

Introduction



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INVESTING IN THE CREATION AND SHARING OF KNOWLEDGE

During 2007/08 the WRC continued to serve South Africa's government reporting via its Board to the Minister of Water Affairs and Forestry, its shareholder, and DWAF. Knowledge created through WRC funds strongly supports DWAF's overarching objective, i.e. water for economic growth and sustainable development. The WRC continued to support the water sector and all its relevant institutions and partners by providing them with knowledge aimed at informing their decision-making processes, improving their monitoring and assessment tools and making available a new and improved range of technologies related to water resource management and the provision of water and sanitation services. The WRC also continued to address the issue of climate change and the linked phenomena of extreme events. Research conducted by the WRC and its research partners will support the development of adaptive and mitigating strategies which will ensure the future sustainability of the country's water resources and services.

The research portfolio for 2007/08 was set on the basis of the WRC's strategic plan. The WRC continued to invest in the creation of knowledge via its four main key strategic areas (KSAs). These areas include **Water Resource Management, Water-Linked Ecosystems, Water Use and Waste Management, and Water Utilisation in Agriculture**. In general, the portfolio as planned for the year under review was well received by the various stakeholders. The Institutional Review also supported the research portfolio and the KSA-based structure, with its four water-centred KSAs (as mentioned above), supported by the KSA: **Water-Centred Knowledge**. This structure continued to form the core operating framework for WRC-funded research and development (R&D) and was further consolidated during the year and became accepted generally.

Water Resource Management – Research carried out by this KSA aimed at ensuring that the water resources of South Africa are protected, utilised, developed, conserved and managed to achieve environmental, social and economic sustainability. The research aimed at developing a scientific understanding of the hydrological cycle (and inter-linkages) in order to promote a systematic assessment and variability of the quantity and quality of water available for development in South Africa; building appropriate quantitative understanding, tools and adaptive strategies for managing the impacts of extreme climatic events (floods and droughts) due to global warming and human-induced impacts on water resources (including an understanding of the impact on human health); providing control measures for improving the prevention, mitigation and control of pollution of water resources and supporting and improving policy reforms for promoting equitable, efficient and sustainable conservation and allocation of water resources among competing needs. During 2007/08 the WRC invested in research projects in four research thrusts in this KSA, including water resource assessment and planning; management of natural and human-induced impacts on water resources; water resource protection and water resource institutional arrangements.

Water-Linked Ecosystems – This KSA invested in the creation of knowledge aimed at enabling good environmental governance and ensuring the utilisation and sustainable management of water-linked ecosystems in our water-scarce country during a time of demographic and climate change. The research developed the understanding of the ecological processes underlying the delivery of goods and services and provided knowledge to sustainably manage, protect and utilise aquatic ecosystems. Three main research areas were addressed during 2007/08, including research on ecosystem processes, i.e. the biophysical processes, form and function of ecosystems;

ecosystem management and utilisation, including issues such as the ecological reserve; and ecosystem health and rehabilitation (rivers and wetlands).

Water Use and Waste Management – This KSA focused mainly on research for the domestic, industrial and mining water sectors. The aim was to proactively and effectively lead and support the advancement of technology, science, management and policies relevant to water supply, waste and effluent management, for these sectors. During the year under review, this KSA supported studies on appropriate technologies for improving the quality and quantity of our water supplies for domestic use with a focus on water supply and treatment technology serving the urban, rural, large and small systems. Research was conducted on new ways to manage and enhance hygiene and sanitation practices, and on institutional and management issues, with special emphasis on the efficient functioning of water service institutions and their viability. Infrastructure for both water supply and sanitation was included. Waste and effluent as well as reuse technologies that can support the municipal, mining and industrial sectors and improve management in these sectors were also addressed and innovative as well as integrated solutions to water and waste management in the industrial and mining sectors were studied. The research areas included water services – institutional and management issues; water supply and treatment technology; wastewater and effluent treatment and reuse technology; industrial and mine water management; and sanitation, health and hygiene education.

Water Utilisation in Agriculture – Research carried out in this KSA aimed at increasing household food security and improving the livelihoods of people on farming, community and regional levels through efficient and sustainable utilisation and development of water resources in agriculture. More specifically, the research focused on increased biological,

technical and economic efficiency of water use, the reduction of poverty through water-based agricultural activities, the increases in profitability of water-based farming systems and the sustainable water resource use through protection. All agricultural sub-sectors were addressed including irrigated and dry-land agriculture; woodlands and forestry; grasslands and livestock watering and aquaculture. During 2007/08, research was conducted in three main areas including water utilisation for food and fibre production; water utilisation for fuel-wood and timber production; and water for poverty reduction and wealth creation in agriculture. Research specifically addressed small-scale farming and rural communities.

Supporting research projects

During the year under review, the WRC supported 286 research projects, of which about 75% (216 projects) were active projects (ongoing and new) and about 24% (70 projects) were finalised. The active projects comprised 149 ongoing projects and 67 newly initiated projects that commenced during 2007/08. The various mechanisms of funding included both non-solicited projects, accommodating projects within the broad research strategy of each KSA, and solicited projects, where research projects are developed in accordance with clear terms of reference, aimed at solving specific problems. The WRC supported 75 solicited projects, which translates to about 35% of active projects.

The reduction in the total number of projects is directly related to the reduction of the number of ongoing projects and is a clear indication of improved project management with special reference to the deliverable framework which was introduced in recent years. In comparison with the previous year, the year under review shows a 9% decrease in the number of projects. There is an increase of 20% in new projects in comparison to the previous year. In addition, this also relates to the increase in the number of active solicited projects which increased by 12% from the previous year. These projects are often large and include a number of organisations working as a consortium. This reflects the WRC commitment to address the needs of the South African water sector where research problems are often of a complex nature which requires larger projects of a multidisciplinary nature.

Total investment in the support of knowledge creation, sharing and dissemination amounted to R99.2m. This represents an increase of 16% from the previous year (R85.5m. total investment was reported in 2006/07). This investment includes about R4.3m. for the Water Information Network (WIN-SA) and other income leveraged for research projects during the year under review. Both the investments in

research projects and in research support, expressed as a percentage of total expenditure, were close to the set budgeted ratios and almost identical to that of previous years. The ratio addressing the funding of the creation of new knowledge (research projects only) is almost identical to that of the previous year, with only a 1% increase. The ratio for research support is also similar to that of the previous year, with only a 1% increase.

Leveraging income for the creation, sharing and dissemination of water-centred knowledge

During the year under review the WRC continued to leverage levy income by striving to obtain funds from other sources to support water research. During 2007/08 this drive has been highly successful. The WRC income originating from sources other than the levy for 2007/08 amounted to R13.3m. Leveraged income included funds allocated to a number of KSAs for direct support to research projects and funds provided for knowledge sharing and dissemination (e.g. WIN-SA). Leveraged income was obtained from both local and international sources, where the main source of income was due to support by various government departments for specific research and other knowledge-sharing projects. Other sources of income amount to about 15% of the total income.

BUILDING THE WATER-CENTRED KNOWLEDGE BASE – CAPACITY BUILDING

During the year under review, the WRC placed strong emphasis on building research capacity in South Africa. By increasing the number of students conducting water research, the WRC provides South Africa with a good basis for future researchers as well as a source of skilled human capital for other institutions within the water sector. In many areas of research supported by the WRC, it is evident that students who participated in earlier WRC projects are currently leading WRC-funded research projects and are serving as members of steering committees as well as reviewers of new proposals.

During the current year (2007/08) the WRC has excelled in its support to students, with special emphasis on historically disadvantaged students. Currently about 664 students are supported by WRC projects, of whom about 65% are from disadvantaged backgrounds. This is a significant increase in the number of students as well as an increase in the percentage of historically disadvantaged students as compared to previous years. This clearly indicates that the WRC's strategy to improve capacity building through its research projects continues to bear fruit. Of all the institutions supporting students, universities are clearly leading

with 452 students, of whom 286 or 63% of students originate from historically disadvantaged backgrounds. Although all universities support students, the University of KwaZulu-Natal exceeded all with about 94 students, followed by the University of Cape Town with 68 students, 48 students at the University of Stellenbosch and 43 at the University of the Western Cape. Science Councils supported more than 50 students, with the CSIR supporting 37 students, of whom 62% are from historically disadvantaged backgrounds. The large water boards, including Rand Water and Umgeni Water, also indicated a large number of students totalling 20 with 60% originating from historically disadvantaged backgrounds. There is also a clear pattern of an increased number of students involved in projects led by consultant groups. Many consulting firms indicated the involvement of about 10 students. The increase in the number of students in non-academic institutions is encouraging as these students represent 'on the job' continuous development and/or new skilled human capital for the sector. The increase in the number of students is also a result of the WRC strategy of building research networks and research consortia.

Institution	Number of disadvantaged students	Total number of students
African Water Institute (AWI)	1	1
Anchor Consultancy (linked to UCT)	13	13
ARC	2	4
AWARD	1	1
Cape Peninsula University of Technology	6	9
Central University of Technology	1	1
Chris Swartz Water Utilization Engineers	16	16
Conningarth Economists	2	4
Conward Consulting	3	4
Council for Geoscience	2	3
CSIR	23	37
Digby Wells and Associates	2	4
Durban University of Technology	2	2
Duzi-uMngeni Conservation Trust	1	1
Emanti Management (Pty) Ltd	3	3
ERWAT	1	2
GEOSS	1	3
Golder Associates Africa (Pty) Ltd	7	7
Groundwater Africa	1	1
HSRC	2	2
Jeffares & Green Consulting Engineers	2	3
Nelson Mandela Metropolitan University	5	20
Nemai Consulting	2	2
Ninham Shand	0	2
Palmer Development Group	2	2
Partners in Development cc	6	6
Pegram and Associates	4	5
Proxa (Pty) Ltd	1	1
Pulles, Howard and de Lange (now with Golder)	7	12
Rand Water	3	8
Rhodes University	7	14
Rural Integrated Eng	7	7
SA Institute for Aquatic Biodiversity	2	7
SASRI	3	4
SAWS	2	3
Sigma Beta	0	1
Source Strategic Focus	2	3
SRK	6	8
Sustainable Environmental Technologies	1	1
TBR Project	1	1
Tshwane University of Technology	11	11
The Impact Free Water Group	4	5
Umgenei Water	10	12
Umhlaba Consulting	1	1
University of Cape Town	45	68
University of Fort Hare	18	19
University of Johannesburg	6	7
University of KwaZulu-Natal	50	94
University of Limpopo	3	4
University of Pretoria	30	45
University of Stellenbosch	28	48
University of the Free State	14	27
University of the North West	8	16
University of the Western Cape	32	43
University of the Witwatersrand	8	18
University of Venda	12	17
Zitholele Consulting (Pty) Ltd	1	1
	434	664

Students supported by the WRC attended and delivered presentations on WRC-related projects within South Africa and also beyond its borders. Examples include, Geoff du Toit from UCT, and Valentina Parco, from Palermo, Italy, who presented a joint paper on the work of their respective Doctorate and Masters degrees at the IWA Young Professionals Conference on Membranes for Water and Wastewater Treatment. The event was held between 4 and 6 June in Berlin. These innovative young students worked in the UCT Water Research Group (WRG) laboratories under the guidance of Professor George Ekama and Associate Professor Mark Wentzel, on a WRC-funded project to better understand the impact of micro-filtration membranes on the performance of biological nutrient removal (BNR) systems. The solid-liquid separation step is crucial to the effectiveness of the BNR process and membranes, when used correctly, can reliably ensure this step in the treatment process. Marcelle Marchand, a Ph.D. student in the Department of Zoology at the University of Pretoria, received a Young Scientist Award (YSA) for her poster presentation at the 17th annual meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in Porto, Portugal in 2007. The award is presented annually and is intended to honour individual prominent performance in scientific work of a junior scientist under the age of 30. Marcelle will receive the award at the Opening Ceremony at the 18th annual SETAC meeting to be held in Warsaw, Poland during 2008. Marcelle's project was achieved through WRC-funded research.

One of the important areas requiring the building of competence is that of local government. The WRC serves as the implementing agent for DWAF with regard to WIN-SA. The WIN-SA sector initiative is growing in strength. WIN-SA is aimed at knowledge sharing and capacity building for local government. WIN-SA's *Water Services Councillor Induction* (instructional DVD) has 'got the whole country talking'. It is a very useful and concise tool aimed at capacitating local government: it captures essential issues, enables councillors to see the real picture and to hear from other councillors. The growth of the WIN-SA *Lessons Series* is highly appreciated by local government and other stakeholders. Nine lessons have been completed covering various themes which focus on improved service delivery by local government. The WIN-SA *Fieldnote Series* was launched this year. This series captures discrete experiences by local government in a two-page document that is easily accessible. The new look WIN-SA website has recently been launched. It seeks to provide easier navigation and access to information. WIN-SA recently conducted a learning journey for 12 officials from the North West and the Northern Cape provinces, to learn more on operations and maintenance of infrastructure. This initiative was highly appreciated by local government in both provinces.

Another key capacity-building area in the development of competencies and capacity regarding water resource management is FETWater. The WRC continues to co-lead the activities of the **Framework for Education and Training in Water (FETWater)**, a joint UNESCO, Belgian and South African programme aimed at building improved capacity in integrated water resource management. During the year under review, the WRC assumed the position of implementing agent for Phase II of the programme.

Building capacity in Africa

The WRC's capacity-building activities continue to address both support for Africa and participation in global initiatives aimed at building capacity: Some examples include:

- **NEPAD – network of centres of excellence for water research in Africa.** This is an ongoing dedicated activity, where the WRC coordinated and led the process of establishing the network in cooperation with the French Institute for Development Research (IRD). During the year under review a framework was developed to determine criteria to select those organisations that would act as centres of excellence. The process of selection is currently ongoing.
- **Water Research Fund of Southern Africa (WARFSA).** The WRC has been involved in this research-capacity programme for a number of years. Currently one staff member serves as a Board member of WARFSA. WARFSA was established with the purpose of building research capacity among regional institutions and individuals as well as promoting the utilisation of research results in the planning and management of water resources in the sub-region. The WRC coordinated the logistics of the WARFSA Board meetings.
- **Streams-Africa.** Another example is the WRC's role in *Streams of Knowledge*, a network of capacity-building organisations, focused on water and sanitation, with most members being from various parts of Africa. The network is led by a staff member of the WRC. In recent months, in cooperation with WIN-SA, a number of African resource centres are developing a plan to build *Stream-Africa*, which will specifically support capacity building in water and sanitation in Africa with an initial focus on Southern Africa.

INNOVATIONS AND KNOWLEDGE APPLICATION

The WRC continues to support the development of new applied knowledge and water-related **innovation**. While the WRC supports many innovations which are considered to be advantageous to the public and are readily available for use, some technologies, processes and products require commercial involvement in order to make them publicly available. In recent years the WRC

supported the **commercialisation** of such innovations where applicable. However, the process has proved to be complex (requiring dedicated specialist support) and to have long-term prospects (often several years are required). In this connection, although a high percentage of the patent portfolio of the WRC is licensed out, the WRC continues in its effort to earn income from its licensed IP. In addition, with the improved capabilities of certain academic institutions to manage IP, the WRC has opted, in certain cases, to sign benefit-sharing agreements and allow these institutions to take the commercialisation process forward. An example is the **Olive Wastewater Treatment Technology** which was assigned to the University of Cape Town (UCT) and a benefit-sharing agreement was signed.

Currently, the WRC has licence agreements with reputable South African and international companies. These include one innovation earning royalties, i.e. **The Secondary Metabolites**, a cluster of 13 patents, which is currently licensed to Synexa-Life Sciences and the WRC has been receiving royalties since 2006. Two other licensed innovations including the **BioSURE™ Process**, a cluster of 36 patents, which is licensed to ERWAT and the **Ambient Temperature Ferrite Process (ATFP)** for removing iron from acid mine drainage, which is currently licensed to Environmental Technology Agencies (ETA) are currently undergoing further development. Such development is often required to allow the technology to function at a large scale. During the year under review another innovation was licensed out. This is an invention that will allow the provision of clean water at a small scale and could effectively provide for drinking water for small rural communities. The **Filtration Membrane Technology (CUF)**, a cluster of 5 patents, was licensed to Ikusasa Chemicals in January 2008.

The filing of 5 patent applications (filed during 2006/07) is at different stages of prosecution and licensing negotiations. These patents include:

- Biosensor
- Method of detecting the presence of micro-organisms in a solution
- Passive sampler
- Application for fly ash and its derivatives
- Synthesis of zeolites.

In January 2008 one Patent Corporation Treaty (PCT) patent application entitled 'Treatment of Wastewater using Dual-Stage Membrane Bioreactor' was filed. The invention relates to a wastewater treatment process for removing undesired impurities from effluent feed. The process includes the steps of providing a discrete acclimation bioreactor system for developing a desired micro-organism inoculum, with the system being in selectively interruptible fluid flow connection with a discrete effluent hydrolysis system. This allows the flow of desired micro-organisms from the

bioreactor system to the effluent hydrolysis system to be regulated independently from the effluent feed flow through the hydrolysis system, leading to greater flow-through and system efficiencies.

The WRC is investigating various modalities for marketing its inventions, and is currently negotiating the support of a reputable South African technology broker company in this regard. The WRC is also developing a technology transfer website (to feature within the WRC website) that would be used to promote WRC inventions.

Innovations

As indicated above, the WRC supports many innovations that do not require a commercial route for their transfer and applications. Examples of such innovative methods and tools include:

- **The Ambic protocol for recovery and detection of *Ascaris ova*** – an improved method for recovery of *Ascaris ova* was developed through a WRC study. The method allows for the removal of interference due to soil particles and improves recovery by up to 77% yield.
- **Water services barometer tool** – general public's knowledge / awareness / understanding / behaviour regarding key water services messages can serve as an indicator of the 'state of community consultation'. The barometer was constructed in order to give a 'reading' of the current state of knowledge and awareness amongst the South African public regarding key water services knowledge areas. The barometer instrument can be applied to assess any community consultation process and can be used as a tool to determine whether the target audience was reached and whether the money was well spent.
- **The twin-channel vertical slot fish-way** – is a new concept internationally. It has revolutionised fish-way design and will reduce the cost substantially from existing designs, carrying a wide range of fish species and sizes. It can be incorporated in the back of a Crump Weir, which is the commonly used design of a gauging weir on the larger South African rivers.

LEADING WATER-CENTRED KNOWLEDGE

The WRC serves South Africa as its water-centred knowledge hub. As such the WRC has to provide leadership and strategic direction regarding knowledge creation, sharing and dissemination. The standing of the organisation locally, in Africa and globally is therefore of utmost importance. During the year under review the WRC improved its standing locally and led and coordinated many local strategic initiatives. In addition, the WRC excelled in its drives to link with and support Africa and in linking South Africa to global knowledge, i.e. with

the aim of excelling in leading water-centred knowledge in South Africa.

LOOKING AHEAD

Effectively looking ahead requires an understanding of where we come from and what has been achieved to date. It also calls for understanding the current and future of the WRC environment and the needs of South Africa. In 2002 the WRC took a strategic decision to transform the organisation into a dynamic hub for water-centred knowledge, addressing South Africa's research needs and supporting the dissemination and application of the created knowledge. This transformation called for fundamental changes that aimed to make the organisation highly relevant, effective and efficient. It required the bold step of streamlining its business, and therefore 18 research fields were narrowed down to 5 KSAs. It also required the need for integrating mechanisms and understanding the impact of the research. The WRC identified the impact areas of the economy, society, health and the environment as key to its research portfolio. Collectively, these areas support the objective of water serving as a driver for economic growth and sustainable development. While organising the WRC along four key areas related to water issues from water resource management to its effective uses, the WRC has built strong support for knowledge sharing, dissemination and application through its **Water-Centred Knowledge** KSA. It has also invested in enhancing its financial and legal functions. Functioning as South Africa's dynamic and credible water knowledge hub required the WRC to be close to its shareholder and key stakeholder, the Minister and the Department of Water Affairs and Forestry and to actively reach out to the water sector, related sectors and the community at large.

Transformation of the WRC was not only internally focused. The WRC targeted research areas and provided knowledge that, if appropriately utilised, could effectively improve the quality of life of all South Africans, providing them with a reliable and safe water supply and sanitation and contributing to future economic growth. Transformation of the water sector also required skills and competencies. The WRC has been supporting historically disadvantaged students with the aim of not only building a new generation of researchers, but also providing new skilled capacity to the sector.

While building and continuing its service to South Africa, the WRC realises the importance of partnerships and building strong networks locally, globally and, especially, in Africa. In recent years the WRC initiated a strategic drive to strategically support a number of initiatives in building water research capacity in Africa.

As reported during the financial year, the WRC continued to serve South Africa as its dynamic water-

centred knowledge hub. Building capacity, creating new knowledge and improving its mechanisms regarding knowledge dissemination were matters of priority. In future years the WRC aims to further build on what has been achieved, adhering to its mandate of providing the country with a knowledge framework that will ensure that the country has safe drinking water and sanitation for all and that the quantity and quality of water available for various water uses will promote a healthy environment and sustainable economic growth. The WRC will continue to support its shareholder and DWAF in realising the objective of water for Sustainable Growth and Development, while providing the knowledge required for sustainable infrastructure for water and sanitation services; effective water management policies; and systems and adaptive and mitigating strategies to face the challenges of climate change.