone to erratic, unpredictable extremes in the form of droughts and floods. Water is most abundant in the geographically small escarpment areas which run in a narrow strip from the north-east of the country and then down the eastern and southern seaboards, remote from the major demand centres in the hinterland.

Many large storage dams have been constructed to regulate the natural variable flow of rivers and to facilitate water transfers between catchments.

Rivers are the main source of water in South Africa. Country-wide, the average annual rainfall is less than 500 mm, compared with a world average of about 860 mm. On average, only some 9% of rainfall reaches the rivers. Sixty-five per cent of the country receives less than 500 mm, which is generally accepted as the minimum required for successful dry-land farming. Twenty-one per cent of the country, mainly in the arid west, receives less than 200 mm a year.

The Orange River Basin is the largest river basin in South Africa with a total catchment area of 1 million km^2, almost 600 000 km^2 of which is inside South Africa, the remainder being in Lesotho, Botswana and Namibia.

The total surface water run-off from rainfall in South Africa is estimated to be about 53 500 million m^3 a year, including that flowing out of Lesotho. Along with the surface water, about 5 400 million kilolitres of water a year may be sustainably obtainable from groundwater, which is distributed in a multitude of secondary aquifers, often of low yield and not suitable for drinking. Apart from erratic rainfall and the low ratio of run-off, which affects the reliability and variability of river flow, the average annual potential evaporation is higher than the rainfall in all but a few isolated areas where rainfall exceeds 1 400 mm per year. Consequently, only about 32 000 million kilolitres of the annual run-off can be economically exploited using current methods.

Usable run-off is further reduced by land uses such as commercial afforestation and sugar cane and by high evaporative losses from the myriad storage dams throughout the country. Farm dams, of which there are a large number, can seriously reduce the flow of rivers and streams during the dry season and also delay the run-off water at the onset of the rainy periods. Furthermore, rainfall, and to a greater extent run-off, is poorly distributed in relation to the areas of greatest economic activity. Accordingly, water is transported over great distances from areas of relative abundance to areas of increasing demand. For instance, water supplies in the populous and economically important industrial hub in Gauteng are supplemented by transfers from the better-watered east.

The current and expected patterns of water use are difficult to determine accurately. The best available figures show that irrigation and stock watering account for about 52% of the water used in South Africa; 12% is used for domestic and municipal purposes, 7,6% by industry, 2,7% by mining and 2,3% for power generation. Of the remainder, run-off reduction owing to commercial afforestation is estimated to be around 7%, and about 15% is required for nature conservation and for ecological purposes such as maintaining rivers and estuaries.

South Africa's rainfall pattern is seasonal and its high evaporation and *(Cont'd Page 14)*

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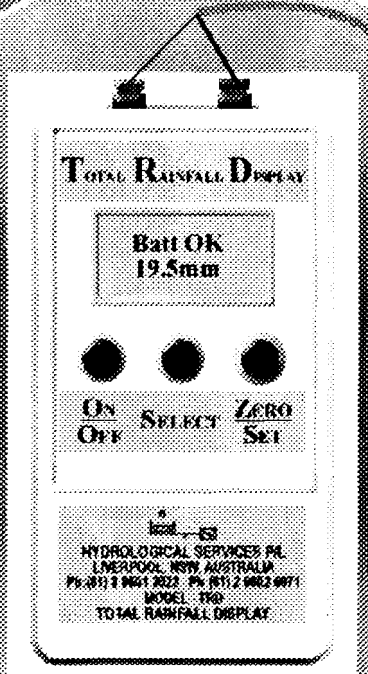

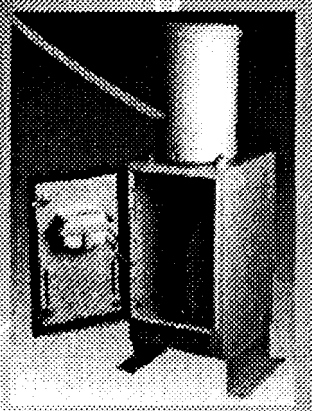

The Hydrological Services Totaliser is a 2 line, 8 digit, 4.5mm high LCD unit that counts and displays the total rainfall from a Tipping Bucket Rainguage. The counts are registered in increments of 0.2mm, 0.5mm or 1.0mm or 0.01 inch or points of inch. The unit also displays time and date.

All functions are push button selectable. These functions include setting of 'rainfall increments', 'switch off' time from 5 seconds or 5 minutes (to conserve battery power) and zero reset.

The Totaliser comes in a sealed ABS case 120mm x 65mm x 22mm which can be wall mounted or internally mounted in the raingauge. There is a provision for two AA lithium batteries. One will operate the unit for up to 5 years and if two are used it will operate up to 10 years. Connecting lead from Totaliser to raingauge can be up to 120 meters in length. A calibration lead one meter long can be supplied allowing the totaliser to be used as a calibration aid when performing field calibration of Tipping Bucket Raingauges.

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sunshine rate allows only 9% of rainfall back to the sea, compared with 31% world-wide. Rivers are the main source of water for the country.

In February 1999, a national groundwater mapping campaign was launched in Bisho, Eastern Cape, following the completion of two maps covering the province. At the same time, the Eastern Cape groundwater liaison committee was established, bringing government and the private sector together in efforts towards the better management of this resource.

Water for all

According to the Constitution of South Africa, 1996 (Act 108 of 1996), it is every person's right to have access to clean water. However, more than 12 million people are still without adequate water supplies.

Between 1994 and June 1999, some four million South Africans gained access to basic water services. This involved more than 1 020 projects.

The Department of Water Affairs and Forestry's Community Water Supply and Sanitation (CWSS) Programme was initiated in 1994 to achieve the constitutional objective of ensuring that all South Africans have access to sufficient water and a healthy living environment, with the focus on rural areas. One aim of the CWSS Programme is to capacitate local government and promote the sustainability of water services projects.

New projects are identified at local level and prioritized by the provincial planning forums, in which provincial and local governments are active participants. Close coordination is promoted with the Municipal Infrastructure Programme, which has focused principally on providing for new developments in urban areas.

Where capacity exists, the operation of existing water-supply schemes at local level particularly in the Northern Province and Mpumalanga will be handed over to local governments or water boards. Programmes are under way to establish new water boards to ensure effective operation of existing schemes and to promote regional water-supply.

The National Water Forum was launched in mid-1999. The Forum is aimed at creating a platform for discussing and exchanging views about issues concerning the use of water resources by role-players. The Forum also provides an opportunity for role-players and interested parties to contribute to long-term sustainability of water resources.

Water policy

South Africa is developing a new multidisciplinary approach to managing the country's scarce water resources based not only on technical considerations, but also on economic, social, political and environmental considerations.

Water Services Act, 1997

The Water Services Act, 1997 (Act 108 of 1997), aims, among other things, to

- ensure and define the rights of access to basic water-supply and basic sanitation services
- set out the rights and duties of consumers and those who are responsible for providing services
- allow the Minister of Water Affairs and Forestry to set national standards (including norms and standards for tariffs) to ensure sufficient, continuous, affordable and fair water services
- promote the effective and sustainable use of financial and natural resources
- regulate contracts for the provision of water services to promote their fair and transparent provision
- create effective and financially viable statutory institutions to assist local government to fulfil its obligations under the Act.

National Water Act, 1998

The National Water Act, 1998 (Act 36 of 1998), provides for

- integrated management of surface water and groundwater
- sustainable use of groundwater within the average annual replenishment rates
- devolution of groundwater management to local level
- the Government to play a support role through functions such as awareness, information provision and capacity-building.

The Act does not differentiate between surface water and groundwater with respect to allocation, protection and conservation. The Act aims to control the use of water resources, protect them from being abused and polluted and ensure that every person has equitable access to water resources.

On 1 October 1999, the Department of Water Affairs and Forestry started a registration drive for users of large amounts of untreated raw water. People who do not register can be fined or imprisoned for up to five years. The new measures will not apply to users of borehole water for domestic purposes, those who use it to grow food for subsistence or those who use it to water a few head of cattle. It will affect those who draw water from a dam, stream or underground aquifer and use it for irrigation, mining, industrial use and feedlots.

Water resources quality management

Water resources management in South Africa has undergone major revision along with the reform of water policy and legislation. The National Water Act, 1998 provides the principles for water resources management. The objective of this policy is to manage water resources in an integrated manner that will ensure a healthy, stable water resource base to meet the current and future needs of South Africa.

The definition of water quality has been extended to a more comprehensive consideration of water resources as dynamic aquatic ecosystems, including indicators such as biotic diversity and the status of river-bank habitat. Water resource quality provides an indication of the status of water resources and the ability of the resources to provide sustained access for use.

Recognizing that protection and conservation are not goals in themselves, the policy reflects the reality that impacts are associated with water use. Water resources management provides a protective framework that is intended to safeguard water resource quality against unsustainable practices, through a system of source controls and resource protection measures. Source-directed measures include a range of regulatory controls aimed at the sources of impacts on water resources, such as

- limitations on abstractions
- prescribed volumes and quality of waste water discharges that may take place.

Resource-directed measures focus on the water resource as an ecosystem and provide measures designed for the required level of protection for that resource, such as

- minimum flow conditions that must be maintained
- provision for biotic mobility.

A classification system provides the basis for setting appropriate resource quality objectives and source controls for the management of the resource. Water use is allocated according to the resource class, including the use of certain water resources for disposal of waste discharges. Water resources classified as sensitive or environmentally important may be stringently controlled, with water use allocations limited to minimize detrimental impacts.

While recognizing that water resources are not freely available for uncontrolled impacts,

it is not realistic to prevent all impacts in economically important water resources. Controlled impacts will be permitted and managed within a system of waste minimization technologies, pollution prevention, recycling and re-use of water. A system of economic incentives will form part of the management approach, through the introduction of waste-water charges in a phased manner intended to foster use of low-water or zero-waste technology.

Voluntary as well as mandatory measures for water conservation are intended to ensure that water is used efficiently, as are demand management strategies which increasingly form part of water-supply, management and development decision-making. The establishment of formal structures for integrated management of water resources at catchment and local level will bring a new dimension to the management of water resource quality.

On 24 April 1999, South Africa, Mexico and Australia linked up electronically to share ideas on how to alleviate problems around water management in rural areas. The concept was exhibited at the seventh annual Water Africa '99 Conference and Exhibition held at the Cairo International Conference Centre in May 1999.

Stronger user representation of all interest groups will ensure equitable allocations among the user groups, as both the costs and benefits of utilizing water resources are realized by the stakeholders. Decision-making will be devolved to the appropriate level, allowing those most affected by the decisions to provide primary input through catchment agency structures.

In February 1999, a step-by-step guide that determines and classifies the quality of water for household usage was released. The guide was published by the Water Research Commission (WRC) in association with the Department of Water Affairs and Forestry. The main emphasis of the guide is on the health aspects of water quality and the ways in which organizations and people could use it. The key guide is a simple colour chart against which the quality of water can be measured.

Working for Water Programme

The Working for Water Programme, to rid South Africa of invasive alien plants, was launched in 1995.

Invasive alien plants are a major threat to water resources and reduce the amount of water available for other purposes while also threatening the normal biodiversity of the natural vegetation.

In the 1999/00 financial year, almost 21 000 people, largely from the marginalized sectors, received employment and training in the Programme and 238 823 ha of invasive alien plant species were cleared.

Apart from creating jobs, the Programme also aims to develop those communities involved. This includes initiatives like developing secondary industries to sustain people in the wake of the Programme and teaching workers about financial management.

Flood and drought management

The Department is in the process of investigating a more comprehensive flood management policy that will focus on the prevention of disasters and not merely the reaction to them.

In September 1999, South Africa hosted the International Conference on Integrated Drought Management with the focus on sub-Saharan Africa under the auspices of the United Nations Educational, Scientific and Cultural Organization's International Hydrological Programme. A key objective of the Conference and the accompanying workshop was to develop practical strategies which will make drought management an ongoing task as part of sustainable development, both nationally and in the region as a whole. *(Cont'd Page 18)*

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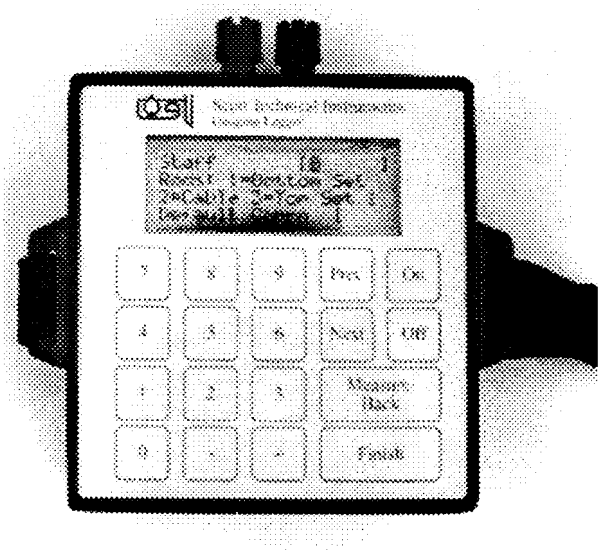

In addition to improving gauging accuracy and presentation quality, up to 20 minutes can be saved per gauging. Cost recovery in a busy hydrology department approximately 1 to 2 years.

Quote:

"The Taranaki Regional Council has recently purchased a second Gauging Logger (known affectionately as a Glogger) to add to its arsenal of gauging equipment. We have found, after the initial and almost inevitable teething problems with new products and software, the Glogger has made the 1-person gauging exercise very efficient and due to the enhancements of the latest software version arguably more accurate. The on-board software is plain and user-friendly and the end results can be easily transferred into most hydrological databases, eliminating the need for double handling. The Glogger being fully water-proof (we have recently done deep wade gaugings with the Glogger under about 400mm of water!) we have no hesitation in recommending it as another item for the Hydrologist's field tool box."
Grant Best, Hydrologist

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In February 2000, higher-than-average rainfall for the season coupled with four days of torrential downpours caused severe flooding in parts of South Africa, Mozambique, Botswana, Swaziland and Zimbabwe.

The floods in South Africa resulted in the loss of life, many injuries, the collapse of numerous homes, damage to electricity and water supply infrastructure and huge losses in commercial and subsistence agriculture.

Mpumalanga, the Northern Province, KwaZulu-Natal and Gauteng were hard hit. Revenues from South Africa's produce market were expected to decline by 60% owing to the flood damage and vegetable prices rose sharply.

The Government provided assistance in the form of food parcels, blankets, clothing and tents in the affected areas and relief workers provided emergency assistance to approximately 5 000 families in Mpumalanga and 120 000 families in the Northern Province.

According to a preliminary assessment of alien plants and water resources in South Africa, prepared by the CSIR for the WRC and the Working for Water Programme and released in January 1999, alien invasive plants use 3 300 million l^3 of water a year in South Africa – enough for every person in the country to have two baths a day for 365 days.

The amount of water used by invasive plants accounted for 7% of the total amount of water that would flow into the country's rivers annually.

The single worst species in invader terms was acacia, with black, silver and green wattle being predominant. Rooikrans and Port Jackson together accounted for 55% of the total invader species. Mesquite was at that stage confined mostly to the Northern Cape, but was becoming more of a problem. A Regional Ministers Review comprising representatives of South Africa, Botswana, Mozambique and Zimbabwe was set up to coordinate activities involving the floods. A National Emergency Relief Fund was also established to provide contributors giving assistance to communities with a point of contact.

The Command Centre is an emergency reconstruction entity which came into existence on 29 March 2000 as a one-stop-shop for the purpose of dealing with relief and reconstruction in the wake of the devastation wreaked by the floods which ravaged provinces earlier in 2000. By June 2000, reconstruction to the value of R31 870 703 had been verified.

Dams and water schemes

Work on a number of new projects is being undertaken by the Department of Water Affairs and Forestry.

Construction of the Injaka Dam is taking place in Mpumalanga on the Marite River, a major tributary of the Sabie River. The Dam will augment the water-supply to the rural communities of Mapulaneng, Mhala and Nzikazi North and its capacity will be sufficient to supply domestic water to the area for the next 15 to 20 years.

Work is progressing on the construction of the R1,1-billion Maguga Dam on the Komati River in Swaziland as the second subphase of the first phase of the Incomati River Basin development.

The construction of the Paris Dam on a tributary of the Phongolo River in KwaZuluNatal by the Impala Irrigation Board was completed in 1999.

The Department of Water Affairs and Forestry contributed R35 million to the R105-mil- lion scheme to provide for domestic water supplies.

One of the most ambitious binational water projects ever to be undertaken by South Africa and Lesotho is the Lesotho Highlands

Water Project. The completion of the first phase was celebrated in January 1998. The first phase of the project is composed of 1A and 1B.

The main components of 1A are dams at Katse and Muela, an 82-km water transfer tunnel and a hydroelectric plant at Muela. Phase 1B will include the construction of the Mohale Dam and tunnel and the Matsoku tunnel and weir.

In June 1999, South Africa and Lesotho signed two agreements to regulate the development and management of the Project. The first agreement aimed to reduce costs for water users by minimizing taxes levied on the Project's activities. The second agreement gave greater autonomy to the Lesotho Highlands Development Authority, which is responsible for running the water scheme in Lesotho.

The Koekedou Dam in Ceres, Western Cape, was completed in 1999 at a cost of more than R92 million. The Dam is unique in South Africa in that it was a joint venture of the Ceres Irrigation Board, the municipality and the Government. The Dam now supplies enough water for local industry as well as for irrigation purposes. Because of the subsidy given by the municipality and the Government, local farmers no longer have to pay for the water they use.

The final decision to continue with the construction of the Skuifraam Dam in the Western Cape was taken in June 1999. The Skuifraam Dam and supplement scheme to be built on the upper Berg River near Franschhoek will be a combined and phased project, with an estimated capital cost of R780 million. Construction is expected to be completed in 2001.

In November 1999, the rural communities of Mokgwaneng and Mamaneng in Mpumalanga's Moutse West celebrated the handing over of a multimillion rand Government-funded water project. The first phase of the R3,1-million project was completed in June 1999.

In May 1998, the Ministry of Water Affairs and Forestry allocated R210 million to KwaZulu-Natal for the implementation of rural water-supply projects. The first project involved the construction of the Hluhluwe Community Water-supply Scheme, which will serve 160 000 people on completion.

The Levuvhu Water Scheme was inaugurated by the Minister of Water Affairs and Forestry on 18 April 1999. It will provide nine million people in the Northern Province with drinking water. The Scheme will also stabilize the water supply for irrigation and alleviate water shortages in the Kruger National Park. The Scheme will be run through the Department of Water Affairs and Forestry's CWSS Programme while municipalities gain the experience and capacity needed to handle the provision of services. Construction of the Nandoni Dam started in May 1998 and it will store water from January 2003. The total cost of the project will be R750 million.

The National Water Conservation Campaign was launched in 1995 to achieve efficient, sustainable and equitable water management, supply and use in South Africa.

National Water Week was held from 20 March to 26 March 2000. The message for the 2000 Week was: *Nothing works without water. Let's all work for water.*

On 21 April 1999, Nelspruit became the first city in the country to sign a concession allowing a private company to provide its water and sanitation services. The concession is valid for 30 years.

Drainage and hydrology

World-wide, 31% of all rainfall returns to the sea by way of rivers. In South Africa, with its abundant sunshine and high evaporation rate, the figure is a mere 9%.

The combined annual run-off of all South African rivers amounts to 53 500 million m³. This is only half the run-off of the Zambezi River and roughly equal to that of the Nile River at Aswan in Egypt or the Rhine River at Rotterdam in the Netherlands.

South Africa lies in a drought belt. Rainfall is seasonal and is influenced by the topography. The slopes of the eastern plateau, which cover 13% of the surface area of South Africa, account for nearly 43% of the total run-off. The Orange River System, which drains almost the entire plateau 48% of the total surface area of the country accounts for only 22,5% (about 12 060 million m³) of the total annual run-off to the sea.

Truly perennial rivers (those that flow all year round) are only found over one quarter of South Africa's surface area mainly in the southern and south-western Cape and on the eastern plateau slopes.

Rivers that flow only during the rainy season are found over a further quarter of the surface area. Rivers in the western interior are episodic, that is, they flow only sporadically after infrequent storms, while their beds are dry for the rest of the year.

Research on river ecosystems is funded by the WRC and the National Research Foundation (formerly the Foundation for Research Development).

Lakes and pans

Except for Lake Fundudzi, which was formed by a huge landslide in the Soutpansberg in the Northern Province, there are no true inland lakes in the country. Coastal 'lakes' are found at Wilderness on the Cape south coast and at St Lucia, Sibaya and Kosi Bay on the KwaZulu-Natal coast. Although they are seldom without water, lakes Chrissie and Banagher near Ermelo in Mpumalanga differ little from the innumerable 'pans' to be found in a wide belt from the Northern Cape through the western Free State to the NorthWest.

Groundwater resources

Groundwater, despite its relatively small contribution to bulk water supply (13%), represents an important and strategic water resource in South Africa.

Owing to the lack of perennial streams in the semi-desert to desert parts, two thirds of South Africa's surface area is largely dependent on groundwater. Although irrigation is the largest user, the supply to more than 300 towns and smaller settlements is also extremely important.

Through the Government's commitment to meeting basic water needs of comm unities, groundwater has also become a strategic resource for village water supply in the wetter parts of the country, because of its cost-effectiveness in a widely scattered small-scale user situation.

Underground water sources also contribute to river flow. This will require reserving a significant part of groundwater resoures for the protection of aquatic ecosystems in terms of the National Water Act, 1998. The maximum quantity of groundwater that can be developed economically is estimated at about 5 400 million m³ a year.

On 30 July 1999, South Africa's Minister of Water Affairs, Mr Ronnie Kasrils, signed an agreement with his Swazi and Mozambican counterparts to study water resource developments in the region to coordinate future plans.

Called the Inkomati Development Initiative, the study, funded by the Danish Government, will gather information on all current and future water projects in the area.

Existing projects are the completed R600-million Driekoppies Dam, which draws on the Lomati River, and the R800-million Maguga Dam, which is under construction.

A national groundwater mapping programme and the development of a national groundwater information system form part of the new strategy.

A number of important secondary maps such as national exploitation potential, groundwater importance, classification and groundwater pollution vulnerability maps have also been produced.