ISSN 1816-7985 (on-line) April 2007

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Newsletter of the Water Research Commission

In This Edition

Interfacing with Wetlands

"I love nature and the outdoors as they renew and refresh one's being. I also love the interface between water and land, which is where wetlands are situated. These factors have been a driving force in my interest." So says Professor William (Fred) Ellery. It was this fascination with nature, the outdoors coupled with a passion for landscapes that virtually drove Fred to choose this career path. To Fred, wetlands study was enticing in that it offered a degree of mystery and encouraged the good professor to want to discover more about these fascinating and beautiful features.

And discover he did indeed. The "journey of discovery" had its origins in the picturesque Okavango Delta where Fred worked together with his wife, Karen. Both of them completed their MSc degrees against the backdrop of the richly-endowed Okavango Delta. This was Fred's dream: "This led me to doing a degree with an emphasis on biology and the earth sciences, since rocks, soil and plants make up the landscape. I love wetlands because they integrate features of the landscape in surprising ways that are not easily predictable from their position in the landscape in which they are situated – between terrestrial and aquatic environments. Our systems are generally not comparable to other systems elsewhere in the world because of our exceptionally high altitude, lack of recent mountain-building and glaciation, and semi-arid climate. These factors mean that wetlands are generally integrated with the drainage network."

The progression from novice (discovering "novelties") to an authority (with over "20 years" of experience) was made possible through sheer passion, hard work and a deep desire to make a difference. The result : "…we were able to develop understanding about a wetland system that has seldom been achieved elsewhere in the world. The stimulus for this understanding was generated through truly multidisciplinary work involving earth scientists, life scientists, hydrologists, sedimentologists and even archaeologists. Remote sensing has also been a very important tool."

Fred is currently involved in a project which is jointly funded by the WRC and Working for Wetlands. The purpose of such research is to preserve our natural heritage, specifically wetlands. The principle of sustainability for future generations forms the core of such pivotal research. "Having worked in the field of wetland science for much of one's life, it is gratifying to be part of the new found interest of Government and Civil Society alike, in the values that these ecosystems deliver for our own well being as well as that of the environment." It takes a particular brand of vision to recognise that certain areas of research are vital to ensure sustainability. This goes hand-in-hand with individuals who embrace this vision, such as Fred, and also organisations such as the WRC and Working for Wetlands who are willing to support such initiatives. "The WRC is doing outstanding work by carefully funding applied work that is of great relevance. Dr Steve Mitchell, our Programme Manager, has deservedly received widespread acclaim for what he does tirelessly in promoting the interests of applied research in the aquatic sciences, particularly in having been awarded one of the prestigious medals of the Southern African Society of Aquatic Sciences."

The message is lucid: We should engage in a collaborative effort to protect our precious wetlands. "Wetlands are a precious resource, and we need to understand them better if we are to manage them wisely. We also need

From left to right: Suzanne Garden, Michael Grenfell and Ryan Edwards

Prof Fred Ellery

Water Research Commission

to embrace the work that Working for Wetlands and the WRC are doing to promote wetland science, and the sensible approach being used by Working for Wetlands in wetland rehabilitation. If programmes like these are to be sustainable, we need parties with passion and with legal and institutional responsibilities to get involved in fostering a culture of stewardship and responsibility towards these valuable systems."

Although Fred provides his own impetus in his ardour for his work, he is also fuelled by robust role models. They provide the inspiration and will to succeed. Fred is no exception. "I have always looked up to those people who believed in me during the early part of my career, particularly to Dr Brian Walker and Prof Kevin Rogers, who funded our work in the Okavango Delta many years ago. Professors Charles Breen and Terence McCarthy played a pivotal role in getting me to engage with big ideas, and I have worked with Terence McCarthy over many years as he is a person who has probably had the biggest influence on my professional life. My family has also been very instrumental in giving me space and opportunity to pursue my interests passionately."

Fred also mentors students in this fascinating field of study. To find out more about the postgraduate research programme in wetland science visit http://www.geography.ukzn.ac.za/

Measuring sediment thickness

Dr Steve Mitchell, Director: Water-linked Ecosystems who has worked closely with Prof Ellery says, "It is a pleasure working with a scientist of Fred's experience, and it has been exciting to follow the advances in the understanding of wetland dynamics which have been made during this programme".

Professor Ellery, the WRC, and, I am sure, most South Africans especially, appreciate your valuable contributions to the research pool. It is such a knowledge base that will make a difference where it really counts – to the environment and the lives of people!

Workshop On Training To Promote Experiential Learning And Participatory Irrigation Management By Farmers On Smallholder Irrigation Schemes: 6-7 February 2007, Farm Inn, Pretoria

The Water Research Commission (WRC) and National Department of Agriculture (DoA) hosted the training workshop. The focus of the workshop was on experiential learning by means of the Wetting Front Detector (WFD) and participatory irrigation management through the Guide for Farmer Trainers (GFT). The purpose of the workshop was to start a process to provide continued training of farmers to implement the WFD and to present courses based on the GFT.

The programme included interactive discussions with a distinct focus on training the trainer and, in so doing, building capacity among farmers, especially the small-scale impoverished farmer. Lessons learnt were also shared among facilitators in SADC countries. Members from most SADC countries were present. Representatives from agricultural colleges in South Africa were also present.

Mr Carlos Graces-Restrepo, Programme Manager from the International Programme for Technology and Research in Irrigation and Drainage (IPTRID) was one of the guest speakers present. IPTRID is an independent multi-donor trust-fund programme hosted by the Food and Agriculture organisation (FAO) of the United Nations which is based in Rome.

Also in attendance was Mr Felix Reinders who is the Vice-President of the International Commission for Irrigation and Drainage (ICID). Professor Richard Stirzaker from Australia, the inventor of the WFD conducted most of the training on the second day.

Postgraduate students under Prof Ellery's supervision, some of whom are funded through the WRC/Working for Wetlands "Wetland Rehabilitation Research Programme"

Warren Botes: Warren's Masters looks at how the success of wetland rehabilitation can be assessed effectively. The approach is to apply a recently developed tool that measures wetland health / integrity to the wetland before and after rehabilitation. A combination of the improvement in wetland health as well as the spatial extent of health improvement, are combined in a single index captured in the phrase "hectare equivalents of wetland health". Use of this index allows comparison between wetlands, and if the cost of rehabilitation is known, it is possible to measure cost effectiveness. It is hoped that this study will contribute to prioritising and planning wetland rehabilitation in the future.

Kirsten Barnes: Kirsten has almost completed her PhD on biogeochemical processes in the uMkhuze Wetland System on the Coastal Plain of KwaZulu-Natal. The wetland is responsible for trapping many tonnes of dissolved chemicals that enter the wetland from the catchment, and the key question relates to the mechanisms through which dissolved solutes are being trapped. This work is important as it describes wetland processes that are responsible for water quality enhancement, for which wetlands are so well known.

Mwitwa Chilufya: Mwitwa's research looks at developing a methodology for monitoring the rate of wetland restoration by using remote sensing. The intention is to fuse medium-scale resolution imagery (collected from the earth's surface) and hyperspectral satellite imagery, to provide indications of wetness and vegetation cover in order to measure temporal change in wetland recovery following rehabilitation. This is critical to monitoring the success of wetland restoration projects.

Ryan Edwards: Ryan is currently conducting an MSc that aims to determine the hydrogeomorphological factors responsible for the initiation, formation and development of Dartmoor Vlei in the KwaZulu-Natal Midlands. This is one of a suite of projects with a similar objective, but it targets a wetland with substantial accumulations of sediment (>8m thick). Most of the other wetlands that have been examined thus far have much less sediment than this, and the intriguing question about Dartmoor relates to why such a small wetland has such a thick sequence of sediments.

Suzanne Garden: Suzanne is doing a study in the Mfolozi Floodplain on the Coastal Plain of KwaZulu-Natal, where she is investigating floodplain geomorphic structure and functioning, particularly since the system has been radically modified by agricultural activities over the last 100 years or so. The interesting questions here relate to how the Mfolozi fits into existing models of wetland formation, and what this means in the future given high levels of human intervention and different scenarios of potential climate change.

Michael Grenfell: Michael submitted his MSc at the end-of 2006, and has been awarded his MSc with distinction. The research developed an understanding of how wetlands form and how they change naturally over time, and Michael applied this understanding to the rehabilitation of these vital yet fragile ecosystems, since we wish to promote rehabilitation that treats the causes of degradation, not just the symptoms.

Zanele Hlongwane: Zanele is doing a part-time Masters Degree looking at the role of termites in modifying the distribution of materials (soils) and resources (nutrients) in the construction of large termite mounds in the uMkhuze Wetland System. The large termite mounds are restricted to very specific locations within the wetland – where there is a combination of reworked marine sand as well as fine floodplain sediment (silt and clay). In these locations, the mounds are very evenly spaced and large – up to 4 – 5 m high! Termite mounds are also associated with distinct assemblages of plants. The key questions here relate to the role of termites in focusing resources that affect floodplain geomorphology and vegetation distribution, as well as to the issue of whether or not termites alone are responsible for observed heterogeneity in the spatial distribution of soil chemical and mineralogical features.

Eddie Riddel: This research focuses on the extent to which technical rehabilitation of large erosion dongas (gullies) through the use of weirs and gabion structures, leads to the improvement of local- and catchment-scale hydrological processes, such as reduction in peak flows and maintenance of base flows. The case study is the small valley-bottom wetland known as Craigieburn, which is situated in the headwaters of the Sand River, Mpumalanga.

Marc Humphries: This is another study that examines the subject of how solutes introduced into the uMkhuze Floodplain Wetland are trapped by the system so that water quality is maintained for downstream users. Marc has recently completed his MSc and been awarded the degree with distinction. This was largely due to the careful detective work that he did in analyzing and describing soil chemistry and mineralogy, leading him to explain interesting mechanisms of solute retention and speculating on the implications of these processes for floodplain structure and function.

Njoya Ngetar: The subject of Njoya's work is the causes of wetland degradation in South Africa, and he is approaching the subject from a geomorphic perspective. This work focuses on natural or physical processes as well as human or anthropogenic activities that are responsible for wetland degradation in South Africa. What is of particular interest is that human activities are always seen as the primary cause of wetland degradation, but it is becoming increasingly clear that long-term climate change (such as increasingly warm and moist conditions since the last Ice Age) may be the most important factor. Thus, in our region, more water may lead to wetland degradation and not to increased wetland formation. Njoya is using the case study of a small valley-bottom wetland (Craigieburn) in the headwaters of the Sand River, Mpumalanga, to increase our understanding on this subject.

Rebecca Joubert: Rebecca's MSc research involves investigating the geological and geomorphological controls on the formation and evolution of Wakkerstroom Vlei, which is a large valley-bottom wetland of particular significance for biodiversity conservation: it is a hotspot for wetland birds, is visited from afar by birders and thus a popular tourist destination. The interesting feature of Wakkerstroom Vlei is that, despite its large size, it does not have a clearly defined channel and a surprisingly low longitudinal gradient. Why does this wetland look and behave the way it does?

John Kareko: John is close to completing a PhD that focuses on both practical and theoretical aspects of co-operation / synergy between statutory and non-governmental agencies with a mandate to promote wetland protection / conservation / wise management. If wetland rehabilitation and management are to be sustainable, there needs to be collaboration between agencies, and the question of measuring the degree of collaboration / synergy and also of improving these behaviours forms the focus of John's work.

Desalination Guidelines

Many consumers in South Africa are faced with the dilemma of not having sufficient freshwater available for consumption. However, in especially many coastal cities and towns saline water is readily available and can provide a solution to this problem. This solution of making this water available for consumption is the fast emerging trend of membrane technology: it is becoming cost efficient and it has the added advantage of making the overall water tariff less dependent on the cost of desalination. The need to devise desalination guidelines and to develop procedures to select and evaluate suitable treatment options for the desalination of seawater or brackish water from boreholes is virtually obligatory.

The published report TT 266/06 by the WRC was the outcome of research into this option – an option that might well be a norm in coastal cities with the advent of climate change. The Western Cape has been on the receiving end of late and this option could very well be a solution in the near future. The WRC, true to its mission as a water knowledge hub, arranged for an information dissemination session on this topic.

The event provided information and guidance to Municipal Managers and Counselors regarding

- a concise assessment of popular desalination technologies and related issues;
- applicable guidance in the process of evaluating potential augmentation of municipal water supply through desalination, specifically within the context of available South African saline water sources. Such guidance is based on consideration of
  - saline water source quality and location,
  - desalination technology and peripheral process selection,
  - operating and maintenance aspects,
  - environmental impact and socio-economic implications,
  - capital and operating cost estimates.

Right: Delegates at the event

Bottom left: Gerhard Offringa with a copy of the guideline document

Bottom right: Kobus du Plessis presents the report to Rashid Khan (DWAF) and Gerhard Offringa (WRC)

The project, a DWAF initiative, was a success. The WRC was the implementing agent. The event was well-attended by engineers, councilors, local authority representatives, consultants and academics.

Courses

The University of Pretoria (UP) will facilitate two environmental courses during May.

Environmental Management
15-17 May

Air Quality Management
22-23 May

For more information contact:
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The WRC at the IWA Workshop

The IWA workshop "Trends and Challenges" was coordinated by Professor Eugene Cloete at the University of Pretoria (UP) on 19 March. The WRC was one of the sponsors at this event. Sponsorship translated to twenty student registration fees being sponsored by the WRC. The WRC also exhibited at the event. WRC CEO, Dr Rivka Kfir, delivered a paper on "Water for Food and the Environment: Future Challenges".

Visitors at the WRC exhibition stand

FP7– the EU's Research Programme

The European Union's Seventh Framework Programme for Research and Technological Development (FP7) was launched at the beginning of 2007. This funding programme will run for seven years, with a total budget of over 50 billion Euros. A training workshop was held at the WRC from 31 January to 2 February 2007.

The workshop provided interested researchers involved in the water research and related areas, as well as research administrators and trainers, with all of the necessary information to participate in the Seventh Framework Programme. It included sessions on introducing the EU and FP7, water research opportunities within the programme, how to get involved in a project, and how to prepare a proposal, contractual and financial issues, and developing a strategy for participation. Many of the sessions were interactive with some group exercises and considerable time was devoted to discussion.

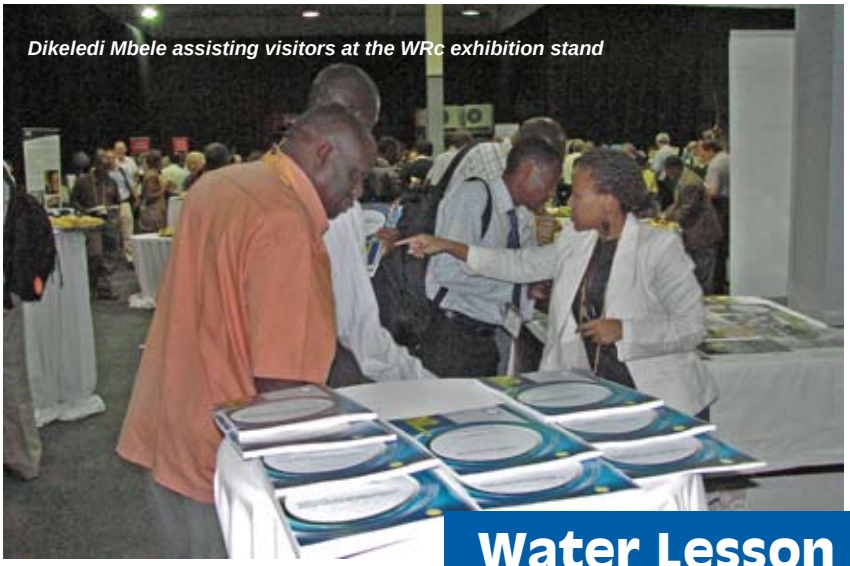
The workshop was facilitated by the UK Research Office (UKRO). In addition to the group training sessions, there was ample opportunity for delegates to speak to the UKRO trainer on a one-to-one basis. The event also included sessions presented by the UK Centre for Ecology and Hydrology and the WRC, as well as some African participants in previous Framework Programmes, who shared their experiences.

Delegates at the workshop

Renias appointed in key position

Dr Renias Dube was recently appointed by the Minister of the Department of Provincial and Local Government (DPLG), Mr S Mufumadi, as a member of the National Disaster Management Advisory Forum (NDMAF). The NDMAF is a body in which national, provincial and local Government and other disaster management role players consult one another and co-ordinate their actions on matters relating to disaster management.

The WRC @ the National Water Conservation and Water Demand Indaba



Dikeledi Mbele assisting visitors at the WRc exhibition stand

The WRC was one of the exhibitors at this event which was held at Gallagher Estate on 22-23 March. The event was well attended and WRC reports were in great demand. Jay Bhagwan, Director: Water Use and Waste Management, delivered a talk entitled "WC/WDM Evaluation and Methodologies Developed by the WRC to Support Implementation."

Water Lesson Packs

The water lesson plan packs are now up on the www.envirolearn.org.za website. The site offers valuable lessons across the water cycle from ages 5 to 17. Response to the website has been good. Registration is free and one needs to register before one can access information. The site also offers a multilingual feature. The project was sponsored by the WRC.

What's New

Report No 1437/1/06 (Contractor: Rural Support services)

An identification and review of the factors in rural water services that facilitate and impact on local economic development in the Eastern Cape

This study endeavoured to identify the factors that both facilitate and impact on local economic development (LED) both during and after the implementation of water services projects in an attempt to address poverty and underdevelopment in rural areas. The objectives of this study were to identify the factors that facilitate local economic development in water services; to identify the factors that impact on local economic development in water services; to develop a framework for planning the delivery of water services that ensures that the issue of local economic development is addressed for both community members and Water Service Providers and to capacitate the communities involved in the research project to link their water schemes to local economic development. The findings from this project reinforce a number of the key issues raised in the literature and provide further information in support of the positive impacts that can be expected if water services projects were viewed as part of an integrated development programme rather than as once-off projects. It is clear that there is an ongoing need for local economic development in rural areas and that this is an issue that should be addressed in both the planning and implementation stages of any project with the full participation of community members. It is also clear that without specific training being provided to rural communities on LED, is unlikely that there will be a significant shift in the understanding of LED and the improvement of rural economies. It is recommended that community members are exposed to awareness raising and training on the importance and meaning of LED. In addition, community members should be capacitated to understand the IDP process and their roles and responsibilities in relation to the development of the IDP. Poor service delivery by both Government and the private sector continues to hamper appropriate development in rural communities and this is an obvious threat to LED. The main constraining factors for economic development in the communities under study are poor infrastructure, lack of access roads, insufficient water and extreme poverty.

Report No 1548/1/06 (Contractor: Department of Waste Management, Environmental Business Strategies cc)

Guidance for the classification, rating and disposal of common hazardous waste streams

It is estimated that approximately 90% of hazardous waste streams are common to most industries. Since the classification, rating, and disposal requirements of these waste streams are problematic, this is often neglected, resulting in legal non-compliance, incorrect treatment, disposal, and contamination of groundwater and stormwater. Instead of every waste generator performing a separate waste classification for these common hazardous waste streams, this project aimed to develop a generic classification for these streams. Having obtained more detailed information on the common waste streams, the generator would be able to concentrate resources on their specific waste streams, which typically constitute more than 80% of the total waste produced by the generator. The study developed a user-friendly guideline document and included recommendations for the classification and disposal of common industrial hazardous wastes. Further information is also provided on the legal requirements, waste management principles and best practices in South Africa for the handling, storage, transportation and disposal of wastes. These guideline documents should add value to the waste management industry, thereby improving both the time and costs required by industry, consultants, waste contractors, disposal companies, auditors and the authorities.

Report No 1539/1/06 (Contractor: Umgeni Water)

Evaluation of sewage treatment package plants for rural, peri-urban and community use

This study investigated the performance of small-scale sewage package plants under South African conditions. The criteria selected for the evaluation of the package plants performance were the standards contained in the revised General Authorisation published in March 2004. This standard offers two sets of criteria: one for discharge into a water resource, and the other for irrigation. The project team proposed that a compliance percentage of 80% or better should constitute acceptable performance for package plants due to the scale of their environmental impact, their sensitivity to diurnal fluctuations and the common lack of expertise in operation. The study determined that small-scale sewage treatment systems tend to fail most often in their ability to effectively nitrify ammonia, and in disinfecting against bacteria. Removal of chemical oxygen demand and suspended solids tended to be successfully done by the small-scale technologies. It was found that the failures of these smaller plants were due to faults in the design and operation of the treatment systems. It was concluded that the design capacity problem could be addressed by the dissemination of effective design parameters. The study concluded that the increased use of on-site sanitation is likely to be an increasing trend in South Africa and internationally. The driving factors included economic factors, site development in areas with physical constraints limiting the choice of on-site sewage treatment processes and a greater degree of environmental impact monitoring and legislative control. It was concluded that there should be a single set of regulations for package plant effluent throughout South Africa. Poor performance may be addressed by the establishment of a national accreditation based on the NSF 40 system. If necessary, by-laws could be amended to ensure that accreditation be obtained before permission is granted to install a plant. It was recommended that a full maintenance contract system should be implemented to ensure that preventative maintenance is performed to prevent breakdowns. It was also recommended that the manufacturers of package plants organise themselves to have a representative body for the industry. This group should be tasked with representing the manufacturer's interests in negotiations with the state and other regulatory bodies. In addition, the organisation would be ideally situated to facilitate the dissemination of advances in technology, and other new developments as well as fostering general cooperation amongst suppliers.

Report No 1458/1/06 (Contractor: Coaltech 2020)

Stability and neutralisation capacity of potential mine backfill material formed by neutralisation of fly ash and acid mine drainage

Project 1242 proved it to be feasible to use fly ash (FA) as ameliorant for the neutralisation of acid mine drainage (AMD). This follow-on project was conducted to evaluate the feasibility of the process on a bigger scale and for a larger range of FA-AMD combinations, its use as an in-situ treatment barrier or as a backfill material to prevent subsurface subsidence, and the production of a bulk material suitable for work up into high value zeolites. Much attention was devoted to develop a better understanding of the chemistry involved in the neutralisation of AMD with FA. The feasibility of using FA as mine backfill was evaluated in simulated passive and active treatment systems. AMD water quality significantly improved during permeation through FA, and changed the FA mineralogy. It was difficult to determine the mineralogy of precipitates from the FA-AMD neutralisation reaction. Experiments were conducted to determine how the different backfill materials would behave when pumped and placed in simulated mine environments. Tests aimed to determine mixtures with appropriate slurry densities, strength development, slurry flow and density parameters. Solid residues performed similarly to residual solid/fly ash combinations and considerably better than the Portland cement amended blend. However, none of the materials were able to neutralise AMD over the long term. This study further demonstrated the potential to use FA in ash walling and to neutralise AMD and the use of the residual residue (or FA itself) to prepare highly adsorbent zeolites, or as backfill in underground mines. The feasibility of these applications need to be further investigated at pilot scale, as part of an integrated waste management approach.

Report No 1241/1/06 (Contractor: CSIR)

Application of pinch technology in water resource management to reduce water use and wastewater generation for an area

In this project, the pinch analysis approach was used to assess the water-saving opportunities in a water-stressed catchment. The application of pinch technology to a multi-sectoral and multi-user application over a large area is relatively novel. The case study selected was the Groot-draai catchment, which DWAF has indicated will soon experience severe water shortages. The specific objectives were to develop an inventory of water users and wastewater generators in this catchment and to develop and apply a water pinch technology model that optimises the water

use and wastewater re-use in the area. The major users in the catchment draw their water from the Grootdraai Dam. Application of the pinch model developed showed that all the wastewater of the different users could be re-used, thereby reducing the demand on the dam. The inflow to the dam would also be reduced, as part of the wastewater is currently released above the dam. Calculations indicated that the wastewater can be allocated to the different users without infringing on their quality requirements in terms of maximum inlet total dissolved solids (TDS). All individual users could take a part or all of the total wastewater but without defining further constraints in the model. It was noted that the study catchment may not be representative for other catchments: only a small percentage of the inlet water is released as wastewater, due to the presence of industries that evaporate most water as part of their processes, and that high TDS water is not returned to the surface water of the catchment, but becomes part of ash disposal sites. The conclusion reached was that the differences between a catchment and a process plant situation are significant, and that considerable changes would likely be required in order to use a water pinch model for catchment modelling. Some factors are the variable and numerous sources in a catchment, the effects of groundwater and its movement and the effects of evaporation and transpiration.

Report No 1268/1/06 (Contractor: University of Stellenbosch)

Hydrophilisation of polysulphone ultrafiltration membranes by polar polymeric solute incorporation

The greatest barrier to increased use of membranes is the tendency toward fouling. Polysulphone (PSU) is the material of choice for the manufacture of various types of ultrafiltration (UF) membranes because of its robustness and chemical stability. Unfortunately, PSU is a hydrophobic material, which is vulnerable to fouling. In order to capitalise on the usefulness of PSU membranes in filtration operations, chemical modification of this material to make it less hydrophobic and fouling was at the core of this study**.** The methodology followed was to impart a more permanent hydrophilic, non-fouling character to the membranes by synthesising a polymeric compound which is compatible with the membrane polymer in solution, but which is not soluble in water. Synthesis of a suitable material, a copolymer of poly(ethylene oxide) (PEO) and polysulphone (PSU) was accomplished with success. The PEO segments of the polymer are polar and impart hydrophilicity to the membrane. All analytical techniques used to study treated membranes showed greater hydrophilicity compared to control membranes that did not contain the modifying material. Scale-up of the synthesis reaction was also successful and quantities of up to 5kg were synthesised at a time. In this project, the first concept of a new, high-flux capillary UF membrane was developed. Although further optimisation studies are still required, it is clear that the membrane developed will have merit for use in drinking water applications and in protein separation.

Report No 1171/1/06 (Contractor: UKZN-PRG)

The establishment of a methodology for initiating and managing waste minimisation clubs

The main aim of this follow-on project was to develop a methodology for promoting, managing and sustaining waste minimisation clubs, by producing *inter alia* guides for effectively establishing and managing WasteMin clubs, specific sectoral self-assessment guides, and training material for WasteMin consultants in a franchised operation. The main conclusions reached were that the success to date of WasteMin clubs formed by WRC and others showed the value of the concept; stronger governmental support was required for further growth, to roll out the support already given to the concept in National policy, and that this project had developed and outlined a strategy for achieving this. The main technology transfer products produced from the project were a Facilitator's Manual and a Training Manual. The Facilitator's Manual is aimed at a person or organisation that wishes to initiate a waste minimisation club and requires guidelines for undertaking such a project. Training is essential for a successful waste minimisation project, and the second manual (the Training Manual) was developed to provide the basic material required to train club members in waste minimisation. In summary, the research products from this project provide a practical and comprehensive guide for establishing, managing and sustaining WasteMin clubs in South Africa, along with detailed information and material for the facilitating and training of practitioners in such clubs.

Report No 1352/1/06 (Contractor: University of the Free State)

Multi-dimensional models for the sustainable management of water quantity and quality in the Orange-Vaal-Riet convergence system

The overall aim of this study was to develop and integrate multi-dimensional models for sustainable management of water quantity and quality in the Orange-Vaal-Riet (OVR) convergence system.

The main results from the research are the following: Salinisation is an important problem in the study area that needs special management attention. The relative importance of the problem differs between Water User Associations (WUAs) and irrigation blocks. The hydrology results show that the Lower Riet Irrigation Block has the highest soil salt concentration in the upper zone, followed by the Orange-Vaal Irrigation Block and the Scholtzburg Irrigation Block, with the lowest soil salt concentrations occurring in the Orange-Riet Scheme Irrigation Block. From various management options, drainage installation and consequent leaching is a better option financially, environmentally and socially than changing to more salt tolerant crops at farm, WUA and regional levels. At regional level the direct and indirect benefits of modelled improved drainage proved far greater than the costs of drainage, and produced the highest index for socio-economic welfare (ISEW), and an addition of jobs to the irrigation and linked industries over the long term. The total real cumulative cost (2005 basis) of salinisation over a period of 15 years for the whole study area was calculated at R955 million, a good benchmark to use to leverage funds for remediation action. The main recommendations of this research project is that drainage installation for facilitation of leaching, needs to be promoted in the Orange-Vaal WUA and especially in the Lower Riet Irrigation Blocks in the study area. Factoring in the costs of drainage into irrigators' water use charges, is less than the additional financial benefits derived from the drainage, and should therefore be acceptable to farmers.

Report No 1359/1/07 (Contractor: University of the Free State)

Effect of irrigation water and water table salinity on the growth and water use of selected crops

This project was undertaken to investigate a number of issues regarding the effect of using saline irrigation water for crop production on soils with shallow saline water tables. Experiments were conducted with wheat, beans, peas and maize under controlled conditions in the laboratory, glasshouse and field with irrigation water that ranged from a low salinity of 15 mS m^{-1} to a high salinity of 600 mS m^{-1}. In laboratory experiments the germination of only pea seed was reduced by increasing water salinity. Water salinity above 150 mS m^{-1} started to inhibit the seedling growth of all four crops. Peas proved to be the most sensitive crop followed by beans, maize and wheat. In the field experiments, the evapotranspiration of all four crops declined with increasing irrigation water salinity. This decline is attributed to a decrease of osmotic potential associated with an increase in water salinity. At the end of a crop growing season the salts were found to have accumulated at or just below the capillary fringe of both soils, with maximum accumulation at 700 mm from the soil surface, where most of the water is taken up by crop roots. A single drainage cycle was able to remove between 2 and 35 ton salt ha^{-1} at a rate of 0.054 kg ha^{-1} mm^{-1} from the more sandy soil and between 0.8 and 13.5 ton salt ha^{-1} at a rate of 0.041 kg ha^{-1} mm^{-1} from the more clayey soil, depending on the initial salinity. Efficiency of salt leaching from both soils decreased rapidly when the depletion level rose above 80% of the total actual salts removed. The findings of this project lead to the development of a stepwise procedure that can be followed to formulate the best management practices for controlling root zone salinity under different conditions. This procedure still needs to be tested, verified and even modified at field scale before it can be extended to optimal practice and the establishment of guidelines for managing the salt load associated with irrigation at farm and scheme level.

Reports can be ordered at orders@wrc.org.za