

THE WATER WHEEL

ISSN 0258-2244

September/October 2006 Volume 5 No 5



Getting to Grapes with Salinity



**Water Institute of Southern Africa
Membrane Technology Division (MTD)**

7th WISA MTD WORKSHOP
Mabalingwe Nature Reserve, Limpopo, 18-20 March 2007
www.mabalingwe.co.za

Call for Papers and Poster Presentations

Please submit abstracts electronically, by e-mail or on disk, as MS Word documents, to Marshall Sheldon (see below). Abstracts should be no longer than 200 words using Times New Roman font, 12 point, and should include:

- Introduction
- Brief description of experimental procedures / project / pilot programme
- Results and discussion
- References

Due dates:

Abstract (200 words)	10 November 2006
Acceptance	8 December 2006
Extended abstract (2 A4 pages)	2 February 2007

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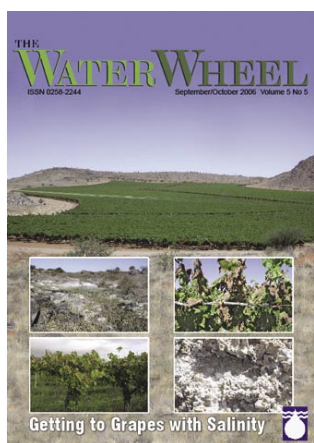
I intend to submit a paper entitled

.....

.....

I prefer: an oral presentation

a poster presentation



Cover: *The causes of salinity in the Lower Orange River region have been investigated - page 12*

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THE WATER WHEEL is a two-monthly magazine on water and water research published by the South African Water Research Commission (WRC), a statutory organisation established in 1971 by Act of Parliament. Subscription is free. Material in this publication does not necessarily reflect the considered opinions of the members of the WRC, and may be copied with acknowledgement of source.

Editorial offices:

Water Research Commission, Private Bag X03, Gezina, 0031, Republic of South Africa.

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WRC Internet address: <http://www.wrc.org.za>

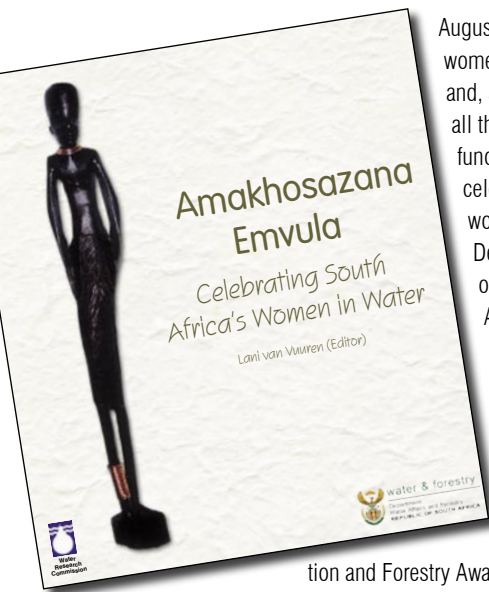
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LETTERS TO THE EDITOR

Editor's Letter Celebrating Water Women



August was women's month and, among all the other functions celebrating women, the Department of Water Affairs & Forestry hosted the 2006 Women in Water, Sanitation and Forestry Awards.

To coincide with these Awards, the Water Research Commission has published a special publication on women in the sector. Entitled *Amakhosazana Emvula* (Princesses of Rain), the publication features profiles on all the previous finalists and winners of the Awards since its establishment in 2002. In total, 48 women are featured in different categories from education, research, the environment to management and policy and community development. According to Minister of Water Affairs & Forestry Lindiwe

Hendricks: "this book is a lasting and beautiful testimony to some wonderful women who have squared up to the challenges of life and have gone that extra mile to make a difference."

The women in the book are strong, talented, and humble and despite their different areas of involvement they have one thing in common: an unconditional love for the sector and their work, which many of us working in this sector can relate to. *Amakhosazana Emvula* should serve as an inspiration, not only to other women in the sector, but to all that call this industry home. It proves that no matter what our individual talents, we can each in our own way contribute to the advancement of water and sanitation in this country.

To order the publication, contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za

One's solution another's problem

In the *Water Wheel* of July/August 2006, in the article "Guide to Help Authorities turn SALT into SWEET", one of the disposal options for the brine is given as "sewer discharge".

Having been involved in Wastewater Treatment for 36 years, I feel that I am qualified to speak on behalf of other wastewater

treatment practitioners when I say that we do not want the brine in our wastewater. The brine would have an adverse impact on the operation of the treatment works, could result in the effluent failing to meet the standard for Electrical Conductivity and most importantly, degrade the effluent thus limiting its re-use and irrigation potential.

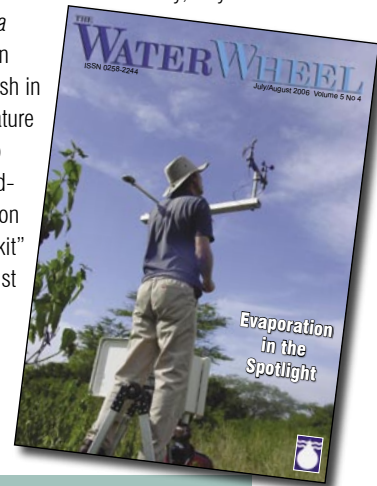
Planners, designers and others wishing to consider desalination must remove the discharge to sewer as one of the potential disposal routes, from their list of options. Please don't make your "solution" our problem.

Peter King, SFWISA, Cape Town

Aliens in KZN

As a concerned 'layman' I would be interested to hear from a relevant authority, why the *Chromolaena odorata* has been allowed to flourish in the Hluhluwe Nature Reserve (refer to the article "Building an Evaporation Monitoring Toolkit" in the July/August 2006 edition of your magazine).

Mrs CM McKenzie, Hyper-by-the-sea



Water on the Web

www.gefweb.org

This is the official website of the Global Environment Facility, an international organisation which helps developing countries fund projects and programmes that help protect the global environment. Projects related to biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants are supported.

www.imwa.info

This is the official homepage of the

International Mine Water Association. Keep updated with the latest efforts to treat acid mine drainage through this website and the association's scientific journal.

www.research4development.info

This portal to DFID funded research includes a searchable database containing records of about 6 000 projects from around the mid-1990s onwards. It also provides access to latest news and activities; success stories and case studies; as well

as projects and programme information across all sectors.

www.waterforschools.net

Water for Schools is an international campaign that provides financial resources; technical assistance and back-up maintenance to schools for the materials needed to get safe drinking water and toilets. The campaign, spearheaded by the World Conservation Union (IUCN), has already constructed facilities for several schools around the world.

Counting the cost of eutrophication

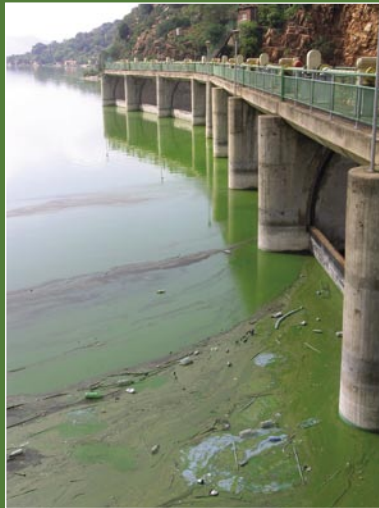
A Water Research Commission funded study has been launched into the costs associated with eutrophication.

Eutrophication, or the enrichment of the water environment with plant nutrients, and its accompanying negative effects are some of the intractable symptoms of water pollution associated with modern society.

Eutrophication causes excessive growth of phytoplankton (free floating algae) and rooted macrophytes, causing problems such as increased water treatment cost, taste and odour problems in drinking water, potential health risks, interference with recreation and a reduction of the amenity values and conservation status of water resources. This has knock-on cost implications for economic sectors as diverse as providers of potable water, industry, agriculture, real estate, recreation and for ecosystems.

The study, which should be completed by mid-2007, is aimed at developing a general model to assess the costs associated with eutrophication in South Africa. The model will then be tested in a case study to be performed on the Vaal River.

In the prevention versus cure debate, it is important to not only focus on the



cost of prevention, but also to recognise the costs associated with eutrophication and the knock-on effect it has on the economy. These costs need to be estimated for different levels of eutrophication to consider and justify often expensive preventative measures.

It is believed that a quantification of the cost associated with eutrophication will also assist in justifying the introduction of waste discharge charges as a preventative strategy and in setting the levels of charges that would be required to compensate users that are negatively affected by it.

'Extinct' science revived through report

A new Water Research Commission (WRC) funded report hopes to revive the scientific interest into the study of South Africa's dams.

South Africa is hugely dependent on its 520 large dams which intercept and capture more than 50% of the country's mean annual runoff. These man-made lake ecosystems are complex entities that exhibit their own distinctive peculiarities. To continue to manage these dams effectively an understanding of their biological, physical, chemical, hydrological and other aspects is necessary.

South Africa is reported to have had an internationally renowned pool of expertise studying the characteristics of these impoundments. However, the art of so-called reservoir limnology all but disappeared after the focus shifted to the study of rivers some 20 years ago.

The latest WRC report is the result of a comprehensive literature survey (involving some 1 450 publications) undertaken by the School of Biological and Conservation Sciences at the University of KwaZulu-Natal. It considers and addresses present and emerging issues in respect of reservoir limnology. The report serves as a point of departure for development of a reservoir limnology thrust.

The report offers an overview of the functional and operational attributes of reservoirs that variously influence, modify and determine the quantity, quality and/or sustainability of the impounded resource. In addition, the physical, chemical and biological structures, functions and interactions that underpin the natural ecology and utilitarian operation of dams are outlined. A chapter on the factors affecting water quality of dams, their consequences and their management is also offered.

To order the report (WRC Report No KV 1713/06), contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za

Call for proposals

The South Africa-Norway Programme for Research Cooperation has called for proposals. The goal of the programme is to establish the basis for long-term research cooperation between the two countries through the funding of joint research projects. Priority will be given to projects in the categories of (among others): health and medical sciences, environment, education and energy.

The deadline for submissions is 12 October. For more information, go to www.nrf.ac.za.

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More female scientists please



The International Council for Science (ICSU) has called on the scientific community to actively encourage the participation of women in the science sector to solve societal problems.

"In our modern, technology filled world, there remains a lack of appreciation of science by society, compounded by the fact that the benefits brought about by

science have yet to reach those places they are needed most," lamented ICSU spokesperson Lineo Mosia.

"It is proper to acknowledge that South Africa has made strides in mainstreaming women in science and technology through the initiatives of, inter alia, the Department of Science & Technology, and the National Research Foundation."

Hand-washing still underrated in SA

Hand-washing remains underrated in South Africa as an effective method of preventing the spread of disease, an international survey has revealed.

According to a global hygiene survey, undertaken in South Africa, the US, UK, Italy, Germany, the United Arab Emirates, India and Malaysia, 55% of South Africans believed that disinfecting surfaces,

avoiding close contact with others and not letting animals into the house were more effective in preventing disease than washing hands. About 1 000 people were surveyed in each country.

Americans reportedly wash their hands most often (68%), followed by Britons (57%). Interestingly, only 15% of Indians wash their hands regularly.

Tennis stars unite for water

This year's Wimbledon tennis championship was not all about strawberries and cream.

Veteran South African tennis player, Johan Kriek, took the opportunity to launch the Global Water Foundation (GWF) to raise public awareness, contribute technical assistance and fund water and sanitation programmes in schools, rural areas and other communities across developing nations. Initial efforts will focus on training, mobilisation and education in regions of Africa. "I was taken by the sense of urgency expressed by world leaders to find solutions to the problem, not only in Africa but other parts of the developing world," said Kriek

at the launch in July. "A source of healthy water is a fundamental right to everyone on earth, and there is so much the international community can do to help where the need is greatest."

Tennis legends John McEnroe, Martina Navratilova and Jim Courier have already pledged to act as 'Clean Water Ambassadors' for GWF. Along with Kriek, GWF's founding directors are Minnie Hildebrand, Joe Cox and Leigh Peric. Other non-executive members include Dr Darren Saywell (UK), Prof Eugene Cloete (South Africa) and Godfrey Mbala (Cameroon).

For more information, go to www.globalwaterfoundation.org

Water by Numbers

- **R50-million** – The funds budgeted by the Nelson Mandela Bay Municipality to eradicate shared toilets in New Brighton, one of the oldest townships in the Eastern Cape.
- **One third** – The amount of all death and disease in developing countries attributed to unhealthy environments, according to a new report by the World Health Organisation. The report shows that Africans are most vulnerable to death, disease and disability caused by unsafe drinking water, poor hygiene and other environmental factors.
- **151** – The number of countries that are members of the Ramsar Convention on Wetlands.
- **R5-million** – The maximum fines that can be issued by the country's new environmental policing unit. The so-called 'green police' will have powers of search and seizure, will be able to set up roadblocks, issue enforceable compliance notices and carry out routine inspections.
- **166 000** – The estimated number of buckets which still need to be eradicated in South Africa, according to Social Development Minister Zola Skweyiya. The majority of these are in the Free State.
- **92%** – The percentage of municipalities who had adopted Integrated Development Plans by July.
- **R3,34** – The price Rand Water's customers are paying for a kilolitre of water from July, after the bulk potable water supplier increased its price by 5%.
- **915** – The full supply level of the proposed De Hoop Dam, planned as part of the Olifants River Water Resources Development Project. The dam is expected to have a gross storage of 347 million cubic metres and a basin area of 1 690 ha.
- **R2,6-million** – Rand Water funds set aside in the present financial year to deal with encroachment of informal settlements on its pipeline network. This is up from R1,3-million budgeted last year.
- **17%** – The remaining percentage of South Africans who do not have access to potable water, according to President Thabo Mbeki.

Natural wealth could lift Africa's poverty

Africa could lift itself out of poverty if the continent's wealth of natural resources is effectively, fairly and sustainably harnessed, according to a new report by the United Nations Environment Programme (UNEP).

From freshwaters to forests, and from minerals to the marine environment, the region is only realising a fraction of its nature-based economic potential, the report, *Africa Environment Outlook 2*, points out. The report says, for example, that the potential for tourism based around nature and cultural sites is huge but relatively untapped. "Africa has numerous tourist attractions, yet it contributes only 4% a year to the multibillion Dollar global tourism industry."

Similar arguments are made in terms of food in a region with "sufficient land resources to produce enough to feed its people, and yet one in three is undernourished at present." The report also overturns the popular view that Africa is short of water, rather it underlines how little of it is used for irrigation, drinking water and power generation.

Africa's renewable freshwater resource is close to 4 000 km³ a year, about 10% of the global freshwater resource. Yet, in 2005, only about 5% of the development potential is being used for industry, tourism and hydropower, notes the report. There are about 50 internationally shared rivers and lake basins in Africa, making cooperation and collaborative management a key concern.

Availability is affected by natural phenomena, such as rainfall and climate variability, as well as human factors, such as population growth, inequitable water



By enhancing its nature-based economic potential, Africa could lift itself out of poverty, according to a new UN report.

management, inefficient use and pollution. Extreme variability in rainfall – across time and space – results in uneven distribution of surface and groundwater resources, from areas of severe aridity such as the Sahara and Kalahari deserts, to the tropical belt of mid-Africa with its abundant freshwater resources.

One freshwater opportunity that remains particularly poorly utilised is hydropower. At present, less than 5% of this potential is utilised. The Congo River accounts for nearly 30% of Africa's surface water reserves, and has the largest hydropower potential in the world – much of it untapped. It is estimated that it could generate 40 000 MW, sufficient power supply for the whole of Africa with enough for export.

Alien invasive species from toads to trees are among the emerging issues facing Africa, says the report. Experts have pinpointed large numbers of life forms, deliberately or accidentally introduced into the region, which are poisoning cattle, damaging water supplies, carrying infections and affecting tourism. The highest number of alien species is found in South Africa, followed by Mauritius, Swaziland, Algeria, Madagascar and Kenya.

Black wattle, a tree introduced into South Africa about 150 years ago, is undermining river banks and harming wildlife in the Cape Floral Kingdom, one of the world's greatest biodiversity hotspots. Since 1995, the South African government has removed and destroyed some five million black wattle trees.

Water Diary

HEALTH & HYGIENE – SEP 18-29

A two-week course on Linking Water, Hygiene & Sanitation to HIV/AIDS will be held in Nairobi, Kenya. The course is being organised by NETWAS International. Enquiries: Tel: 254-020-890555/6/60; Fax: 254-020-890553/54; E-mail: training@netwas.org; Web: www.netwas.org

IRRIGATION – SEP 25-27

The International Workshop on Global

Irrigated Area Mapping, organised by the International Water Management Institute (IWMI) will be held in Colombo, Sri Lanka. Visit: www.iwmidsp.org/iwmi/giam-workshop/

IWRM – SEP 26-28

The Third International Symposium on Integrated Water Resources Management will take place in Bochum, Germany. Enquiries: Tel: +49-3641-35 33 221; E-mail:

water@conventus.de;

Visit: www.conventus.de/water

MUNICIPAL ENGINEERING

– OCT 11-13

The 70th Conference of the Institution of Municipal Engineering of Southern Africa will be held at the University of Johannesburg, Soweto Campus. The theme is 'Knowledge for Action'. Enquiries: The Secretariat, Tel: (012) 667-3681;

(continued on p 8)

New Group Executive for CSIR



Khungeka Njobe (36) has been appointed as Group Executive of CSIR. Her portfolio includes research and development outcomes and strategic human capital development. Her appointment follows the departure of Dr Phil Mjwara who is now Director-General at the Department of Science & Technology.

Before joining the CSIR Executive, Njobe headed CSIR's unit for Natural Resources and the Environment which spans the domains of mining, forestry, pollution and waste, water, resource-based sustainable development and ecosystems. "As part of its renewal process, CSIR has embarked on a targeted intervention with the long-term goal of growing its pool of skilled people in science, engineering and technology. Transformation and quality will be the main characteristics of this pool of expertise, with staff being trained in scarce science skills," commented Njobe.

Company briefs

- Prof Mzamo Mangaliso, formerly of the Isenberg School of Management at the University of Massachusetts, in the US, has been appointed as the new president of the **National Research Foundation**.
- **Gold-mining** companies Simmer and Jack, Harmony Gold, AngloGold Ashanti and Siltfontein Gold have joined forces to create a new water company to control, and sell underground pumped water from the Klerksdorp-Orkney-Stilfontein-Hartbeesfontein area in the North West.
- **Thames Water** was fined more than any other firm in England and Wales for pollution last year. The company, which received penalties totalling £128 000, was joined by other water giants Southern, Severn Trent and United Utilities in the top 10 list.
- The **Coca-Cola company** has severely polluted the groundwater around its bottling plant in Plachimada in south India, according to a new report. The Hazards Centre and the People's Sciences Institute, which conducted the study, reports that the nine samples collected showed excessive levels of chromium, while eight showed excessive levels of cadmium and six showed excessive levels of lead.

New life for pipelines

Rand Water has been upgrading two of its bulk water supply pipelines.

Reconditioning of the 48 km long B4 pipeline, which runs along the Umfoleni region, was reportedly completed in May at the cost of about R103-million.

In August, the bulk water supplier was to start reconditioning of its O2 pipeline, which runs from the Palmiet Pump Station to Modderfontein, on the East Rand. This 9 km pipeline is being renovated at an estimated cost of R40-million.

Pipeline in progress

Civil Engineering Company Sanyati Holdings has secured a R37-million contract to construct a new pipeline for Umgeni Water.

The project, which is being undertaken by company subsidiary Afriscan Construction, involves the construction of a steel water pipeline from Amanzimtoti Water Works to Quarry Reservoir. As a social responsibility initiative, the local schools' water infrastructure would also be upgraded.

Water Diary (continued)

Fax: (012) 667-3680; E-mail: confplan@iafrica.com; Web: www.imesa.org.za

BIOFUELS – OCT 10-12

South African Institute of Agricultural Engineers, Pretoria. Biofuels and various other relevant agriculture-related topics. Enquiries: Colin Talanda, Tel: 084 555 8044; Fax: (012) 842-4067; E-mail: dafelfp@arc.agric.za

WASTEWATER – OCT 28-30

The First International Symposium on Water and Wastewater Technologies in Ancient Civilisations will be held in Crete, Greece. Organised by the IWA, the symposium will examine which ancient water

and wastewater technologies may still be relevant today. Enquiries: Dr AN Angelakis; Tel: +30 3810 245851; Fax: +30 2810 245873; E-mail: angelak@nagref-her.gr; Web: www.nagref.gr/symposium

IWRM – NOV 1-3

The Seventh Waternet/WARFSA/GWP-SA Symposium will take place at Capital Hotel, Lilongwe, Malawi. The joint symposium, which has the theme 'Mainstreaming IWRM in the Development Process' will provide a platform for researchers, policymakers and other stakeholders to meet and exchange ideas. Enquiries: Tel: +265 1 524 222 Ext 177 or 237; Fax: +265 1 524046; E-mail: symposium07@chanco.unima.mw; Visit: www.chanco.unima.mw

or www.waternetonline.org or www.gwpsatac.org

SUSTAINABLE DEVELOPMENT – NOV 13-17

The 32nd WEDC International Conference will be held in Colombo, Sri Lanka. The theme is 'Sustainable Development of Water Resources, Water Supply and Environmental Sanitation'. E-mail: iesl@slt.lk or wedc.conf@lboro.ac.uk; Web: <http://wedc.lboro.ac.uk/conferences/conference1.php?ID=7>

IRRIGATION – NOV 15-17

The South African National Committee on Irrigation and Drainage is hosting a symposium on 'The Changing Face of

(continued on p 10)

Regional Masters Degree Programme



Building Capacity for Water Resources Management in Southern Africa

in Integrated Water Resources Management 2007

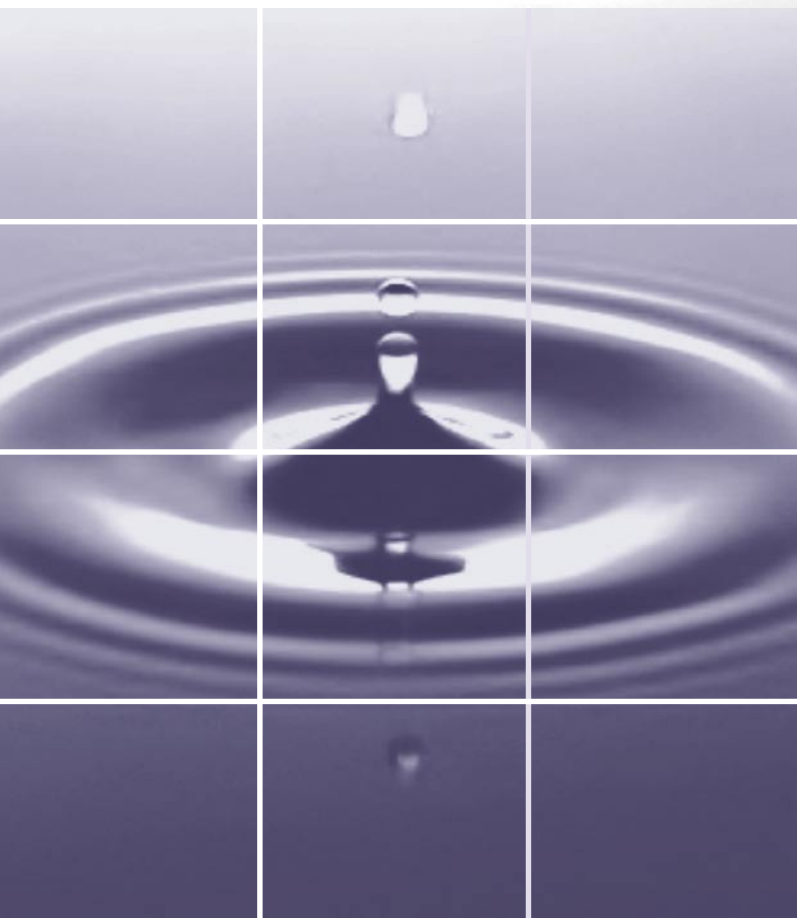
Applications are herewith invited for admission to the regional Masters programme in Integrated Water Resources Management to be offered in 2007 by WaterNet member institutions.

Structure of the programme

The programme comprises a compulsory core consisting of six modules, followed by a specialisation consisting of three modules and two electives.

The compulsory modules are:

Principles of IWRM; Principles of Hydrology; Socio-Economic Aspects of Water and Environmental Resources; Principles of Aquatic Ecology and Environmental Management; Policies, Laws and Institutions; Project



The specialisations are:

Specialisation 1: Water Resources Management

- Water Analysis and Planning
- GIS and Database Management
- Catchment Management

Specialisation 2: Hydrology

- Hydrogeology
- Remote Sensing and GIS
- River Engineering

Specialisation 3: Water and Environment

- Environmental Impact Assessment
- Water Quality Management
- Environmental Water Requirements

Specialisation 4: Water for People

- Water Supply and Sanitation
- Utility Management
- Waste Water Management

Specialisation 5: Water and Society

- Water and Security
- Environmental Education
- Water and Development

Specialisation 6: Water and Land

- Agricultural Water Management
- Wetlands, Ecology and Management
- Catchment Management

Financial assistance

WaterNet will offer scholarships to selected successful applicants. The scholarship covers tuition, fees, travel, accommodation, and reasonable living expenses.

How to apply

The initial application is made to the WaterNet Secretariat, who will then pass the application to the relevant member institution.

The application should include:

- An application letter in which first and second choices of specialisation are clearly indicated.
- A short curriculum vitae with academic background and professional experience.
- A one-page essay motivating why you should be selected for the Masters programme and the reason for your choice of specialisation.
- Copies of degree transcripts and certificates.
- A letter of support from your employer.

Applications will only be considered upon submission of all of the above requisites.

Submit the application in electronic form to waternet@eng.uz.ac.zw or in hardcopy to WaterNet, PO Box MP 600, Mount Pleasant, Harare, Zimbabwe. Applications should reach WaterNet on or before 15 September 2006. (PS: Please clearly distinguish your first name, other name(s), and surname in your application.)

Only the successful applicants will be contacted. If you have not been contacted by the end of January 2007, please consider your application unsuccessful.

For any further information, please contact the WaterNet Secretariat.

T: +263-4-333248 or 336725
F: +263-4-336740
E: waternet@eng.uz.ac.zw
I: www.waternetonline.org





A fix for pipes before they fail

Researchers of CSIRO in Australia have developed a predictive model for estimating likely failures in underground pipeline networks made from a range of materials.

The model reportedly uses probability distributions – developed from anecdotal evidence from industry and forensic investigation of failed pipes – to estimate the probable defect size along a pipe, and the probable loading conditions the pipeline experiences.

“The model preserves the detail of physical degradation and failure mechanisms that occur in service, and can account for changes in operating loads and the surrounding soil environment,” explains Dr Paul Davis of the Integrated Urban Water Systems research team. “However, we can also extrapolate the model to estimate network-wide failure rates, which are more meaningful for utility asset managers.”



Rooftop harvested water quality questioned

An international review, published by the International Water Association, shows that the quality of harvested water from roof catchments often does not meet the drinking water guideline values.

Most of the studies from different parts of the world revealed that harvested water is heavily contaminated microbiologically unless special care is taken during collection and storage of rainwater. Heavy metals and trace organics could also pose problems in some cases.

Appropriate treatment of collected rainwater is necessary to make the harvested rainwater fit for drinking. The review also shows the need for further research on proper design and maintenance strategies to reduce contamination of roof-collected rainwater supplies.

To access the review, go to www.iwaponline.com/jws/055/jws0550257.htm

Rare clouds spotted above Antarctica

Rare clouds spotted above Antarctica are a possible indication of global warming, Australian scientists say.

The so-called nacreous clouds can only form in temperatures lower than minus 80°C, and are occasionally produced by air rising over Arctic and Antarctic mountains in high polar altitudes during winter.

More than a curiosity, these clouds apparently reveal extreme conditions in the atmosphere, and promote chemical changes that lead to destruction of the vital stratospheric zone.

World water briefs

- The **European Investment Bank** has signed a loan agreement with the Mozambican government for €31-million for the rehabilitation and expansion of the Maputo water supply system.
- **Portugal** has guaranteed €5-million for preliminary studies into the construction of the Bue Maria Dam on the Pungoe River in central Mozambique under a new agreement signed between the two countries in July.
- Despite being hit by one of the worst drought in 100 years, residents of the **Australian** town Toowoomba have said no to a scheme to supplement their drinking water with recycled wastewater. The 100 000 residents voted overwhelmingly against the idea, despite enduring tough water regulations.
- The world's largest cities are working together to tackle climate change under a new partnership spearheaded by former US president **Bill Clinton**. The partnership is aimed at reducing greenhouse gas emissions and increasing energy efficiency.
- Researchers at the University of Vermont, in the **US**, are developing a computer model that will give a sophisticated portrait of the ecosystem dynamics and value for any spot on earth.

Water Diary (continued)

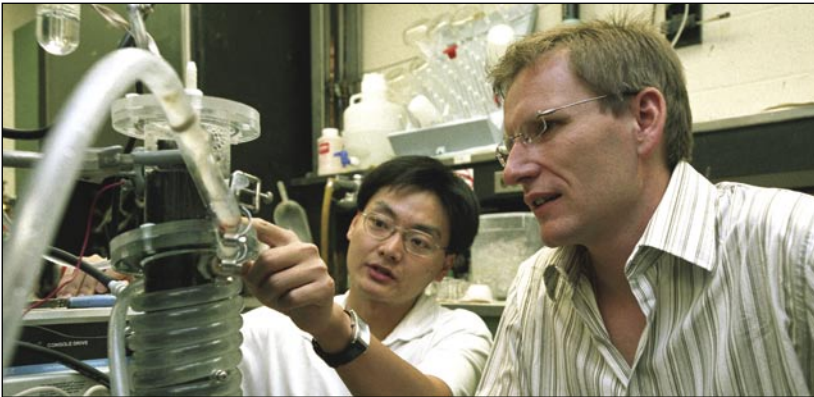
Irrigation in Southern Africa' at Aventura Swadini, Mpumalanga. Enquiries: Isobel van der Stoep; Tel: (012) 420-2174; Fax: (012) 362-5218; E-mail: Isobel.vanderstoep@up.ac.za; Web: www.sancid.org.za

AGRICULTURAL INNOVATION – NOV 20-23

The Innovation Africa Symposium will convene a group of internationally recognised experts on innovation systems to share their latest thinking with agri-

cultural researchers and development partners. Enquiries: Dr Susan Kaaria, Rural Innovation Institute, Tel: +256 41 5678; Fax: +256 41 56 7635; E-mail: s.kaaria@cgiar.org

Energy from wastewater



Jason He and Dr Lars Angenent seek to perfect a microbial fuel cell.

Researchers at Washington University, in the US, are working on a microbial fuel cell that generates electricity from wastewater.

Advances in the design of this fuel cell in the last year have reportedly increased the power output by a factor of ten. Wastewater enters from the bottom of a system and is continuously pumped up through a cylinder filled with granules of activated carbon. The organic matter in the wastewater provides food for bacteria that have developed a biofilm on a simple electrode in the anode

chamber. A U-shaped proton exchange membrane inside the anode chamber separates the anode from the cathode.

As the bacteria feed on the organic material in the wastewater they release electrons to the anodic electrode. These electrons then move to the cathodic electrode via a copper wire. The formed protons are transferred through the membrane towards the cathode where they react with electrons and oxygen to form water. A maximum of 29 Watts per cubic metre of solution has been achieved.

New guidelines for drinking water quality

The Third Edition of the World Health Organisation's *Guidelines for Drinking Water Quality* is now available.

This edition reportedly includes significantly expanded guidance on ensuring the microbial safety of drinking water – in particular through comprehensive system-specific 'water safety plans'. Information

on many chemicals has been revised to account for new scientific information and information on chemicals not previously considered has been included. For the first time, reviews of many waterborne pathogens are provided.

To access the report online, go to www.who.int/water_sanitation_health/en/



Purification method uses less space, energy

Delft University Technology researchers, in the Netherlands, in partnership with DHV Engineering, have reportedly developed a compact and environment-friendly water purification method in which aerobic bacteria form granules that sink quickly.

With this aerobic granular sludge technology, aerobic bacterial granules are formed in the water that is to be purified. All the required biological purifying processes occur within the granules.

It is reported that the new purification system only requires a quarter of the space required by conventional installations, and uses 30% less energy.

Save the environment, drink beer

Beer drinkers can now enjoy a pint with a clearer conscience after a Japanese university demonstrated that beer bran, a byproduct of the brewing process, can be used to clean polluted water.

New Scientist magazine reports that researchers at Kobe Pharmaceutical University found that the bran adsorbs hazardous organic compounds, including benzene and trichloroethylene (used in adhesives and paint) from chemical and industrial wastewater.

Companies commonly use activated carbon filters to remove pollutants from water. However, it is reportedly expensive and energy-consuming to produce.



Grap(pe)ling with Salinity Along Lower Orange



Courtesy of ARC

In the Lower Orange River region increasing salinity of irrigation water is potentially threatening the livelihood of grape farmers in the area. The Water Research Commission (WRC) funded a study aimed at unearthing the root of the problem with the eye on possible solutions. Lani van Vuuren reports.

It is reported that high water tables and salinisation have been a problem in irrigated areas along the Orange River since 1948. Salt build-up beyond certain limits will certainly be costly to rectify and can irreversibly harm agriculture in the region. It is estimated that 4% of irrigated land in the Northern Cape is already severely affected by salinity or water logging.

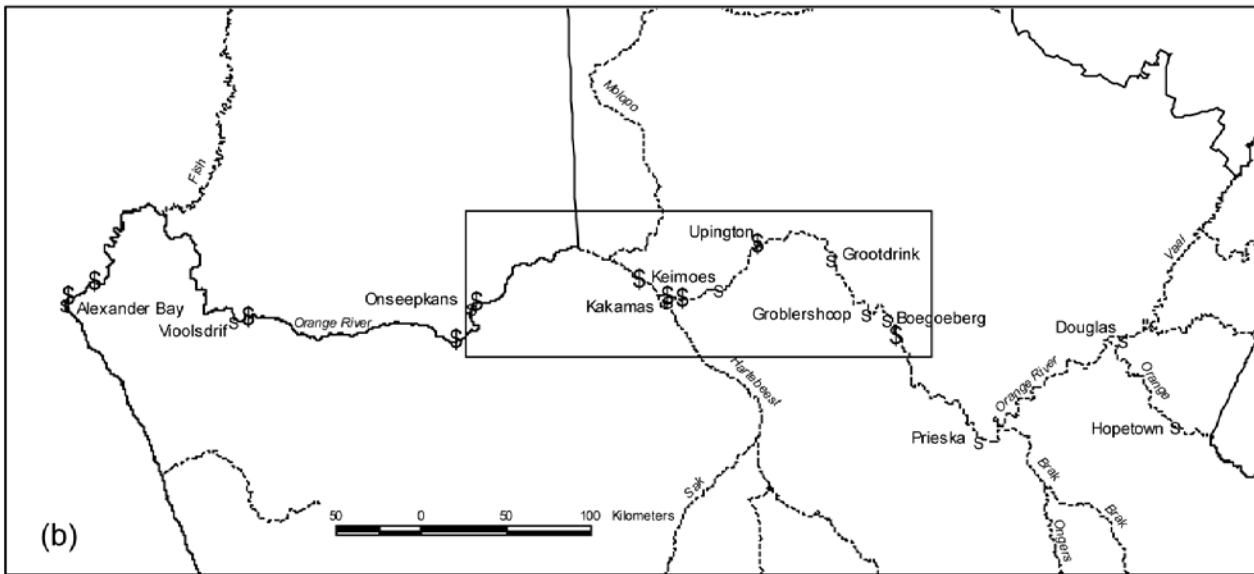
The Lower Orange Water Management Area (WMA) is located in an arid region with limited rainfall that is characterised by high evaporation losses. The tributary inflows in the area are intermittent, and only

contribute to the river flows during periods of unusually high precipitation in the Lower Orange River basin.

With the implementation of the Lesotho Highlands Water Project substantial volumes of low salinity water from the Orange River is being diverted to the Vaal River Catchment, leading to increased salt levels in the Gariep and Vanderkloof dams. At the same time, expansion of the table grape industry in the upper part of the Lower Orange River system could put additional pressure on the system by decreasing the available volume of water and increasing irrigation return flow to the river.

The WRC funded study, led by the Agricultural Research Council, focused on the river reach between Boegoeberg and Onseepkans. Irrigation is the dominant water user in this region, comprising 94% of the total water required. Nearly all irrigation developments are dependent on water from the river. More than 35 000 ha of land are being cultivated between Boegoeberg and Onseepkans, with grapes (60%) and cotton (20%) constituting the main crops.

An unyielding increase in salinity could seriously affect the economy of the area as it has been found that grapevines are more sensitive to



The location of the study area.

salinity under local conditions than found by international salinity guidelines.

WATER QUALITY

Investigations of the water quality of the Lower Orange River between Boegoeberg and Onseepkans indicated that the water is still of good quality, with limited potential for salinity and sodicity problems and almost no toxicity problems at all. Interestingly, the potential for problems increased from Onseepkans to Alexander Bay, with the highest potential at Alexander Bay where the water quality was influenced by tidal flows.

Of specific concern was the pH that remained above 8 for all the monitoring sites. It exceeded the upper limit for irrigation water use at Vooledrif from time to time. Water with pH in excess of 8,4 may cause foliar damage or decrease the visual quality of marketable products if it is wetted during irrigation, affect the availability of several micro- and macronutrients and increase problems with encrustation of pipes and clogging of drip irrigation systems.

Concerns regarding salt retention in the Boegoeberg to Onseepkans river

reach appear to be valid, but should be seen in context, according to the researchers. The longitudinal annual average river salinity profiles and salt balance for the river reach between the two areas for high- and low-flow years, respectively, indicated that the river oscillates between a salinisation profile and equilibrium, or even a mobilisation profile. The salinity tends to be low if the flow is high and vice versa.

Water with pH in excess of 8,4 may cause foliar damage or decrease the visual quality of marketable products if it is wetted during irrigation.

It is hypothesised that salt retention occurs in the Boegoeberg to Onseepkans reach during periods following high flow in the river. The salt retention in the river reach occurs due to water-logged conditions in low-lying soils, which make effective leaching of salt periodically unfeasible. The presence of high water tables promotes salinisation of these soils under conditions of high evaporative demand that are typical for the Lower Orange River region.

During years of low water flow, salts can be effluxed from the river reach as low water tables allow salts to be effectively leached from the salinised soils. Drainage irrigation originating from over-irrigation of foothill soils may aggravate the situation during high-flow years or prolong the period of water logging and the potential for salinisation. It also has the potential to mobilise salts which can have devastating effects on crops cultivated on low-lying alluvial soils, and to cause deterioration of the surface water quality through groundwater seepage.

Return flow from irrigated fields and leaking canals between Boegoeberg and Onseepkans is estimated to constitute between 15% and 20% of the irrigation requirement per year. It was, however, impossible to determine any effect of this return flow on the river water quality due to the lack of a reliable database. Nevertheless, indications are that return flows from irrigation cannot be the main source for the salinity in the Lower Orange River reach between Boegoeberg and Onseepkans.

SALT CONTRIBUTION FROM SOILS

Laboratory research on the salt leaching potential of the soils from

14 Water quality management

the foothills indicated that these soils are not particularly saline in their virgin state, although some local spots of exceptionally high salinity and sodicity were found. The sources of salts in these soils are both soluble salts as well as accelerated weathering of primary minerals such as feldspar and biotite. It is estimated that the earlier stages of vineyard development could release several times more salt than that which could be applied through irrigation water alone.

Contrary to belief, it was found that when virgin lands were converted to irrigated vineyards, a slight increase in salinity occurred. There was also evidence of local saline patches within vineyards. To counter the development of such salinity, sophisticated

drainage should be a prerequisite for any new irrigation development on the foothills, while review of regular gypsum and fertilizer applications are strongly advocated.

Digital aerial photography was employed to map potentially salinised plots, i.e. plots which exhibited impaired vegetation growth. An estimated 14% of the randomly selected plots were found to be saline. Most of the salinised plots were either stony, sandy or water logged. In addition, most of these plots were found at the lowest elevation points in the floodplain, such as where old drainage channels had been filled and subsequently cultivated.

Specific management actions for national government, local authori-

ties, local extension services and producers are recommended to curtail water quality deterioration and development of soil salinisation in the Lower Orange River region. Management options revolve around various aspects of improved water delivery, irrigation efficiency and reuse and disposal of drainage water.

The most important management actions proposed for the region include restricted gypsum application, improvement of irrigation efficiency (including irrigation scheduling), application of adequate leaching, revision of irrigation practices in severely salinised areas, lining of water delivery and storage structures, maintenance of drainage systems



Courtesy of ARC

An example of leaf burn due to salinity. Local vineyards are reported to be more sensitive to salinity than international standards dictate.

already installed, installation of drainage basin lands ('hollande') and well-judged installation of cut-off drains between the irrigated foothill soils and the basin lands to intercept drainage water.

According to the researchers, the absence of a drainage management strategy for the area as well as a lack of appropriate policy to enforce installation of drainage or to retire irrigated land where severe salinisation is apparent, undoubtedly hamper effective management of surface water and soil salinisation.

- To obtain this report (WRC Report No **1358/1/05**) contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za



Courtesy of ARC

An example of serious soil salinisation.



Courtesy of ARC

Soil salt leaching potential studies being undertaken in a vineyard.





Cholera – The Threat Is Not Over

MAPPING THE PATHOGEN HIGHWAY

A Water Research Commission funded study successfully assessed the source of several disease-causing pathogens, their route through and survival in the environment, thereby forming a basis for the development of appropriate catchment management and intervention strategies to reduce the health risk to water users.

The most common source of contamination of surface waters is human and animal wastes. The introduction of waterborne pathogens by these sources is of particular concern, especially since there are still millions of people in South Africa who, out of necessity, make use of these unsafe sources for drinking water and other uses.

At present, most of the water industry's efforts are focused on the removal of waterborne pathogens during water treatment rather than preventing these pathogens from

entering the environment. However, the authors of this report believe that a catchment management approach towards microbial pollution will only be successful if it is based on a clear understanding of the origin, fate, survival and transport of pathogens that have been introduced into the water body.

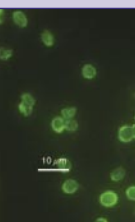
The possible sources of selected parasites (*Cryptosporidium*), and bacteria (*Salmonella* and *Vibrio cholerae*) in freshwater environments, their survival and clinical reference in a rural and peri-urban area were investigated. An assessment of the environmental factors and social determinants that contribute to the transmission of disease associated with the selected waterborne pathogens was also undertaken.

A number of key findings were revealed in the study. For example, it was observed that cryptosporidiosis is mostly spread through

person-to-person contact rather than from animals to humans. The high percentage of the human genotype (80%) observed in the cases investigated suggests the importance of person-to-person contact and human sewage contamination of drinking water, recreational water and food sources, as a means of spreading the parasite.

Although food has been implicated as the main source of *Salmonella* infections, the role of contaminated water in the transmission of the disease in developing countries was largely unknown to date. This study revealed that *Salmonella* was indeed prevalent in the environment. This could be due to faecal contaminants from animal and human excreta that find their way to freshwater sources.

Further research indicated that *Salmonella* survived for extended periods of more than six months in sediments at temperatures typically



In 2000/01 South Africa faced one of its biggest health threats ever when a cholera epidemic swooped the country, leaving at least 265 people dead and infecting 117 147 in five provinces. In reviewing the epidemic the Human Sciences Research Council (HSRC), in collaboration with the Municipal Services Project, found that the water-related disease threat for vulnerable communities is far from over. Lani van Vuuren reports.

The cholera epidemic demanded an urgent review of the state of water provision to the traditional rural areas and informal settlements where it was concentrated. The reason was that those who could not afford the new charges were returning to traditional and untreated water sources, and were falling victim to the disease.

In the period since the cholera epidemic, events have shown that this was not a unique occurrence. The outbreak of typhoid in Delmas during August to October 2005 in

which there were at least five deaths and almost 600 cases demonstrated the continued vulnerability of poor people in urban and rural settings to water-related disease. The evidence in this case pointed to problems in the management of the bucket system, affecting the quality of water.

EPICENTRES OF DISEASE

Led by Dr David Hemson, the HSRC research drew on two study sites in KwaZulu-Natal, one at Nqutshini, a small tribal-governed settlement near Empangeni and the other at Nkobongo, a developed, low-cost housing area with continued informal settlements near Ballito. In both cases a series of open-ended interviews were undertaken to capture the ideas and feelings of the local people followed by a small-scale survey.

The household survey indicated that considerable improvement in access to piped water and toilets had been achieved. A positive response to the epidemic has been a renewed interest in sanitation, and toilets (including ventilated improved pit toilets and arch loos) have been constructed in the communities concerned.

Unfortunately, at the time when the interviews were conducted (2004), Free Basic Water services had still not been implemented in these communities, and the cost of water still continued to play a major factor in people's access to sufficient safe water. Households reported that, compared to the situation during the cholera outbreak they were now paying for water instead of fetching it from the nearby river.

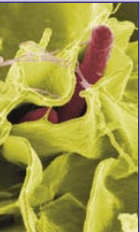
Although prepaid standpipes were modified to provide 200 ℓ/day to those with cards, a major obstacle to receiving free water remains the cost of the card itself. Greater vigour and prioritisation needs to be given to ensure that the rural poor and those in poor peri-urban communities who need it most benefit from the provision of free basic water. This will ensure that people are not forced to revert to untreated and unsafe sources, the researchers say.

INTERRUPTED SUPPLY


One of the unexpected features of water delivery in the community (particularly in Nqutshini) is its unpredictability and poor management. The research revealed that despite the enormous attention focused on the area as the early centre of the cholera outbreak it continues to be common for water to be unavailable from the taps at Nqutshini without reason or notification.

From the figures it appears that repairs take some time to be implemented, and that breakdowns lasting days were happening several times a year. In contrast, the operation of water services in Nkobongo appears stable even though the costs of water are comparatively high.

Poor water service has elicited a range of responses and coping mechanisms at the community level, namely buying (or stealing) water, storing water and vandalism. The latter, in particular, has exacerbated problems and has affected community social dynamics. The reasons for vandalism were closely associated with high levels of dissatisfaction and



associated with freshwater streams and rivers in South Africa. This is of concern as they could easily be released from the sediment into the water phase at high concentrations during rain events or other disturbances of the sediment.



This study also examined the genetic diversity of *Vibrio cholerae* in the Vaal Barrage catchment. Several different strains of *Vibrio cholerae* were discovered in the Vaal Barrage, an indication that the bacteria could adapt to its environment allowing it to survive longer. This may portray the potential of environmental populations of the bacteria to serve as reservoirs for future epidemic strains.

- To order the report (WRC Report No 1398/1/05, contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za)

Reasons for water interruptions during the year		
	Frequency	Per cent
Vandalism	17	21%
Burst pipes	14	18%
General maintenance/repairs	12	15%
Pump not working	7	9%
Non-payment for services (cut off)	6	8%
Not enough water in the system	3	4%
Water only delivered at fixed times	3	4%
No interruptions	1	1%
Poor management	1	1%
Do not know	16	20%
Total	80	100%

Source: HSRC

hostility among those who felt their water was interrupted for no good reason, whose water was cut off due to non-payment, and who were unable to afford yard connections.

Vulnerable communities need an efficient water service with low levels of interruption. This will require better municipal services. Greater accountability and responsiveness to community needs can be achieved through public participation, the study recommends.

STORING DISEASE

In community interviews people mentioned that they stored water against the probability of long interruptions of supply (in some cases water was stored for up to two months at a time). This increased water storage

had led to a higher risk of households experiencing cholera. This is because the containers may not be clean and bacteria multiply, particularly when the containers are not sealed.


There should be greater awareness about this danger among health authorities and health promotion to reduce disease resulting from a lack of knowledge of this problem. The problem is unlikely to fade away, however, until there are more stable levels of operation, the researchers note.

The two communities have roughly the same level of access to water services through public provision, and household income levels in both areas range between poverty and extreme poverty. This study established that extreme poverty is

a key indication of household vulnerability to both cholera and diarrhoea in the two communities researched.

Lower household income is associated with the incidence of cholera in 71% of cases compared to 39% in the higher income bracket. In addition, of the 13 households reporting diarrhoea among children, ten had a household income of below R400 a month.

Investigations also revealed that those communities and families that have previously experienced water-related diseases appear to be particularly vulnerable to recurrence. In this study, diarrhoea among children is closely linked to the previous experience of cholera.

Health and municipal authorities should give priority to communities and families that have had a history of water-related disease to ensure that every measure is taken to end the cycle of disease, the authors note. "The cholera epidemic has passed, but the problems of access, improved management and water quality remain. Continuing reports that a significant percentage of water services authorities are not meeting water quality standards is cause for concern and an argument for greater civil society monitoring and assessment," the study concludes. 



Girls struggling to dig a new hole to get cleaner water. The lack of Free Basic Services in some rural areas still force people to return to using unsafe sources.



Breakdowns in services cause many people to store water, increasing the risk of disease.



The Limpopo River flowing through Mozambique.

Database Helps SA Keep Pledges to Neighbours

For the first time in South Africa, a central database has been created for the country's agreements with its neighbours regarding the management of its transboundary rivers.

The easy-to-access database stemmed from a Water Research Commission (WRC) funded project into South Africa's cross-border freshwater agreements. The project was undertaken jointly by CSIR and the African Water Issues Research Unit (AWIRU).

South Africa has signed and ratified the United Nations (UN) Convention on the Law of the Non-Navigational Uses of International Watercourses, which promotes the principles of equitable and reasonable utilisation and the obligation not to cause significant harm (to downstream states).

Additionally, the convention calls for the establishment of a framework for the exchange of data and information, the protection and preservation of shared water bodies, the creation of joint management mechanisms, and the settlement of disputes.

South Africa shares four main international resources with its neighbours, namely the Incomati, Orange, Limpopo and Maputo rivers. The country has a long and rich history of entering into agreements with other states regarding its shared water resources, and agreements regarding all of its shared resources have been signed.

However, prior to this project, there was no central repository for these agreements, with some being housed at the Department of Water Affairs & Forestry, and others at the Department of Foreign Affairs. Some agreements pertaining to international freshwaters were found not to be on record with either the two government departments.

If these agreements are the primary tools to promote cooperation between basin states over shared water resources, any oversights or omissions can impact negatively on the ability of South Africa and the region



The Katse Dam, in Lesotho, one of the main features of the Lesotho Highlands Water Project.

SOUTHERN AFRICAN SHARED RIVER BASINS		
	Area of Basin in Country	
Countries	km ²	%
Incomati		
South Africa	29 200	62,47
Mozambique	14 600	31,20
Swaziland	3 000	6,33
Limpopo		
South Africa	183 500	44,25
Mozambique	87 200	21,02
Botswana	81 500	19,65
Zimbabwe	62 600	15,08
Maputo		
South Africa	18 500	60,31
Swaziland	10 600	34,71
Mozambique	1 500	4,98
Orange		
South Africa	563 900	59,65
Namibia	240 200	25,40
Botswana	121 400	12,85
Lesotho	19 900	2,10

Source: Atlas of International Freshwater Agreements

to uphold the objectives of the UN Convention. If the government is unaware of its commitments and the ramifications because these agreements are not readily available, it will

not be able to carry out any duties that might be stipulated under those agreements.

Regional cooperation and security will be enhanced if the most powerful state in the area is seen to act promptly and equitably in accordance with such agreements. South Africa will then be in a position to fully utilise its equitable share of the region's freshwater resources for the development of the country, secure in the knowledge that it is upholding the spirit as well as the letter of the UN Convention.

Some of these agreements studied date as far back as the days when South Africa was still an English colony. The degree of predictability that agreements provide contributes to a spirit of cooperation and collaboration over shared water resources. However, the long-term effectiveness of these agreements depends on their regular upkeep; in this case ensuring that they are readily accessible to present day decision-makers, planners and managers. Apart from creating this central database, the WRC project also looked at the effectiveness of the present agreements.

CENTRAL DATABASE

The database contains 59 records or agreements that South Africa entered into up to 2004 which are related to international (shared) water resources. Only agreements entered into after 1910 (when the Union of South Africa was formed) were included in the database.

The list is not intended to be an exhaustive record. Rather it lists only those agreements that play a direct role in the definition and management of those international water resources that South Africa shares with its neighbours. So, for example, agreements entered into with former homelands have not been included as these now form part of South Africa.

The earliest agreement included in the database is the Agreement between the Union of South Africa and the Province of Mozambique, which was signed on 8 February, 1926. In turn, the most recent agreement is that signed between the governments of South Africa and Swaziland regarding the Lavumisa Government Water Supply Scheme, signed in 2004.

Most agreements were signed in the 1990s after South Africa's first democratic elections. Of the 20 agreements signed since 1990, 12 have been bilateral agreements that focus on a range of issues, such as the establishment of commission of cooperation and the utilisation of water. There are also several agreements with the Kingdom of Lesotho regarding the Lesotho Highlands Water Project. The remaining eight are multilateral agreements and international treaties.

Interestingly, the database also includes all the treaties and agreements related to water resources shared by South West Africa (now Namibia) and its neighbouring

territories which South African authorities entered into while they administered the country.

Users of the database are able to search for agreements using keywords, among others, countries, rivers, issues, areas or allocation mechanisms. At the time of writing, AWIRU had offered to host a live version of the database on its website and to make periodic updates of the database as needed. Meanwhile, the database is available on CD-Rom.

FORGOTTEN BUT STILL VALID

While digging up the agreements the researchers came to some interesting realisations. For example, it was revealed that the rate at which South Africa enters into agreements with other countries is increasing. This is linked partly to the normalisation of the country's relationship with the international community and partly to the global trend of concluding more multilateral treaties on water resources and management.

In addition, it was found that older agreements that were entered into while South Africa was still a British colony, or with other colonial powers prior to those territories gaining independence, are still valid and their provisions – both rights and responsibilities – are still in place, unless they have been specifically provoked by the country concerned after independence. The study also revealed the intricacy of international agreements – both in terms of the domestic ratification process that must be followed, and on an international level with other states.

Two key agreements of regional importance to which South Africa is a party were analysed. They are the Tripartite Interim Agreement between the Republic of Mozambique, the Republic of South Africa and the Republic of Swaziland for Cooperation

TRANSBOUNDARY RIVERS IN THE WORLD

There are at least 263 rivers in the world that either cross or demarcate international political boundaries. These international river basins account for nearly half



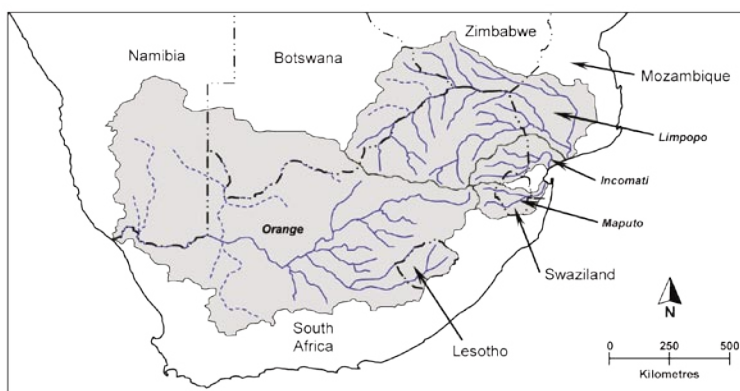
of the earth's land surface, generate roughly 60% of global freshwater flow, and are home to about 40% of the world's population. A total of 145 countries contribute territory to international basins. Geographically, Europe has the largest number of international basins (69), followed by Africa (59), Asia (57), North America (40) and South America (38).

The physical, economic and social disparities between riparian nations that share river basins

make their management complex. Yet, co-riparian states have demonstrated a remarkable ability to cooperate over their shared water supplies. International treaties and agree-

ments serve to provide structure to allow nations to address these disparities within a legal framework. This structure may provide for joint management and monitoring of the resources to support sustainable development of the water resources, including management of water flow, water quality and infrastructure development.

Source: *Atlas of International Freshwater Agreements*



The positions of the four river basins that South Africa shares with its six neighbours.

on the Protection and Sustainable Utilisation of Water Resources of the Incomati and Maputo Watercourses (signed in 2002), and the Treaty on the Lesotho Highlands Water Project Between the Government of the Republic of South Africa and the Government of the Kingdom of Lesotho (signed in 1986).

The analysis showed that these two agreements meet the requirements for effective cooperation. While the Lesotho Highlands Water Project Treaty contains important elements of 'modern' international water law,

the Incomaputo Agreement reflects the developments of international water law to a higher degree. With its comprehensive basin-wide management regime, the latter agreement is well suited to function as a model agreement for other, future, basin-wide water agreements that may be considered by the Southern African Development Community.

- To order the report (WRC Report No 1515/1/06) please contact Publications at Tel: (012) 330-0340 or E-mail: orders@wrc.org.za



Groundwater Prospects Probed for Olive Farm

The prospect of the establishment of an olive plantation near Malagas, in the Western Cape, prompted an in-depth investigation into potential sources of water for irrigation, writes Lloyd Flanagan of SRK Consulting.



A young olive tree requires about 15 to 20 litres of water weekly during the first growing season.

The medium-density olive plantation is being established on Milkwood River Farm, a property located about 10 km east of Malagas, in the Breede River Management Area. The Greenleaf Olive Company plans to plant 300 ha of olive trees in the first phase to produce about 500 000 t/a of olive oil for the local and international market.

About 1,61 million cubic metres of water a year is required to meet the irrigation demand on the farm. About 85% of the required annual supply will be used during the summer months between October and March each year. It was initially proposed that in-stream dams be built on both the perennial Melkhout and Jacobs rivers, with a combined capacity of 1,5 million cubic metres a year. However, the proposal was rejected due to the potential negative impacts of abstraction and storage.

This prompted an investigation into possible use of groundwater from the Table Mountain Group (TMG) Aquifer in addition to an off-stream dam with a capacity of 0,6 million cubic metres

a year. At present, no groundwater is used in the vicinity of the property, with the main source of water being the Breede River and its tributaries.

SRK Consulting was appointed to undertake an assessment of the groundwater exploitation potential, determine the groundwater Reserve and conduct an environmental impact assessment to obtain the necessary license for abstracting groundwater for irrigation on the property.

INVESTIGATIVE DRILLING

Four boreholes were drilled on the farm between November 2005 and February 2006. The first was drilled to only 40 m, yet a blow yield of over 35 l/s was estimated by the driller. The remaining three boreholes were drilled to 100 m deep, with final flow yields between 10 l/s and 20 l/s. On completion of drilling, artesian flow was observed at all four boreholes.

To determine the optimum and sustainable yields of the four boreholes, as well as the effect of pumping on surrounding boreholes, step drawdown tests and constant discharge tests were performed. No springs were identified or reported by people residing in the vicinity of the farm. The recommended pumping rates for the borehole ranged from 7 l/s to 19 l/s over a 12 hour/day pumping regime.

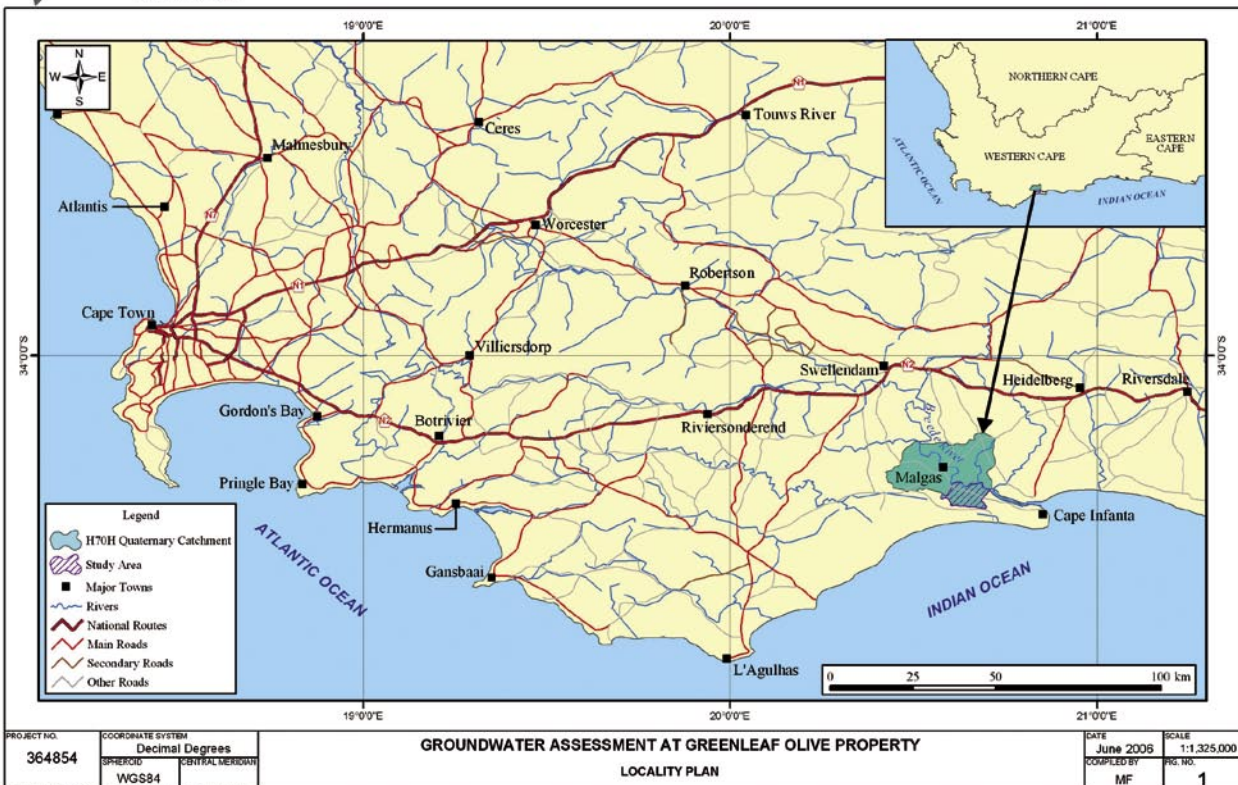
About 1,61 million cubic metres of water a year is required to meet the irrigation demand on the farm.

In addition, a hydrocensus of groundwater users was undertaken. This is an effective and cost-effective means of collecting geohydrological informa-

tion about the area. The hydrocensus resulted in the identification of three existing boreholes in the area, although none had equipment installed in them.

SUSTAINABLE ABSTRACTION

Sustainable groundwater abstraction depends on adequate recharge to replace the water being removed from the aquifer system by pumping. The secondary aquifers underlying Milkwood River Farm are recharged by direct rainfall infiltrating the overlying unconsolidated material, and permeating into the underlying Bokkeveld and TMG aquifers. In addition, higher recharge occurs along the southern boundary of the area where elevated topography results in increased mean annual precipitation. The fractured TMG rocks also outcrop with little or no cover material, allowing direct infiltration into the TMG aquifer.



Location of Milkwood River Farm



THE SOUTH AFRICAN OLIVE INDUSTRY

Olives have been grown at the Cape since the days of Jan van Riebeeck, however, the real start of olive growing as a commercial enterprise in South Africa was when Italian Ferdinando Costa started his olive farm in the 1920s. Today, the Paarl Valley remains the centre of the local olive industry.

It is reported that South Africans consume some 3 000 t of table olives and some 700 t of olive oil a year. About 40% of local production is sold as table olives, with the balance processed into olive oil. While the country is only a minor player in the



global sector, local olives and olive oils are becoming increasingly popular.

Recharge along the elevated southern parts of the area flows along the preferential fault and fracture paths down gradient towards the farm. Recharge for the study area was

estimated to be 1,45 million cubic metres a year, which equates to an average recharge rate of 4,6% of mean annual precipitation. Recharge during drought periods is estimated

to be one million cubic metres a year while during high rainfall seasons it is 1,9 million cubic metres a year.


CALCULATING THE RESERVE

During this assessment, the Reserve was calculated to account for about 21% of the estimated recharge. Based on the assessment undertaken, some 1,15 million cubic metres a year of groundwater can be allocated to Milkwood River Farm for irrigation. Interpretation of the results obtained from pumping tests confirm the four boreholes can sustainably yield some 1,2 million cubic metres a year of groundwater.

Mean recharge has been used during this assessment, and it is likely that recharge may be as high as 1,9 million cubic metres within the investigated area. Should this be the case, 1,61 million cubic metres a year of groundwater could be sustainably abstracted at the farm.

Results derived from a planned formal long-term monitoring programme will determine the feasibility of abstracting more than 1,15 million cubic metres a year. The importance of undertaking a proper groundwater monitoring programme is therefore emphasised.

It is concluded that no undesirable impacts to the environment will occur due to the proposed groundwater abstraction, as no springs are evident in the area and the identified wetlands appear not to be fed by groundwater. In addition, groundwater is not used in the area at present.

Thus, based on the results of the investigation it is probable that the decision to issue a licence to use groundwater to meet the water demand of the development at the farm will be approved by the Department of Water Affairs & Forestry. 



Towards a New Stormwater Management Approach

An investigation into South Africa's research needs regarding urban stormwater drainage and sanitation has not only identified the gaps, but is proposing a new way forward.

Report by Neil Armitage, William James and Haneem Hendricks.

The Water Research Commission (WRC) appointed the University of Cape Town to investigate research needs in the fields of urban stormwater drainage and sanitation in South Africa. This was undertaken with a view of assisting the organisation in identifying gaps and aiding it in the development of a new strategic research framework for the funding of relevant research.

The focus was on the urban setting, with particular emphasis on the problems of local informal settlements.

Workshops on the topic were held across the country. In addition, the recommendations for future research contained in the relevant WRC research reports over the last ten years were examined. More information was gleaned from scanning websites of high-profile international research organisations in the field and inspecting papers from selected conference proceedings.

The investigation not only captured perceived research requirements regarding urban drainage

management in South Africa but is suggesting the country adopt a new research paradigm.

IDENTIFYING RESEARCH NEEDS

Five main service categories of research requirements (urban stormwater drainage, sanitation, greywater, groundwater and urban rivers) were identified. Several research proposals were captured under each of these categories, with the issue of sanitation generating the largest number of



The issue of sanitation generated the largest number of research requirements.



The dire need for increased technical capacity is becoming increasingly apparent.



Protecting the country's urban rivers requires more urgent attention.

research issues. Proposals ranged from the creation of infrastructure/asset management systems, improved stormwater modelling, and user-friendly maintenance manuals for small communities to examining indigenous sanitation technologies, investigating groundwater contamination due to low-cost, density housing; investigating cooperative governance of urban rivers, and developing education material.

It became evident during the workshops that a major problem was not the lack of research per se, but the difficulty in identifying and assessing existing documentation. There were also several issues that came up repeatedly.

One was the frustration with the political process, which has resulted in low levels of technical competence at the decision-making process. There is a lack of trust between engineers appointed in the old era and politicians elected in the new, resulting in poor (and possibly inappropriate) service delivery. Linked to this was the continual reference to the lack of capacity in local government coupled with an apparent desire to give a high priority to the provision of houses (and structures) rather than the services to those houses.

Another issue is the vast gulf that exists between the technical competence of large metropolitan areas and the smaller local authorities.

As a consequence, the needs for staff in the two types of authority are vastly different. While large metros require computer-based information management tools that will allow a handful of experts to manage very complex systems, smaller authorities need easy-to-understand instruction manuals to allow for efficient management using staff with modest technical capabilities.

FUTURE URBAN WATER SYSTEMS

Worldwide, urban water problems can be summarised into three categories, namely not enough water, there is water but it is polluted and too much water. Habitat and biodiversity problems appear to be serious and getting worse with evidence of accelerated loss of species. It is possible that long-term sustainable civilisation could be dependent on preventing – or restoring – habitat and biodiversity.

Perhaps the time has come for a new philosophy of design, one where urban design focuses on 'less unsustainable ecosystems' which ideally implies, inter alia:

- ◆ Biological equity must determine design;
- ◆ Design must reflect bioregionality;
- ◆ Renewable energy systems should be used;
- ◆ The living world should be the matrix for all design, which should integrate and mimic living systems; and
- ◆ All projects should be beneficial to the planet.

Society should endeavour to design in a manner that examines very long-term changes and impacts (> 100 years), that improves and restores the natural balances and biodiversity, imitates the structure of the natural, native or indigenous system and is good for all parts of the natural system, and finally does not enrich one

individual or group to the distress or impoverishment of another.

All too often, designers use simplistic, short-term models that offer solutions that fit single-minded ideas of economic growth (e.g. what is the minimum culvert diameter?). Complex, long-term and meaningful models open up a greater variety of options (e.g. how are animal populations affected by the culvert?).

TOWARDS A NEW RESEARCH PARADIGM

There is a tendency in South Africa for proposals such as the above to be dismissed as being unaffordable, unsustainable and too risky – and thus irrelevant – in developing and transitional countries. While caution is required, nothing could be further from the truth. South Africa should learn from the mistakes of the developed countries, not repeat them!

Many developed countries are now spending an enormous amount of money dismantling many of the great engineering projects of the past, e.g. channels to drain urban areas, and mitigating the impact of others such as combined sewage. Furthermore, modern technologies, generally called sustainable urban drainage systems (SUDS) in the UK and best management practices in the US, are not necessarily more expensive than conventional design.

It is time for South African researchers to adopt a new research paradigm that focuses on 'less unsustainable ecosystems'. Implicit in this is the concept of integrated urban water management (IUWM) which refers to the practice of managing freshwater, wastewater and stormwater as links within the resource management structure, using an urban area as the unit of management. The closer the urban hydrological cycle mimics the natural hydrological cycle, the less



An apparent lack of trust between engineers appointed in the old era and politicians elected in the new is resulting in poor (and possibly inappropriate) service delivery.

unsustainable it is likely to be. Water supply, sanitation and stormwater drainage cannot be studied independently of one another any longer.

It is also important to carry out life-cycle assessments (LCAs). LCAs attempt to look at the total cost of (in this instance) a water service over its entire projected life. The objective is to help managers choose those services that have the least lifecycle costs, thereby ultimately maximising service delivery.

Fortunately for South Africa, much research into the appropriate technologies has already been carried out elsewhere, and much sophisticated software is readily available. What is now required for local researchers is to concentrate on those elements that are lacking in the South African situation.


RECOMMENDATIONS

To achieve the shift towards IUWM several activities can be promoted. This includes, the collection, archiving and presentation of data; as well as in-depth studies of the various different urban communities within South Africa to better understand water behaviour needs, obstacles to development, and ultimately to

ensure the selection of appropriate technologies that will be supported.

In-depth studies could also be undertaken into the interaction between urban water quality and quantity; the interaction between urban water supply, sanitation (including grey-water), stormwater, groundwater and urban streams; as well as into the development and use of more sophisticated models that, wherever appropriate, take into account sociological and ecological concerns.

In-depth studies of alternative water technologies (their advantages and disadvantages for South Africa); various funding models with respect to water infrastructure (with particular focus on operation and maintenance); and decision-making within the new political arena in South Africa to determine that correct decisions are made should also be considered.

Lastly, there is a need for the development of new materials to promote a better understanding of urban water issues among the different elements of urban society, whether illiterate people in the informal settlements, children in school, working class people, middle class people, industrialists or politicians. 

Watching the Clouds Go By

Have you ever lain on your back on a Sunday afternoon and just watched the clouds go by? Do you know how they form and what their purpose is?

Clouds are actually suspended masses of water and ice floating above us. Clouds form when warm, supersaturated air rises and condenses in cooler temperatures, releasing its watery burden and creating thousands of millions of droplets that are only micrometers in size.

DID YOU KNOW?

English naturalist Luke Howard created the system of cloud classification in 1803, based on Latin roots for layer (*stratus*), curl of hair (*cirrus*), heap (*cumulus*) and violent rain (*nimbus*).

There are 27 different sub-types of cloud – from the wispy to the ominous. Clouds are named according to their height and form. Cirrus typically forms high in the sky (above 6 000 metres), when strong winds sweep ice crystals into shapes that remind of wisps of fleece.

Impenetrable grey sheets, stratus creates the rainy-day look typical of Cape winters. Altostratus forms in the middle of the cloud-forming layer of the atmosphere (2 000 to 6 000 metres) and may contain ice and water. Rain-bearing sheets of cloud are called nimbostratus.

Those cauliflower-shaped clouds are called cumulus. These clouds begin in the lower level of the sky and may tower up to 16 km high. Although all clouds are white, dense, rain-bearing clouds with vertical development (cumulonimbus), often capped with an anvil-shaped head, appear dark grey when viewed from below.

Of the various miscellaneous cloud types, heavy mammatus, formed when

clouds sink in air, is the most recognisable. Mammatus is characterised by grey cloud that hangs like cows udders, and is often a harbinger of rain. Other types of clouds are orographic clouds. These clouds are formed as moist air rises over mountains or other major geographic features. The air floats up the side of the mountain and cools quickly, condensing and turning into a cloud.

A pileus cloud is a smooth cloud that is found over or on the top of a major geographic feature, like a mountain. A contrail (short for CONDensation TRAIL) is a cloud-like vapour trail that forms behind some aircraft when flying in cold, clear, humid air. The contrail forms from the water vapour contained in the jet's engine exhaust.

Clouds play an important part in trapping and reflecting heat back to Earth – this is the 'greenhouse effect' that allows us to survive on Earth. Low, white, lumpy cumulus reflects sunlight away from the Earth, while thin, wispy, high-altitude clouds transmit light and trap heat, warming the Earth.

STORM CLOUDS

Storm clouds start small and grow as warm, humid air rises in an unstable atmosphere. Here, cool and warm air mixing creates strong updraughts that support large amounts of water.



CLOUDS ON THE WEB

- ◆ <http://en.wikipedia.org/wiki/Clouds>
- ◆ www.carlwozniak.com/clouds
- ◆ <http://pals.agron.iastate.edu/carlson/main.html>


MAKING CLOUDS

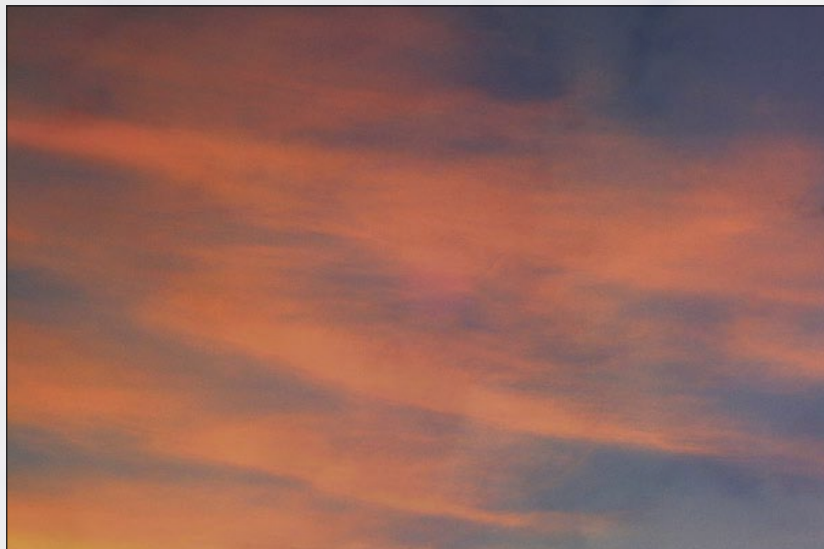
Clouds are created in five ways:

- ◆ As air heated by the ground rises in thermal currents into cold air.
- ◆ As air is forced upward by a topographic feature such as a mountain (called an orographic cloud).
- ◆ As two fronts meet and the warmer front is forced to rise.
- ◆ As turbulent air currents sweep across the Earth's lumpy surface.
- ◆ As cold air meets the warm ocean surface.

Eventually the updraughts weaken, or the amount of water becomes so great that the updraught can no longer support it aloft, and it falls to the ground as rain. Severe storms usually hit in the afternoon when the Earth's surface is hottest, but can be difficult to predict.

Hailstorms are the bane of car insurance companies and crop farmers, dangerous to anyone caught unawares. Hailstorms form as small particles of ice circulate in the updraughts of storm clouds, and can increase their size by accumulating layers and colliding with other ice fragments.

Clouds can also become electrically charged, building up a negative charge at the base and a positive charge at the top of the cloud. Although the mechanism is poorly understood, the charge imbalance may be created as collisions knock electrons off water molecules within the cloud. The intensive electric field created repels the electrons at the Earth's surface, creating a positive charge on the ground. Lightning addresses this imbalance with a surge of electricity, heating the air to around 30 000°C. 



KZN girls awarded for special tea



The South African National Youth Water Prize was awarded to three female learners from KwaZulu-Natal this year. The awards, aimed at enhancing learners' interest in science and technology, went to Thobile and Thokozani Mbanjwa and Nompilo Mahlobo, all from Mehlokazulu Secondary School in Imbali Township, outside Pietermaritzburg, for their 'plant tea' concept, which uses an infusion of organic household waste from the kitchen and greywater to grow food gardens. Amidst entertainment from Imbubu Primary School, last year's winner, Elvis Moshodi, spoke some words of encouragement to the girls who were to compete for the Stockholm Youth Water Prize, which has been won by South Africa twice in the last three years. Minister of Water Affairs & Forestry, Lindiwe Hendricks, pleaded with mothers to encourage especially their girls to apply their initiative and creativity and seek employment in the 'scarce' skills, such as engineering and science.





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