CORPORATE PLAN

2016/17 - 2020/21

WATER
RESEARCH
COMMISSION

The WRC Vision

To have highly informed water decision-making through science and technology at all levels, in all stakeholder groups, and innovative water solutions through research and development for South Africa, Africa and the world

WRC Mission

To be a global water knowledge node and South Africa's premier water knowledge hub active across the Innovation Value Chain that:

- Informs policy and decision making;
- Creates new products, innovation and services for socio-economic development;
- Develops human capital in the water science sector;
- Empowers communities and reduces poverty;
- Supports the national transformation and redress project; and
- Develops sustainable solutions and deepens water research and development in South Africa, Africa and the developing world.

WRC Values

- A culture of learning and sharing
- Innovation and creativity
- Integrity and fairness
- A spirit of professionalism and service orientation
- Facilitating empowerment and social change
- Good governance

OFFICIAL SIGN-OFF

It is hereby certified that this Corporate Plan:

1. Was developed by the Water Research Commission under the guidance of the Water Research Commission Board.

2. Takes into account all the relevant policies, legislation and other mandates for which the Water Research Commission is responsible.

3. Accurately reflects the strategic outcome-oriented goals and objectives which the Water Research Commission will endeavour to achieve over the period 2016/17 – 2020/21.

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Chief Financial Officer

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Chief Executive Officer

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Chairperson of the WRC Board

EXECUTIVE SUMMARY

South Africa is in its 21st year of democracy. Few will argue against the considerable achievements in extending services to the previously unserved in both the water and sanitation domains. Fewer will argue that, while these achievements have been phenomenal when compared with other countries globally, the road ahead to achieve the last mile connections and the complexity of ensuring the sustainability of the interventions are of paramount concern. And this all has to be achieved in an environment of increasing resource scarcity. This is a combination of both natural resources, as the same quantum of water has to be made available at good quality to a larger number of users, as well as economic factors. The latter is, in turn, a combination of the global economic contraction as well as South Africa's own import dependencies for many solutions and products.

South Africa is also part of a global water scene where the world is grappling with the post-2015 development agenda. The new Sustainable Development Goals (SDGs) have been defined, which will build on the Millennium Development Goals and address in a balanced way all three dimensions of sustainable development.

When heavy wheels need to be turned in low power environments, gears are the answer. Science and technology have a long tradition of providing the gearing effect in socio-economic development, and the clarion call for a high contribution to uplift South Africa's water and sanitation fortunes is loud.

This is a point worth emphasising. The world's water-secure countries and companies share an import set of characteristics. They tend to have adequate and well-maintained infrastructure, which in turn is managed by sufficient pools of skilled talent. The water behaviour of its people and Corporate Citizens is highly responsible. And these systems are strongly advised in their decision-making by very good science and technology. In fact, these water systems as a whole are highly knowledge-driven in addition to being highly knowledge-informed.

The close connection between science productivity and the economic fortunes of systems also has to be made more pronounced.

Figure 1. R&D and the cubed challenge

The South African cubed challenge is poverty, unemployment and inequality (Figure 1). The word 'triple' does not do it justice. Each of these factors has a pronounced effect on the fortunes of the other two and is not merely additive, as each individually increases both the magnum and complexity of the partner challenges; hence the cubed or power-of-three challenge.

It is important to recognise that research and development (R&D) offer important opportunities and catalysts to economic activity and economic activation that has the net result of lifting people out of poverty (Figure 2). This can be through enterprise and entrepreneur development to deal directly with the challenge of unemployment, or the provision of knowledge and tools to enable self-sufficiency to develop sustainable livelihoods and ensuring access to basic needs. The WRC, together with the DST, has already developed the Ten-Year Water Research, Development, and Innovation/Deployment Roadmap, which provides a sector-defined, needs-driven research agenda that caters for the public sector (utilities, municipalities), private industry, agriculture, and environmental protection.

The third leg of the cubed challenge – inequality – is a vexing one. The science contribution is at least two-fold. The first is the availability and development of knowledge, and management of the knowledge system to transform the South African cohorts of both knowledge workers as well as water management practitioners at all levels. The second is to contribute to South Africa's

stated desired goal of transforming into a knowledge-based economy from a primarily resource-based economy.

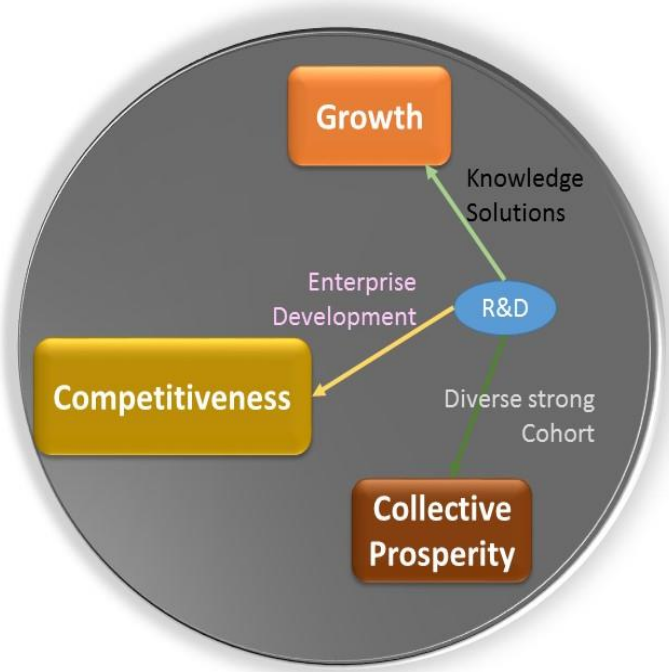

Figure 2. R&D and the cubed opportunity

It is also important to understand that this is part of the development continuum. That the very same science factors, mechanisms and trajectories of achievement will be equally successful in ensuring that South Africa will also be able to fully engage on a pathway to growth and international competitiveness on the back of a successfully transformed and prosperous society.

The WRC response to this in the Corporate Plan for the 2016/17 to 2020/21 period (CP16) is to shift to higher investments in the 'impact' domain. This period will see a higher profile in the water quality and sanitation domains and special programmes to assist with water scarcity and drought events across water use sectors and role-players. The latter is of particular importance as scientific evidence indicates that South Africa has entered a drought cycle. Various studies also indicate that drought frequency, severity and intensity will increase as a result of the effects of climate change.

Further, the shift of emphasis toward realising higher impact will be guided toward the following objectives:

1. **Shortening the Innovation Value Chain**. The classical journey from the research activity to the real economy is currently a long one. Various experiments to 'shorten' the chain have given us encouragement to use the following measures in CP16. The first is the expansion in real numbers and in participation of the Innovation Projects portfolio in the WRC. The second is very active knowledge mining of the overall water research and related repositories for solutions and 'pre-innovations' that need shorter-term projects to bring the solutions to fruition and hopefully closer to market and/or use. The third is to introduce mechanisms and tools to provide business development support for knowledge-based offerings in the water and sanitation sector to be assisted into becoming sustainable enterprises.
2. **Better knowledge management**. We are severely hamstrung with the lack of centralised or co-ordinated water knowledge repositories in the public domain. The WRC will expand the work that it began with the water history and hydrological information efforts to a broader water knowledge management in the public interest drive, together with mechanisms and platforms to better access water knowledge for all user groups and the general public.
3. **Innovative resource mobilisation**. The CP16 will be resourced through a series of partnerships with public and private sector entities across the innovation value chain. These will be research partnerships, technology development partnerships, implementation partnerships and, of course, funding partnerships. These will be both local and international. A special new area will be corporate social responsibility (CSR) partnerships with corporates – utilising WRC knowledge solutions and corporate CSR budgets to make meaningful differences in the lives of communities.
4. **Increasing the internationalisation of South African water and sanitation science and technology.** This objective has the dual goals of building South African water and sanitation R&D through international partnerships as well as assisting with the development of water R&D in Africa and other parts of the Global South. The WRC will continue to engage with partners towards achieving the targets of the sustainable development goals across the three core pillars: poverty, unemployment and inequality.

CP16, positioned four years into the current planning cycle, has seen several strategic elements come to fruition, most notably: the first WRC Knowledge Tree Reports supporting the expanded drive to an increased emphasis on the outcomes and impact of WRC R&D; the multi-year, multi-project WRC Lighthouses; and an Annual Performance Plan (APP) which is constantly improving toward a more streamlined post-transition indicator set.

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List of Acronyms

AMCOW	African Ministers' Council on Water
CEO	Chief Executive Officer
CMA	catchment management agency
CP14	WRC Corporate Plan 2014/15 – 2018/19
CP15	WRC Corporate Plan 2015/16 – 2019/20
CP16	WRC Corporate Plan 2016/17 – 2020/21
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DHS	Department of Human Settlements
DMR	Department of Mineral Resources
DRDLR	Department of Rural Development and Land Reform
DST	Department of Science and Technology
DWS	Department of Water and Sanitation
GDP	gross domestic product
HCD	human capital development
HEI	higher education institution
IP	intellectual property
IWRM	integrated water resource management
KSA	Key Strategic Area
MDG	Millennium Development Goal
NDP	National Development Plan
NEPAD	New Partnership for Africa's Development
NGP	New Growth Path
NPC	National Planning Commission
NWRS	National Water Resource Strategy
PDI	previously disadvantaged individual
R&D	research and development
RDI	research, development and innovation
RHP	River Health Programme
RPS	Research Policy and Strategy Committee
SADC	Southern African Development Community
S&T	science and technology
TIA	Technology Innovation Agency
WEF	Water–energy–food (Lighthouse)

WIN-SA	Water Information Network for Southern Africa
WRA	Water Research Act
WRC	Water Research Commission
WSD	Water sensitive design
WWF	Worldwide Fund for Nature

PART A: STRATEGIC OVERVIEW

1. INTRODUCTION

This five-year Corporate Plan (CP16) focuses on the period 2016/17 to 2020/21.

Access to sufficient water of an appropriate quality is necessary for life, for economic growth and for social development. It underpins the well-being and prosperity of South Africa and all of its people. For the South African water science community the challenges are clear – translating research, development and innovation (RDI) into real solutions to address poverty, inequality and unemployment, while applying knowledge solutions to advance opportunities to enable economic growth, improve competitiveness and ensure prosperity.

CP16 is founded on four core principles conceptualised in the first iteration of the five-year Corporate Plan for 2013/14-2017/18:

Investment in the 'multiplier effect': The 'multiplier effect' relates, firstly, to the *WRC Knowledge Tree* which aims to *inform policy and decision-making*, *contribute to sustainable development solutions*, *develop products and services* for the economy, actively *contribute to human capital development*, directly *empower communities*, and *enable the national transformation project*. Secondly, it speaks to the continuous improvement of a programmatic approach to choose a significant proportion of new projects in each funding cycle that build on the knowledge base of existing and previous funding cycles.

Research concentration for accelerated knowledge and solutions development: This will be done through the development of *WRC Lighthouses*. These are trans-disciplinary, multi-KSA and inter-institutional *mega-projects (platforms)* that will examine priority water issues across the innovation value chain.

A further diversification of the research philosophy: This will allow the WRC to expand the number of projects in the portfolio that move from the classical independent-observer scientific approach to an action-research paradigm. This entails the broadening of our scope to one that *actively involves communities in the research project*, and engages key partners to upscale and maintain interventions post-project.

Several key points of focus will be further enhanced through **elevations in research** during this five-year period; for example, through the development of new WRC Lighthouses, and the broadening of scope of others, while building new research cadres and capability and expanding participation in Centres of Excellence.

Elevations in important impact areas: The WRC is pursuing elevations in several key impact areas through, among others, technology scanning, reverse engineering, and the pursuit of ready-to-use solutions in a plug-and-play mode.

Partnership: To stretch the impact of the Water Research Fund, the WRC has a strategy to increase the WRC's partnerships in various domains. These include research partnerships, implementation partnerships and innovation value chain partnerships.

2. LEGISLATIVE AND OTHER MANDATES

The WRC serves as the R&D partner of the sector leader, the DWS, and provides the sector with knowledge and capacity to ensure sustainable management of water resources and enhance water services.

2.1 Constitutional mandate

The WRC is bound by the Bill of Rights contained within the Constitution that is applicable to all laws. In the execution of its mandate, the WRC upholds several key principles of the Bill of Rights, most notably section 27.1.b that gives everyone the right to have sufficient access to water. The WRC regards the ready availability of water knowledge and understanding as critically important to the adoption of effective and innovative strategies for equitable water service provision, management and use. It also has the pivotal role of being the knowledge partner to the respective implementing agents in the realisation of the Bill of Rights.

Additionally, section 16 of the Constitution, which addresses freedom of expression, including the right to academic freedom and freedom of scientific research, also applies to the work of the WRC.

2.2 Legislative mandates

The WRC is governed by the Water Research Act (WRA), Act No. 34 of 1971, which outlines the purpose and mandated objectives of the organisation. The WRC also operates and accounts for its activities in accordance with the Public Finance Management Act (PFMA), Act No. 1 of 1999, and is listed as a national public entity in Schedule 3A of this Act.

The mandated objectives of the WRC are also in accordance with the requirements of the policies of the DWS for the Water Services Act (Act No. 108 of 1997) and the National Water Act (Act No. 36 of 1998). Key legislative frameworks and their applicability to the WRC are highlighted below.

Water Research Act (Act No. 34 of 1971 as amended)

The principal aim of the WRA is to provide for the promotion of research in connection with water affairs. The Act requires the establishment of the WRC and the Water Research Fund, and sets the framework within which the WRC operates. It also provides for the establishment of the WRC

as a Schedule 3A public entity, thereby requiring compliance with the PFMA Act (Act No. 1 of 1999) and Treasury Regulations.

The WRC's mandate, as set out in this Act, highlights the following functions to be carried out by the organisation:

- Promote co-ordination, co-operation and communication in the area of water research and development
- Establish water research needs and priorities
- Stimulate and fund water research according to priority
- Promote the effective transfer of information and technology
- Enhance knowledge and capacity building within the water sector

National Water Act (Act No. 36 of 1998)

The objective of the National Water Act (NWA) is to ensure that South Africa's water resources are protected, used, developed, conserved, managed, and controlled in a sustainable and equitable manner, for the benefit of all persons. The NWA also provides for the pricing strategy for water use charges, the primary mechanism for the calculation of a charge, payable by some or all raw water users, that is also set for research purposes by the WRC. The role of the WRC is to align its funding priorities with those key national water challenges articulated in the NWA, and to help solve water-related problems which are critical to South Africa's sustainable development and economic growth.

Water Services Act (Act No. 108 of 1997)

The objective of the Water Services Act (WSA) is to provide for the right of access to basic water supply and basic sanitation by setting national standards and norms. Section 156, read in conjunction with Part B of Schedule 4 of the Constitution of the Republic of South Africa (Act No. 108 of 1996), vests in the Executive Authority the responsibility to support and strengthen the capacity of municipalities to manage their own affairs, to exercise their powers and to perform their functions. Again, the applicability of the WSA to the WRC rests in the WRC's duty to respond to water supply and sanitation needs with research and development that helps to address those needs.

2.3 Planned legislative mandates

All three Acts are being revised, and have a strong possibility of being amended in a manner that strengthens the WRC mandate.

Review of the water-related legislation

The Department of Water and Sanitation is currently reviewing the National Water Act, 1998 (Act No. 36 of 1998), the Water Services Act, 1997 (Act No 108 of 1997) and the Water Research Act, 1971 (Act No. 34 of 1971).

While the National Water Act provides a legal framework for the progressive realisation of the right to access to sufficient water, the Act is under review to ensure that there is equity in the allocation of water, to improve water resource management and to streamline regulatory processes. In turn, the Water Services Act is being reviewed to improve the provision of water services to ensure alignment with the provisions of the Municipal Systems Act, 2000 (Act No. 32 of 2000) and the Municipal Finance Management Act, 2003 (Act No. 56 of 2003).

The revised policy positions necessitate the consolidation of the NWA and WSA into one piece of legislation that will govern the entire water value chain covering water supply and sanitation services as well as water resource infrastructure. This consolidation will not only allow for managing water across the value chain but will also enhance cooperative governance and set clear institutional roles and responsibilities with commonly agreed targets for water delivery.

Water Research Amendment Bill

Addressing current and future water knowledge gaps and the way in which these are currently prioritised in the South African context demands the evolution of the regulation and governance structures of any research institutions. The purpose of the Water Research Amendment Bill, 2013, is to:

- Amend the WRA so as to insert certain definitions and substitute others;
- Effect certain textual improvements and name changes;
- Provide for the appointment of members of the Board and the CEO in line with other public entities in the water sector and current practice of Corporate Governance;
- Regulate the governance of the Water Research Council (Water Research Commission in the current Act)
- Align the Act with applicable legislation, such as the NWA, WSA and the Public Finance Management Act, 1999; and to
- Provide for matters incidental hereto.

While the new clauses in the Amendment Bill do not legislate for a change in the relationship between the DWS as the shareholder department and the WRC as a public entity, the process of developing the draft Bill has created the discussion space enabling these two public sector partners to draw closer together and iron out the modalities of governance, cooperation and the complementarity of roles.

2.4 Policy mandates

The WRC will continue to support DWS in its call for mainstreaming of water and sanitation as the basis to enable and catalyse economic growth and sustainable development. The WRC is therefore actively involved in key DWS initiatives, including the legislative and policy review, and the institutional realignment programme, as well as the implementation of the NWRS-2. Specifically, the WRC's five-year strategy is designed to support the further refinement and implementation of NWRS-2, together with the DWS and associated departmental plans for water services and sanitation. This is closely followed by the water-related components of the Presidential-led National Infrastructure Plan and its associated 18 Strategic Integrated Projects (SIPS), the Department of Environmental Affairs–led Climate Change Response Strategy and the Department of Science and Technology's 10-year Innovation Plan, as well as the broader South African sustainable development agenda. A third layer addresses the water-related components of the other core development strategies for these five years, for example, in the areas of local government, agriculture (including forestry), rural development, mineral resource development, the spatial development plans, and water-related enterprise development. The outcomes of our research projects provide scientific knowledge which informs initiatives such as the water pricing strategy and water infrastructure management.

Alignment of WRC activities to NWRS-2

The NWRS-2 calls for a much larger contribution from R&D to empower the implementation of the Strategy. In addition, the Strategy also engages the further development of water sciences in South Africa. One of the key deliverables that the NWRS 2 emphasises is the Sector Research and Innovation (R&I) Strategy.

In support of this, it is incumbent upon the WRC to coordinate the development of the National Water R&D Plan, with the latter also emphasised in the Water Research Amendment Bill. Some of the additional contributions that the NWRS-2 requires from the WRC include:

- Desalination of seawater
- Job creation
- Mining, energy and manufacturing industries
- Awareness and communication
- Research and development
- Scenarios, climate change modelling and water availability
- Hydraulic fracturing and coal-bed methane extraction

These areas call on the WRC to collaborate with the DWS and other Government departments such as the Department of Trade and Industry, Department of Economic Development, Department of Environmental Affairs, Department of Human Settlements, and the Department of Mineral Resources, as well as other sector partners such as Eskom, Rand Water and Sasol, to

develop appropriate technologies and support the development of relevant centres of excellence in several of the fields of research described above. In this regard, the WRC, together with the DST, has completed a consultative process and developed the Ten-Year Water Research, Development, and Innovation/Deployment Roadmap that provides a sector-defined, needs-driven research agenda that caters for the public sector (utilities, municipalities), private industry, agriculture, and environmental protection.

The roadmap outlines seven 10-year plans that provide itemised, actionable tasks under the following topic headings:

- Water supply

1. Increase ability to make use of more sources of water, including alternatives
2. Improve governance, planning and management of supply and delivery
3. Improve adequacy and performance of supply infrastructure
4. Run water as a financially sustainable "business" by improving operational performance

- Water demand

1. Improve governance, planning, and management of demand and use
2. Reduce losses and increase efficiency of productive use
3. Improve performance of pricing, monitoring, billing, metering and collection

The roadmap has been endorsed by DWS as the implementation plan for the R&D chapter of NWRS-2.

3. SITUATIONAL ANALYSIS

From food and energy security to human and environmental health, it is well recognised that water contributes to improvements in social well-being and inclusive growth. As the world grapples with increasing water scarcity, numerous international water bodies have identified water as a priority concern, including the World Economic Forum (WEF).The 2015 WEF Global Risk Perception Survey identified water as the number-one social and economic risk for the next ten years. The report assesses risks that are global in nature and have the potential to cause significant negative impacts across entire countries and industries. Global water requirements are projected to be pushed beyond sustainable water supplies by 40% by 2030, while food production, which already accounts for 70% of total water consumption globally, will need to increase by 50% by 2030 as the population grows and dietary habits change.

While recognising these risks, the world has moved beyond the Millennium Development Goals (MDGs), towards a post-2015 development agenda. Water-related goals have moved past the mere provision of water supply and sanitation towards a more integrated approach that

encompasses the supply of basic services, the sustainable management of water resources, improved water governance, water quality and wastewater management, and mitigation against water-related disasters.

South Africa is already a water-scarce country. The National Water Resource Strategy 2 (NWRS-2) underlines a need for effective monitoring and assessment of South Africa's water resources – from source to sink (tap). Drought is a recurrent characteristic feature of the country's highly variable climate, with current evidence suggesting that South Africa has entered a dry period. In addition, several studies have indicated that drought frequency, severity and intensity will increase as a result of projected climate change.

The effective and sustainable management of the country's limited water resources is essential for community health, development and cohesion, as well as continued economic activity. R&D, along with innovation, has long since been recognised by Government as holding the key towards ensuring a water-secure future for the country.

The R&D community has an important contribution to make to steer South Africa towards five strategic water-security goals:

- Good and well maintained water infrastructure
- Smart, highly-aware water users
- A sustained pool of highly talented people managing and maintaining the system
- Good partnerships with academic and research entities
- High investments in knowledge-based solutions

South Africa's current water research expenditure is in the ballpark of R300 million a year (Figure 3), which is 2% of the Government portion of R&D spend. This translates to only 0.0069% of GDP.

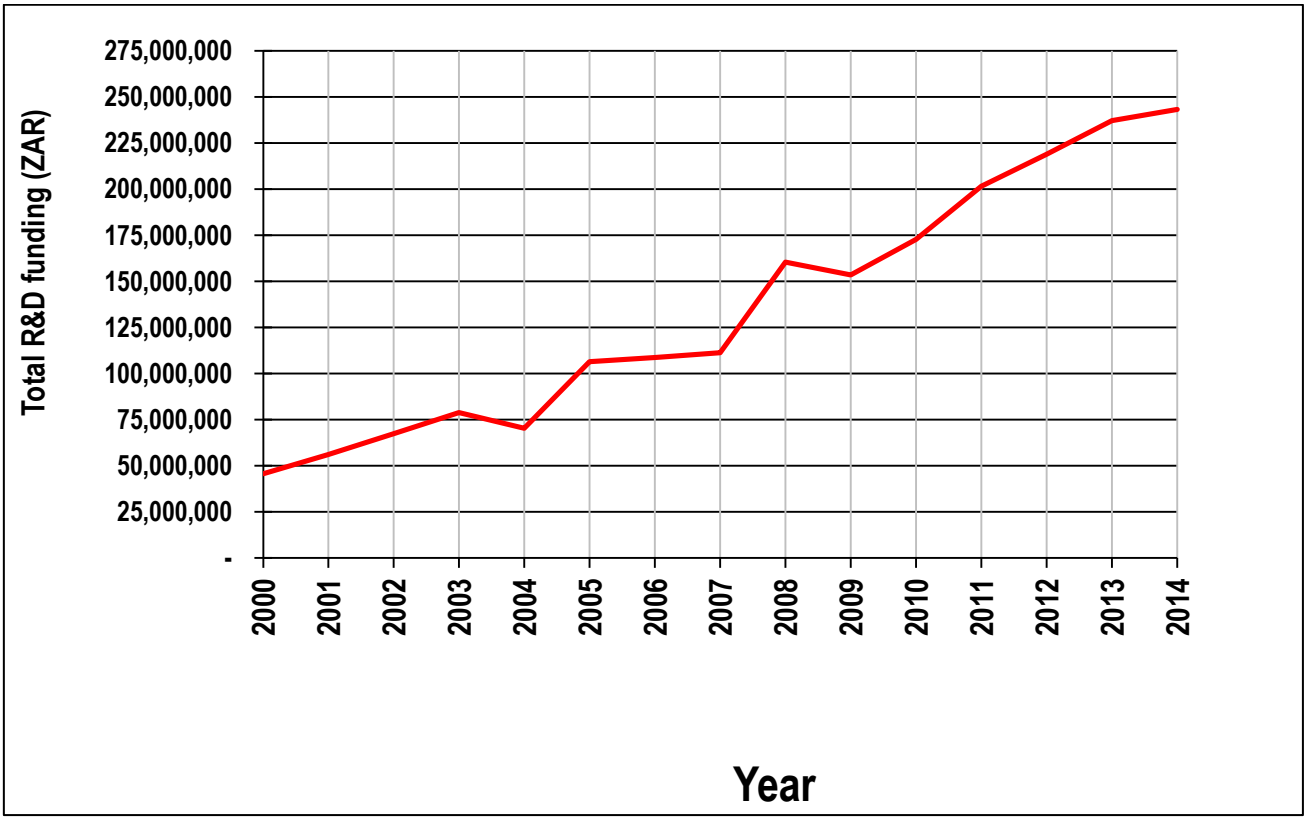


Figure 3. South Africa's current water research expenditure per annum

Taking into consideration the fact that South Africa is ranked 18th in the world in terms of research outputs, albeit with a limited funding supply, South Africa is punching above its weight in the water and sanitation research output domain. The challenge now is to ensure that the research that is funded addresses the cubed challenge of poverty, inequality and unemployment in a very real way.

In this regard, the WRC has taken the lead in the development of South Africa's Water Research, Development and Innovation (RDI) Roadmap. This Roadmap is a high-level planning tool that facilitates and guides refocusing of research, reprioritisation of funds, synergising of existing initiatives and ring-fencing of new resources in order to facilitate a more optimal water innovation system.

3.1 Performance environment

The WRC's performance environment is created on the premise that the crux of the water and sanitation challenge in South Africa is a capacity and capability challenge. The WRC addresses the three dimensions of this challenge, namely, new knowledge, human capital, and technological solutions. It will endeavour in its projects to create a high concentration of activities that support each of these dimensions. In so doing, the WRC funds and facilitates research in water-related innovation and disseminates such knowledge for the advancement of national water security. The recipients of this knowledge may be higher-education institutions (HEIs), science councils, or private agencies/contractors, as well as the various tiers of government.

While our increased efficiencies, innovativeness and partnerships will continue to maintain the knowledge production levels, it is becoming increasingly difficult to meet two very basic challenges in the South African water and sanitation system. The first is the ability to address the increasingly complex nature of water problems such as non-revenue water and acid mine drainage. The second is the WRC's ability to both transform the South African R&D community through the development of researchers from the designated groups as well as to create further avenues for job creation and entrepreneurship development, which are all restricted by the limited availability of R&D funds.

At the same time, technological innovation, improvements in communication, increased collaboration and international partnerships have enhanced our ability as a South African water R&D community to conduct better research, to train students at higher levels, and to organise for better translation of research into products and services for the economy. These improvements, together with new resources, will guarantee our ability to make a significant difference to South Africa's water fortunes.

3.2 Organisational environment

The primary functions of the WRC have always been to fund and steer the water research agenda in South Africa, and to effectively disseminate and communicate research findings. Administrative activities are carried out to ensure compliance with regulatory requirements and to provide an enabling environment for research management.

However, in recent years the WRC has been increasingly called upon to not only develop new knowledge in the water and sanitation science and technology domain, but also to support and further develop human capacity and skill as well as lead technology, product and industry development (Figure 4). This not only necessitated an expanded mandate but also a suitable organisation structure capable of handling these added responsibilities. In 2015, the WRC re-engineered its operations and structure to address challenges faced by the water and science sectors and the country.

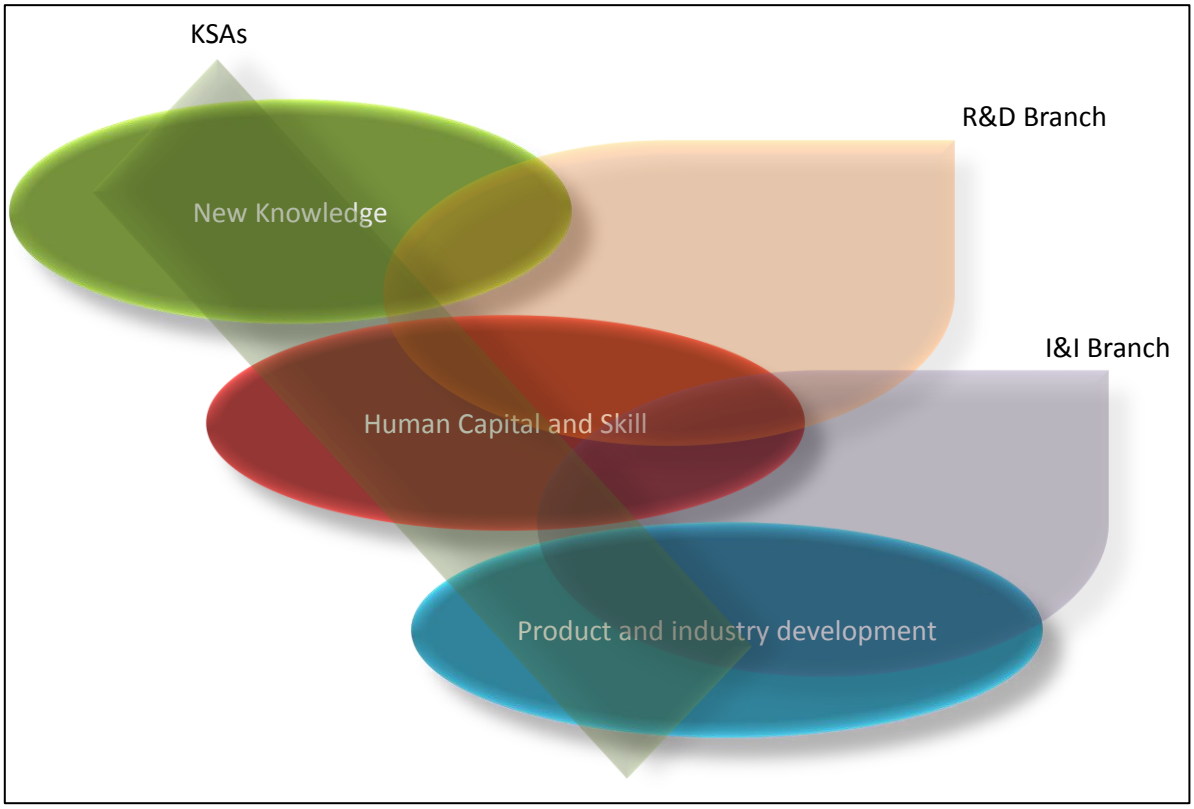


Figure 4. The WRC's reorientation towards innovation and impact

As such, two core teams have been developed (Figure 5):

1. Research and development – which focuses on the generation of new knowledge as well as the mechanisms needed to support this, including human capital development and skills development
2. Impact and Innovation – which entails a redefined focus on technology, product and industry development, business development and innovation realisation on the one hand, and enabling mechanisms such as knowledge dissemination, communication and marketing on the other.

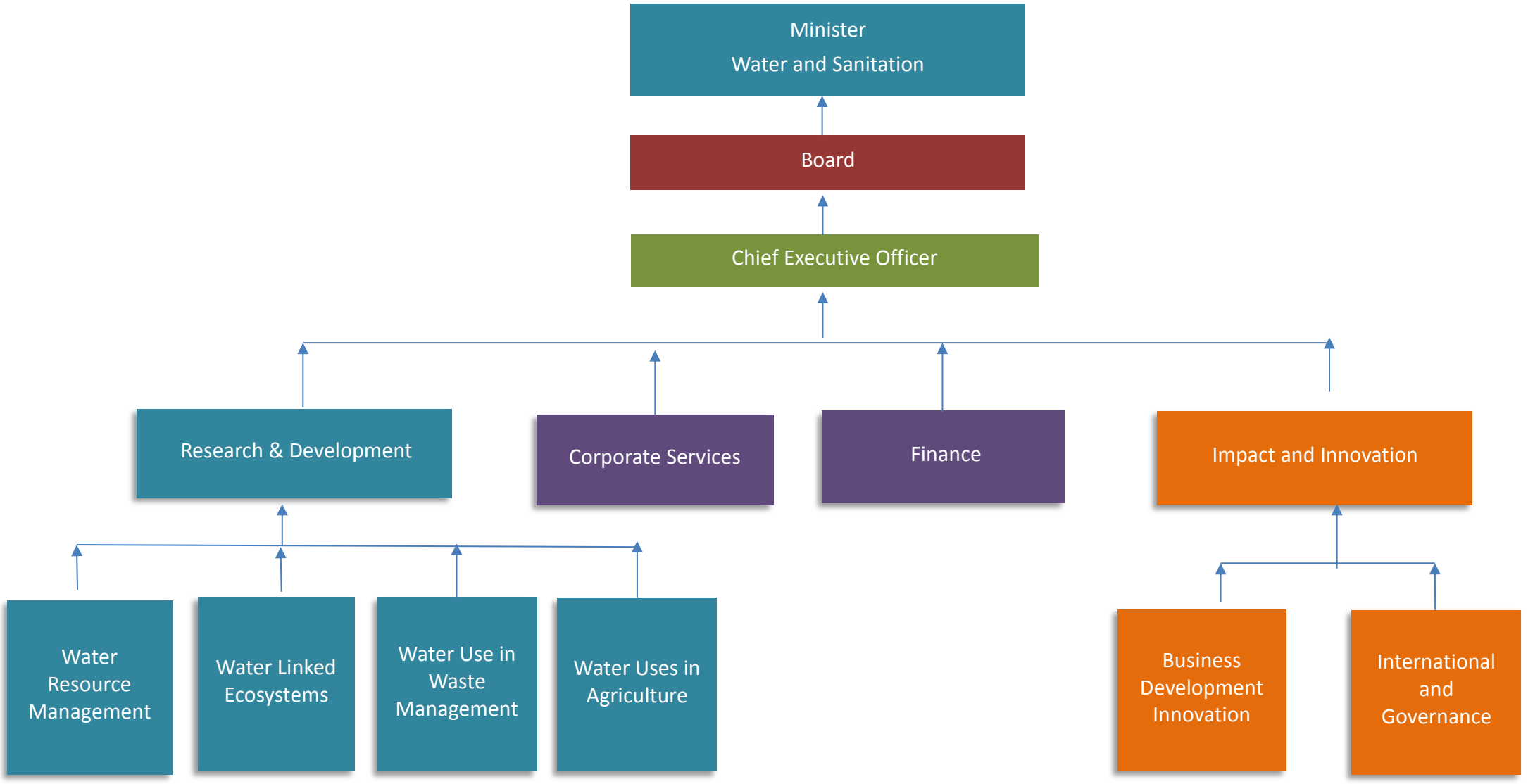


Figure 5. The WRC organisational structure

The following structure defines the internal governance framework:

- The Minister of Water and Sanitation is the Executive Authority of the WRC.
- The Department of Water and Sanitation is the shareholder representative.
- The WRC Board is the Accounting Authority of the WRC.
- The Chief Executive Officer (CEO) is the Accounting Officer and an ex-officio member of the WRC Board.
- The Group Executives (GEs), the Chief Financial Officer and the Executive Manager for Corporate Services report directly to the CEO.
- The Executive Managers for Water Resource Management; Water-Linked Ecosystems; Water Use and Wastewater; Water Utilisation in Agriculture; Innovation and Business Development; and Knowledge Dissemination, Marketing and Communications report to the GEs.

3.3 Description of the WRC's corporate planning process

The process conducted to develop this Corporate Plan is characterised by three important elements. Firstly, it has been an ongoing and iterative process. Secondly, it has been consultative, incorporating discussions and considerations from the DWS and WRC stakeholders in various forums. Thirdly, it has employed both forecasting and back-casting approaches to the development of strategic objectives, involving an analysis of the WRC's current positioning in the sector as well as a reflection on developments and potential developments in the external and organisational environment that could have an impact on the five-year planning cycle. All of these processes have been under the guidance of the WRC Board.

The formal planning process continued from the developments in the previous year's iteration of the Corporate Plan for 2015/16 – 2019/20 (CP15). Other important inputs and events feeding into the corporate planning process are shown in Figure 6.

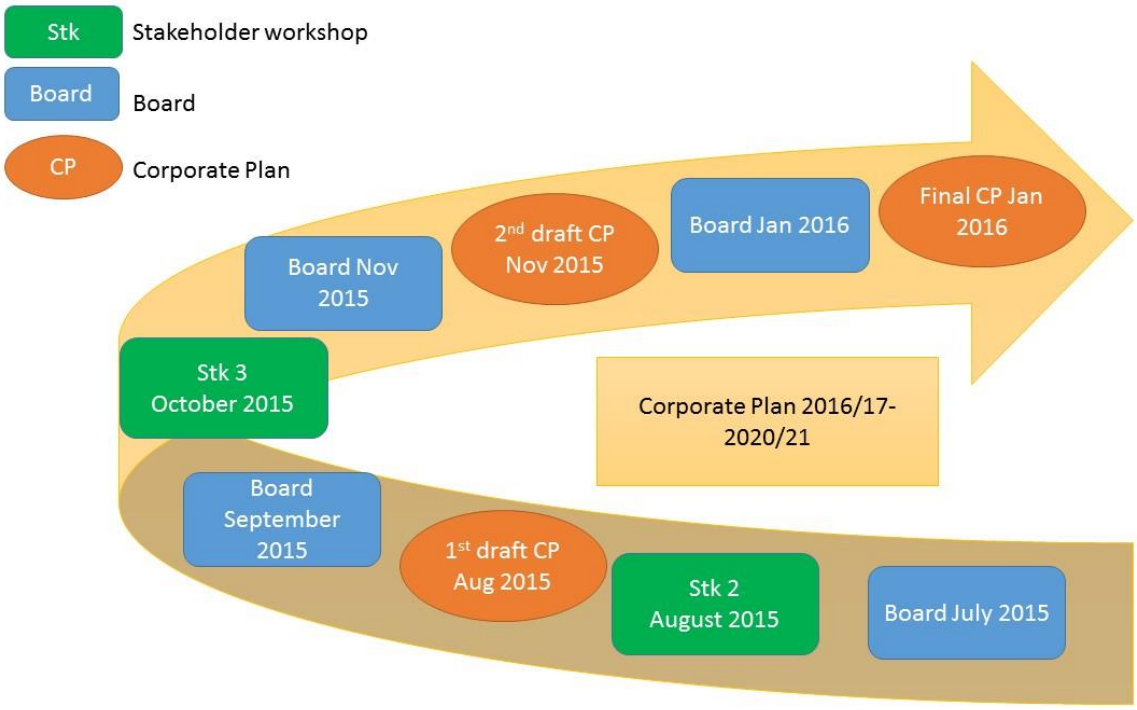


Figure 6. Corporate planning timeline

4. STRATEGIC OUTCOME-ORIENTED GOALS OF THE INSTITUTION

Section 4 outlines the strategic intent of the WRC over the period 2016/17 – 2020/21. This comprises the WRC's contribution to achieving several Government Outcomes, the National Development Plan (NDP) objectives, as well as five strategic outcome-oriented goals, which are based on the operationalisation of the WRC Knowledge Tree.

4.1 Contributing towards achieving Government Outcomes and NDP objectives

As a national public agency, the WRC actively strives to support the Government of South Africa in achieving its strategic outcomes, with particular reference to the NDP objectives as well as the Corporate Plan (Annual Performance Plan) of the DWS and the performance agreement of the Minister of Water and Sanitation.

The WRC also applies the outcome-based approach developed by Government (Figure 7) and aims to support all Government Outcomes and Outputs through its research portfolio, with special emphasis given to Government Outcomes 6, 7, 9 and 10 (Table 1). Firstly, Outcome 6 addresses the need for an efficient, competitive and responsible economic infrastructure network. WRC-funded projects support water availability through examining and finding solutions for issues

related to bulk water supply, and through supporting the development of appropriate regulations regarding water quantity, quality and usage. A second emphasis is Outcome 7, which focuses on vibrant, equitable and sustainable rural communities and food security for all. This is carried out through a number of projects addressing water utilisation in agriculture as well as projects focusing on informal settlements and peri-urban communities. Thirdly, Outcome 9 aims at establishing a responsive, accountable, effective and efficient local government system. The WRC supports this outcome through research focused on improving services, with special emphasis on the delivery of water and sanitation services. Finally, Outcome 10 addresses the protection and enhancement of the country's environmental assets and natural resources. This outcome is supported through research in aquatic ecosystem connectivity processes, sustainable utilisation, restoration, global change and biodiversity protection. The WRC work-plan is geared to the improvement of the quality and quantity of South Africa's water resources through both its research projects as well as its innovation and technology development activities. Examples include technologies and strategies to reduce water loss in distribution systems, better sanitation solutions and improved wastewater treatment.

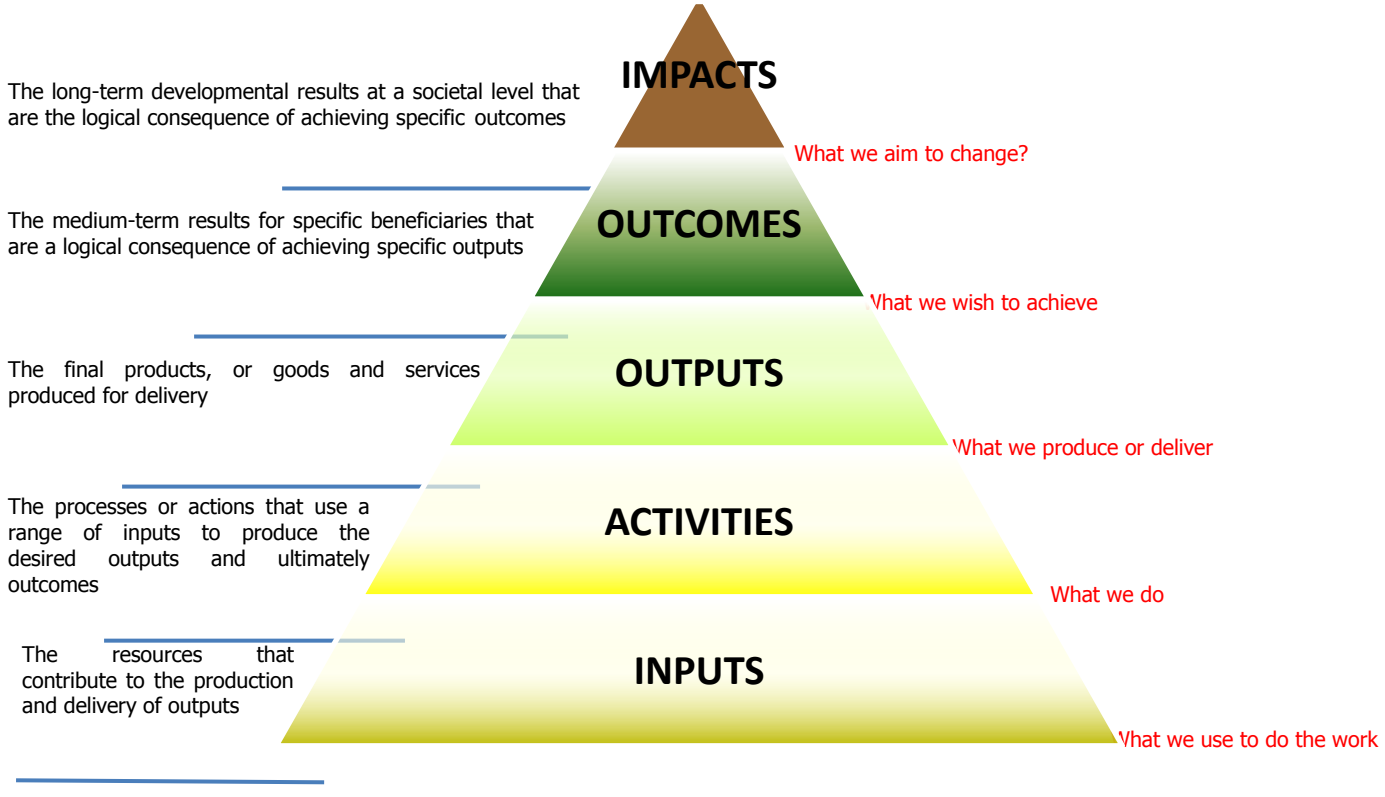


Figure 7. Government Guide to Outcome Approach, May 2010 (Source: *www.thepresidency.gov.za)*

Table 1. Alignment with Government Outcomes and NDP objectives

WRC Strategic Outcome-Oriented Goal		Alignment with Government Outcomes	Alignment with NDP Objectives
Strategic Outcome-Oriented Goal 1	**Inform policy and decision-making**		
	The WRC aims to commission appropriate evidence-based knowledge generated to guide decision-making, influencing the development of policy, practice or service provision, shaping legislation, altering behaviour, contributing to the understanding of policy issues, and reframing debates. Through the R&D that it commissions it also aims to inform decision-making at all levels within government but also in non-governmental arenas. WRC projects also aim to improve basic services, with special emphasis on delivery of water and sanitation services.	1. Government Outcome 9: A responsive, accountable, effective and efficient local government system. 2. Government Outcome 12: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.	Building a capable and developmental state objectives: Chapter 13
Strategic Outcome-Oriented Goal 2	**Develop new products and services for economic development**		
	The WRC capitalises on those projects that have potential to develop new intellectual property or to introduce innovations which create new or improved technologies, products and services that can be used in the economy. Effectively, this is the WRC's contribution to job creation and economic development through water and sanitation science innovations. Additionally, WRC projects support water availability by finding solutions to problems related to bulk water supply and assisting the development of appropriate regulations regarding water quantity, quality, and usage.	1. Government Outcome 4: Decent employment through inclusive economic growth. 2. Government Outcome 6: An efficient, competitive and responsive economic infrastructure network	Economy and employment objectives: Chapter 3 Economic infrastructure objectives: Chapter 4

Strategic Outcome-Oriented Goal 3	**Enhance human capital development (HCD) in the water and science sectors**		
	The WRC strives to have high student participation in its projects. Although the emphasis is on post-graduate degrees, inclusion of undergraduates has also been investigated. There is also a particular emphasis on previously-disadvantaged individuals (PDIs) and women. The WRC also aims to support institutional development through mentorship provided to new research leaders.	1. Government Outcome 1: Improved quality of basic education. 2. Government Outcome 5: A skilled and capable workforce to support an inclusive growth path.	Improving education, training and innovation: Chapter 9
Strategic Outcome-Oriented Goal 4	**Empower communities**		
	The WRC places an emphasis on projects that: (a) include communities not only as end-users of research but as active participants in the research process from the project design phase; (b) have a direct impact on the livelihoods of communities through water-related interventions; and (c) build sufficient capacity to assist with the post-project sustainability of those interventions. Additionally, the WRC has projects addressing water utilisation in agriculture, as well as in informal settlements and peri-urban communities. The use of water by small-scale farmers (smallholders) and water allocation reform have been addressed. The WRC will continue to support the wise use of water for agriculture, and to reduce water demand from irrigation.	1. Government Outcome 6: Vibrant, equitable and sustainable rural communities with food security for all. 2. Government Outcome 7: Sustainable human settlements and improved quality of household life.	Environmental sustainability and resilience objectives: Chapter 5 Inclusive rural economy objectives: Chapter 6 Transforming human settlements objectives: Chapter 8
Strategic Outcome-Oriented Goal 5	**Promote transformation and redress**		
	This goal focuses on growing PDI involvement/leadership in projects, as well as helping to promote socio-economic development through the reduction of poverty and inequality in South Africa, particularly of marginalised groups such as women and youth.	1. Government Outcome 5: A skilled and capable workforce to support an inclusive growth path. 2. Government Outcome 11: Create a better South Africa and contribute to a better and safer	Improving education, training and innovation objectives: Chapter 9 Transforming human settlements objectives: Chapter 8

		Africa and World. 3. Government Outcome 12: An efficient, effective and development oriented public service and an empowered, fair and inclusive citizenship.	Building a capable and developmental state objectives: Chapter 13 Nation building and social cohesion objectives: Chapter 15
Strategic Outcome-Oriented Goal 6	**Drive sustainable development solutions**		
	The WRC prioritises those projects that provide sustainable development solutions that have had positive effects on the environment, economy and society, including: protection of water resources, optimal water use, and equity between generations, equitable access, environmental integration and good governance. Additionally, this goal focuses on developing knowledge products that are fit-for-use to ensure the uptake of research. Examples include technologies and strategies to reduce water loss in distribution systems, better sanitation solutions and improved wastewater treatment. The WRC will continue to invest in studies on climate change and related energy issues. Biodiversity related to aquatic life and ensuring ecosystem health through monitoring tools development, as well as protection and restoration of aquatic resources, will continue to be supported.	1. Government Outcome 7: Vibrant, equitable and sustainable rural communities with food security for all. 2. Government Outcome 8: Sustainable human settlements and improved quality of household life. 3. Government Outcome 10: Environmental assets and natural resources that are well protected and continually enhanced.	Environmental sustainability and resilience objectives: Chapter 5 Inclusive rural economy objectives: Chapter 6 Transforming human settlements objectives: Chapter 8

4.2 Alignment with DWS strategic objectives

Table 2 outlines the WRC's alignment with DWS strategic objectives.

Table 2. Alignment with DWS strategic objectives

DWS strategic objectives	WRC strategic objectives
An efficient, effective and development-oriented sector leader	1. To enhance the governance of water in South Africa through knowledge and practice derived through research 2. To enhance human capital development through support of students in water research projects as well as the development of researchers 3. To contribute to economic transformation by supporting SMMEs in the water research, development and innovation 4. Enhance the diversity of project leadership as part of the broader national transformation project to promote the ongoing transformation of the water R&D sector 5. Achieve efficient and effective institutional governance including a good audit report 6. Enhance the relevance and presence of the WRC locally and globally by coordinating strategic local and international partnerships by establishing MoUs, knowledge-sharing agreements/understandings or strategic partnership agreements with knowledge-sharing institutions and/or strategic partners 7. Strengthen the WRC's strategic position regarding water research and development
Equitable and sustainable water and sanitation services	1. To increase water knowledge on water and sanitation services by initiating new research projects 2. To provide the country with supportive knowledge via completed projects 3. To improve knowledge dissemination (number of final research reports and technical briefs published) 4. To promote the uptake and communication of WRC research in the form of manuals, guidelines, and other supporting materials produced 5. To engage the sector in knowledge-sharing events through public dialogues and workshops
Protection of water across the value chain	1. To increase water science focusing on protection of water across the value chain by initiating new research projects 2. To provide the country with supportive knowledge via completed projects 3. To improve knowledge dissemination (number of final research reports and technical briefs published) 4. To promote the uptake and communication of WRC research in the form of manuals, guidelines, and other supporting materials produced 5. To engage the sector in knowledge-sharing events through public dialogues and workshops

4.3 Achieving the six goals of the WRC 'Knowledge Tree'

In this, the WRC's fourth year of conceptualising and developing the WRC Knowledge Tree, the WRC can boast a diverse portfolio of research projects, all geared towards investment in the 'multiplier effect'. In addition to the knowledge products and publications from the WRC research portfolio, the WRC is using that knowledge to inform policy and decision-making, contribute to sustainable development solutions, develop products and services for the economy, actively contribute to human capital development, directly empower communities, and enable the national transformation project.

Each of the Knowledge Tree strategic outcome-oriented goals provides a specific priority categorisation for the WRC's projects and activities. Each has its own kind of contribution to the Government Outcomes, either directly or indirectly. The goals are not mutually exclusive. For example, a 'new product' may be a 'sustainable development solution' that 'empowers communities' and 'informs policy and decision making'.

The guiding principle is that every WRC project will strive to achieve as many of the WRC Knowledge Tree outcomes as reasonably possible. This applies within the project, to post-project actions, and to follow-on projects.

Table 3. The WRC's Strategic Outcome-Oriented Goals

Strategic Outcome-oriented Goal 1	Inform policy and decision-making
Goal statement	The WRC will reinforce its efforts to commission appropriate research projects to actively inform both policy development by Government partners and decision-making by all parties in the water sector. Particular effort will be made to: a) provide appropriate evidence-based information to guide decision-making, b) effectively communicate scientific findings to decision-makers, c) provide advisory services to parliamentary portfolio committees, the shareholder department and other decision-making bodies, and d) provide a platform for dialogue on various issues involving the policy landscape.
Examples	• **South African Mine-Water Atlas.** The *South African Mine Water Atlas* is intended as a comprehensive reference of the extent of mine-influenced water in the country, both on the surface and underground. Once completed, it will be the most comprehensive

Strategic Outcome-oriented Goal 1	Inform policy and decision-making
	document of its kind in South Africa. Among others, decision-makers will be able to look to the atlas for background information and tools to assist in fulfilling commitments made in other recent events and declarations. • **WR2012.** The Water Resources of South Africa 2012 study (WR2012), currently underway, serves as the cornerstone of baseline national water resource assessment and planning for South Africa. The objective of the study is to assist decision-makers at all levels of Government to make informed choices about all policies concerning South Africa's water resources.

Strategic Outcome-Oriented Goal 2	Develop new products and services for economic development
Goal statement	The WRC will continue to capitalise on those projects that have potential to develop new intellectual property or to introduce innovations which create new or improved technologies, products and services to be used in the economy.
Examples	• **WADER**. In a joint partnership with DST, the WRC has established the Water Technologies Demonstration Programme (WADER) to optimise the water innovation value chain. Within the next two years, WADER will activate at least four technology demonstrators through collaborative partnerships with industry, academia, Government and civil society. • **Product beneficiation from sewage**. In a current project the WRC is investigating the use of electrochemical precipitation (SEP) technology to recover energy and nutrients from domestic sewage**.**

Strategic Outcome-Oriented Goal 3	Enhance human capital development (HCD)
Goal statement	The WRC will strive for high student participation in its projects, as well as partnering with higher education institutions (HEIs) to grow capacity in new and emerging disciplines, e.g., biomimicry.
Examples	• **Student participation.** All WRC projects are encouraged to have a component of student participation where possible. • **Supporting new PDI project leaders.** A special programme of short-term projects is planned to encourage and empower previously-disadvantaged individuals to be project leaders. • **The WRC Empowerment Fund.** The WRC and DWS have partnered to implement the WRC Empowerment Fund to capacitate emerging project leaders and also help develop various capacities for CMAs. • **Student Bursaries.** The WRC has partnered with DST to offer student bursaries in scarce-skills areas such as biomimicry and environmental ecosystem services.

Strategic Outcome-Oriented Goal 4	Empower communities

Strategic Outcome-Oriented Goal 4	Empower communities
Goal statement	The WRC and its partners will increase emphasis on projects that (a) have a direct impact on the lives and livelihoods of communities through water-related interventions, and (b) build sufficient capacity to assist with the post-project sustainability of those interventions.
Examples	• **AfDB partnership.** The WRC, in partnership with the AfDB African Water Facility, is improving water services delivery to the communities of Limpopo Province. Over 20 000 people are expected to get improved access to water for domestic and agricultural purposes, among others. • **SanIC.** The Sanitation Innovation Challenge (SanIC) aims to provide a vehicle for technical evaluation and demonstration of appropriate sanitation technologies by bridging the knowledge gap on the functionality of novel sanitation solutions, and the appraisal of the design quality of these solutions. The outcomes of these evaluations will be used to provide recommendations to national and local government on the appropriateness and effectiveness of the evaluated technologies. • **SFRA.** The WRC, with the Bill and Melinda Gates Foundation (BMGF), has launched the Sanitation Research Fund for Africa (SRFA). The fund is aimed at stimulating competency and capacity in the area of sanitation in the African region, in order to support the development and scaling up of sanitation solutions. • **Citizen science in water resource management.** WRC products such as miniSASS have been adopted by schools and communities to monitor and assess the health of their local streams. This product has won international awards.

Strategic Outcome-Oriented Goal 5	Promote transformation and redress
Goal statement	This five-year Corporate Plan has transformation and redress as a central driver, both within the organisation as well as in the project portfolio. The goal is necessarily cross-cutting in that it drives the 'human capital development' and 'empowerment of communities' goals.
Examples	• **Project focus.** Continued diversification of the WRC portfolio is planned in terms of project leadership, student participation, institutional participation, project selection, and project site selection.

Strategic Outcome-Oriented Goal 6	Drive sustainable development solutions
Goal statement	Sustainable development will remain a core principle driving all WRC projects and activities. Specific focus is placed on sustainable development *solutions*.
Examples	• **Protection of water resources.** A specific highlight is the WRC's current research to build a body of knowledge around unconventional gas mining. One new project is looking at the potential impact of this technology on South Africa's water resources with a view to develop best practice guidelines. • **Optimal water use.** The WRC's projects in the field of water utilisation in

Strategic Outcome-Oriented Goal 6	Drive sustainable development solutions
	agriculture address this directly, for example, projects determining the water footprints of selected field and forage crops. Other projects are developing sustainability indicators that can be used to manage groundwater use. • **Equity between generations.** A significant initiative focuses on improving management of South Africa's wetlands of international importance (so-called Ramsar sites). • **Current equitable access.** There is considerable emphasis on supporting the provision of safe drinking water. Projects have been wide-ranging, from improving our understanding of the concept of free basic water to transfer of knowledge to communities relating to rainwater harvesting. • **Environmental integration.** The WRC Lighthouses, by their very nature, epitomise the WRC's acknowledgement of the need for integrated approaches. In addition, the focus of the WRC on the water–energy–food nexus also acknowledges the complexity of some of the core water-related problems being faced today.

In terms of the achievement of the above-mentioned strategic outcome-oriented goals (Table 3) depicted by the WRC Knowledge Tree, the WRC manages a multi-year portfolio of projects numbering approximately 300 at any time (Table 4).

Table 4. Baseline summary for strategic outcome-oriented goals

INDICATOR	2013 (FOR PROJECTS STARTING IN 2014/15)	2014 (FOR PROJECTS STARTING IN 2015/16)	2015 (FOR PROJECTS STARTING IN 2016/17
TOTAL NUMBER OF PROJECTS APPROVED	98	81	88
TOTAL VALUE OF PROJECTS OVER CYCLE	R119 699 766	R130 247 457	R122 820 771
TOTAL BUDGET (1ST YEAR)	R37 229 185	R38 756 546	R34 112 713
NUMBER OF PDI PROJECT LEADERS	53 (54%)	45 (56%)	57 (65%)
NUMBER OF STUDENTS (DISTINCT) IN PROPOSALS	247	315	233
HDI PARTICIPATION (CONTRACTING ORG - LEAD)	13 (13.3%)	12 (15%)	24 (27%)
SMME LEADS	28 (29%)	19 (23%)	22 (25%)
FEMALE PROJECT LEADERS	33.7%	37%	38
NUMBER OF PROJECTS WITH INTERNATIONAL COLLABORATION	18 (18%)	8 (10%)	2

PART B: STRATEGIC EMPHASES

Within the Government Outcomes and the WRC Knowledge Tree goals, the next five years will place special emphasis on a series of elements that aim to further strengthen the overall profile, relevance and effectiveness of the WRC.

These elements cut across the various units of the WRC and include the following key emphases (Figure 8.)

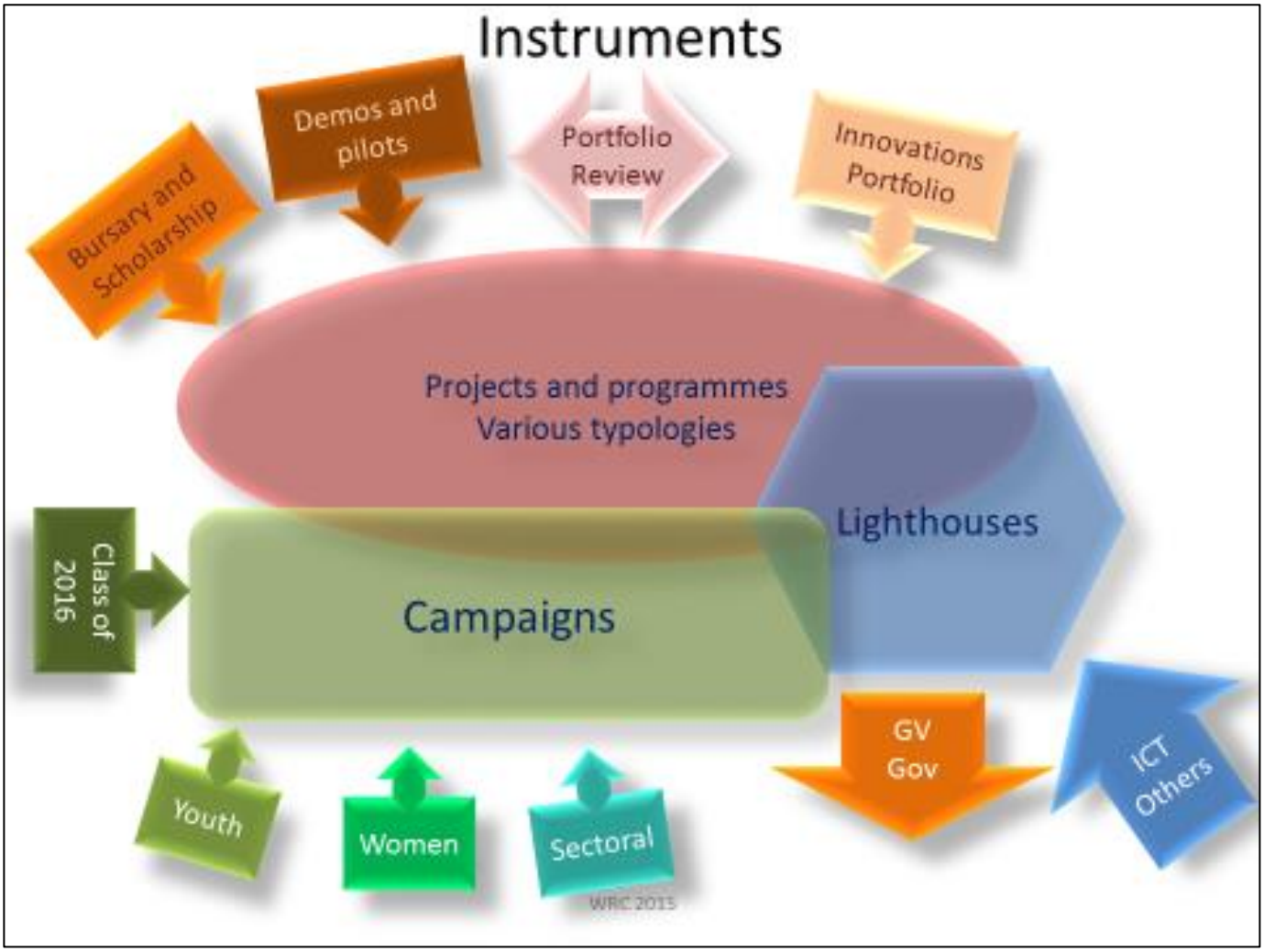


Figure 8. Key strategic instruments and elements

5. WATER RESEARCH AND DEVELOPMENT DRIVING NATIONAL SOCIO-ECONOMIC TRANSFORMATION

The first administration of the third decade of South Africa's democracy has made the notion of a 'radical socio-economic transformation' the centrepiece of its five-year strategy. In the water and sanitation sector this translates to achieving universal access to sustainable water and sanitation services in South Africa while maintaining or where possible enhancing the integrity of our water resources, both surface and groundwater. Water security remains not only the key to a good quality of life for all in South Africa both today and tomorrow, but also to South Africa's economic future and international competitiveness.

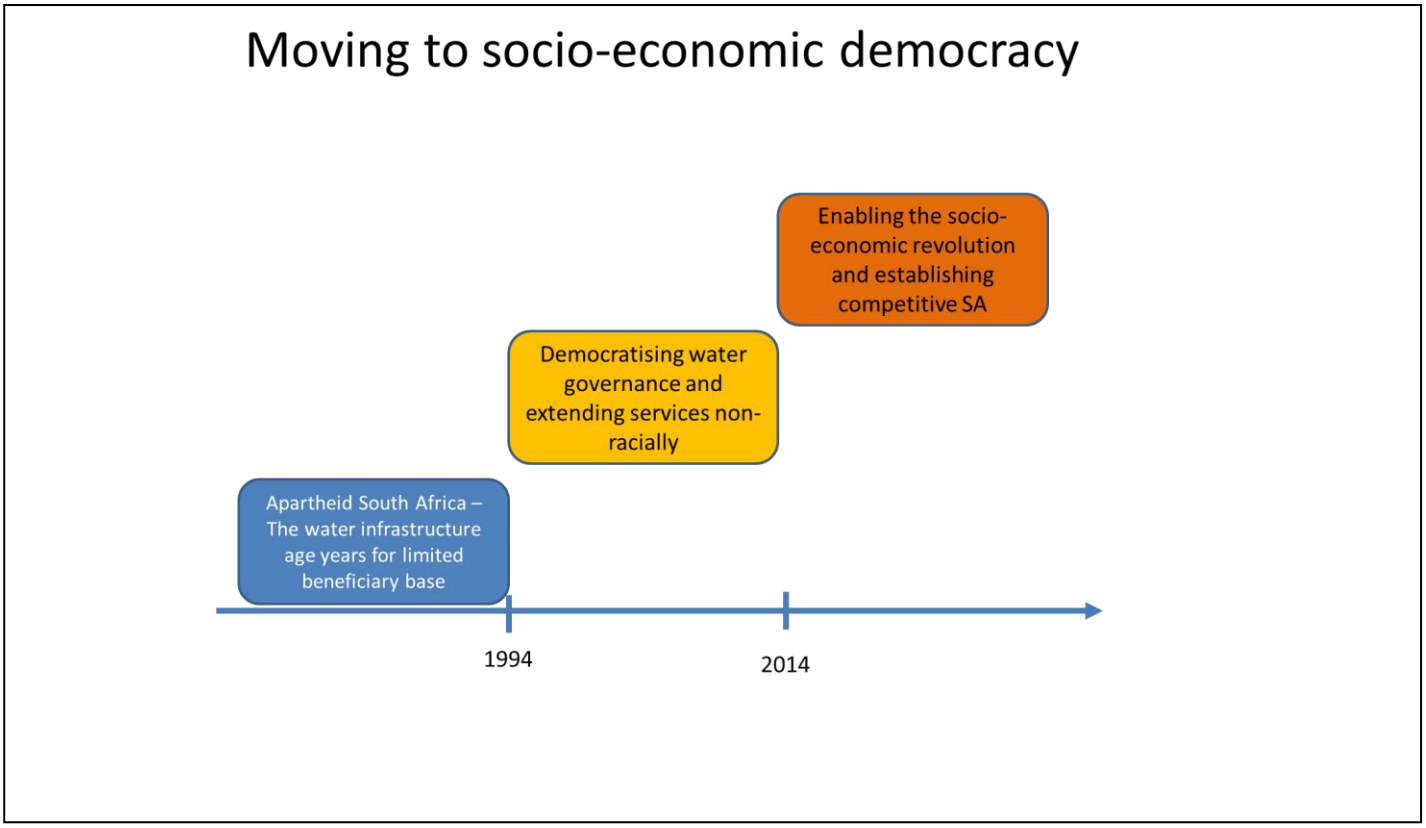


Figure 9. Representation of three phases of water development in South Africa

Phase 1 is the Apartheid years until 1994, when the larger foci were in the realm of water resource development (dam development and inter-basin transfers) with the obvious bias to prioritising the servicing of White South Africa and reinforcing the separate development philosophy of the Apartheid government. Phase 2 represents the first 20 years of democracy, key features of which were the development of a new governance model for water, moving away from the riparian doctrine toward a national custodianship as well as the quest for universal access to services in order to address the Apartheid legacy of differential citizenship based on

race. This phase made many gains in entrenching the new political democracy and many of the political institutions as well as the policy environment sought to effect the political transformation of the system. Extension of access to water services has been a hallmark, but this has not achieved the sustainability parameters and progress with sanitation did not share the same momentum. Phase 3 seeks to effect a real and tangible socio-economic democracy characterised by the growth of the South African economy on the back of a better water-security outlook while concomitantly ensuring the pathway to universal access to sustainable water and sanitation services in South Africa (Figure 9). Water should also be a catalyst to economic inclusion and participation.

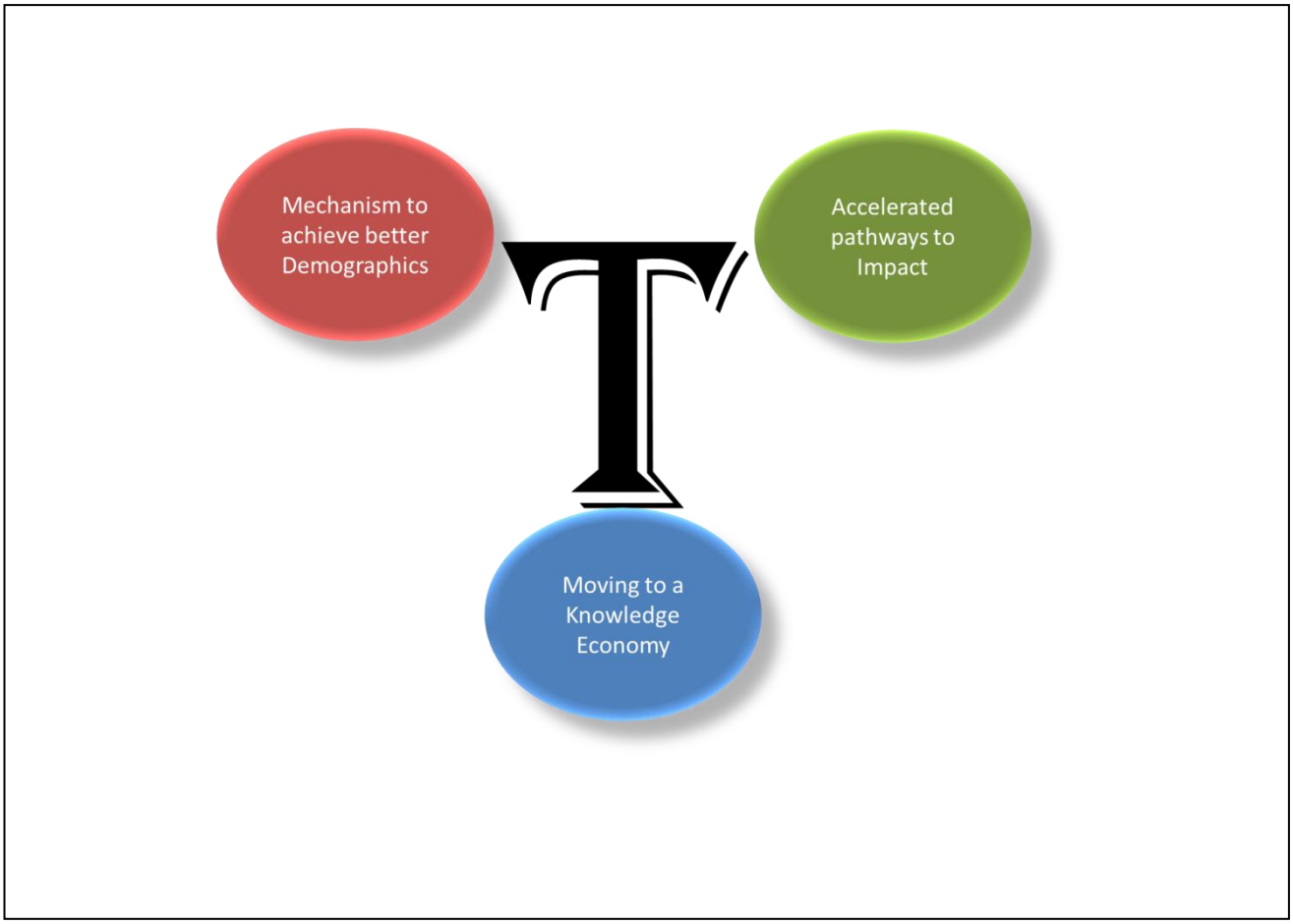


Figure 10. The three components of transformation in water research and development

The first component of transformation is to increase the diversity of participation in WRC projects. This includes higher numbers of research leaders who are previously disadvantaged individuals (PDI), more PDI students supported in WRC projects, and higher levels of enterprise development – all in the frame of WRC project leadership, and, where possible, enterprise development in WRC projects. In the second dimension there shall be a concerted effort to create innovative pathways to accelerate impact on the ground. This will include both new project

design as well as new projects. The third critical dimension is to contribute to the further transformation of South Africa's largely resource-based economy into the desired knowledge-based economy envisaged in the National Development Plan (Figure 10).

This seeks to build on the successes in the 2014/15 financial year in which the WRC reached its highest levels of project leader representation from previously disadvantaged groups, with greater than 60% of new project leaders coming from the PDI group. At the same time we managed to have 28% of projects led by SMMEs and have had record participation of HDIs in the projects portfolio. The crowning achievement in this domain has been the greater than 80% representation of students in WRC projects from the PDI group. The general consensus from the community of practice is that the value-add of this injection of diversity is already having a positive impact on the overall portfolio.

The transformation agenda is also reflected in the greater representation of community-empowering activities as well as the larger contributions of science to inform policy and decision-making. The latter has been particularly important in the frame of the Water Policy Review and the finalisation of the 2nd National Water Resource Strategy. The performance report will show a high achievement index, not only in the six focus areas of the WRC Knowledge Tree, but in all areas of the Annual Performance Plan.

This period has also seen a dramatic increase in the WRC Dialogues, as this is rapidly becoming the platform of choice for stakeholders across the board to find one another when addressing some of the highly complex 'wicked' problems of our time. These have included shale gas harvesting through fracking, non-revenue water and acid mine drainage challenges.

This was all achieved on the back of a strong partnership with a highly productive South African water research and development community of practice. South Africa managed to improve its position to 18th in the world in 2014, in terms of published papers in ISI-listed peer-reviewed journals, contributing a little over 1.61% of the global share of papers in the water resources domain. The WRC is proud to have supported this progress.

The 2014/15 baseline will be built upon in the five-year strategy 2016/17 – 2020/21.

6. THE WRC LIGHTHOUSES

The construct of the WRC Lighthouse is a strategic developmental tool that will be further developed and implemented in this five-year planning cycle to direct research in key areas identified by the WRC. These Lighthouses are flagship programmes, and are trans-disciplinary, multi-KSA and inter-institutional mega-projects that will examine priority water issues across the

innovation value chain. The WRC will actively seek to direct key projects into these programmatic areas.

Since the establishment of this programmatic approach, the following two lighthouses have achieved their objectives:

1. **The Green Village**: The WRC initially initiated the Green Village (GV) Lighthouse to demonstrate that the fragmented, silo-based research products that are aimed at bettering the livelihoods of marginalised societies can respond better to addressing the basic needs if an integrated approach to implementation is followed – however, a number of the stated objectives have been achieved and the rest have been integrated into the Water Sensitive Design Lighthouse.

2. **Water governance** involves the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their rights, meet their obligations and mediate their differences (UNDP, 1997). It is enabled through legal reforms, organisational alignment and coordination, adequate resourcing and agentised participation of all stakeholders. This Lighthouse has defined its scope and context based on numerous engagements and the creation of a reasonable cohort of interested parties from research institutions, NGOs, private sector and government. Due to it having achieved its objectives and active participation of partners, this Lighthouse has been developed into a full research programme.

The WRC will actively seek to direct key projects into these remaining Lighthouses:

6.1 Water Sensitive Design

The Water Sensitive Design Lighthouse has been progressing well since 2013. The purpose of this Lighthouse has been to develop a critical mass of knowledge around the integration of planning activities for the adoption of more integrated and sustainable solutions using the water sensitive design (settlements) lens for urban, peri-urban and rural environments.

Thus, in 2014 the Community of Practice programme was initiated aimed at building awareness (Figure 11), and providing decision

support by funding research and building capacity within the sector. In 2015 the WRC officially launched the concept to the broader planning community and water sector at the Khuluma Sizwe Series "Two histories, One Future" Dialogue held in Johannesburg to share the Framework and Guideline documents. Under the CoP platform a total of 18 activities are planned over the next 3 years.

On the research front we have continued to support feasibility and scenario planning projects to build capacity and understanding of the principles through context-specific examples. The Lighthouse also set out to involve practitioners (water and spatial planners) from municipalities early in the process and can report that the City of Cape Town and eThekwini Metros have water sensitive design principles written into their spatial development and related policies while the City of Johannesburg and City of Tshwane Metros are in the process of considering them. Through research, demonstration and engagement it is envisaged that these principles will be adopted, adapted and ultimately incorporated into planning, guidelines and policy. A major gap identified is the lack of water sensitive design research capacity in South Africa and particularly researchers dealing with the rural space. Thus, 2016 will look to support other research institutions interested in water sensitive design in rural environments. Furthermore, projects and pilots dealing with multi-functionality, diversification of the water mix, fit for use and the appropriate technologies will continue to be supported and encouraged.

Figure 11: WSD awareness and communication activities

6.2 Climate Change

The WRC climate change lighthouse is undertaken through collaborative research on priority water-

related climate issues with partnerships forged along the innovation value-chain to enhance water research and development nationally and globally. The intention, among others, is to ensure empowerment of people for enhanced resilience, and development of the knowledge base for climate adaptation and decision support tools, together with guidance and a framework for sectoral response. Water is critical for development, economic growth and 'a better life' (SONA, 2015). It is a key factor for inter-sectoral linkages. Climate change impacts on water resources and development cannot be undermined. Increased occurrence of extreme climatic events comes with negative implications for infrastructure, health, production and economic growth, amongst others. All these have a negative influence on development.

Key issues of concern include extreme climate events (floods, droughts, landslides, heatwaves, wildfires, etc.), water quality and health, coastal zone management, water supply, groundwater recharge and the energy–water nexus. The role of this Lighthouse in climate-change response is embedded within adaptive capacity, resilience, improvement of early warning systems, reduced vulnerability and an improved ability to respond, coupled with proactive planning. In coordinating a response, the Climate Change Lighthouse areas requiring attention include mainstreaming and site-specific responses, adaptive management, and local-scale planning to incorporate climate-resilient approaches and continual characterisation of the climate system and water leading into the future. These issues will involve reorientation and restructuring (including economic reforms) and bridging the science–policy interface.

Implementation of this Lighthouse is cross-cutting in nature and requires a coordinated effort to address the consequences of a changing climate. Climate change capital (Figure 12) represents a cross-sectoral approach for implementation of the Climate Change Lighthouse. The approach will support a basic and applied research base for knowledge generation, innovation, capacity building and research for developmental impact. This will incorporate capacity development covering both research teams (and mentoring of upcoming scientists) and the recipients of the knowledge, interventions and innovations generated, including support for commercialisation of the generated technology.

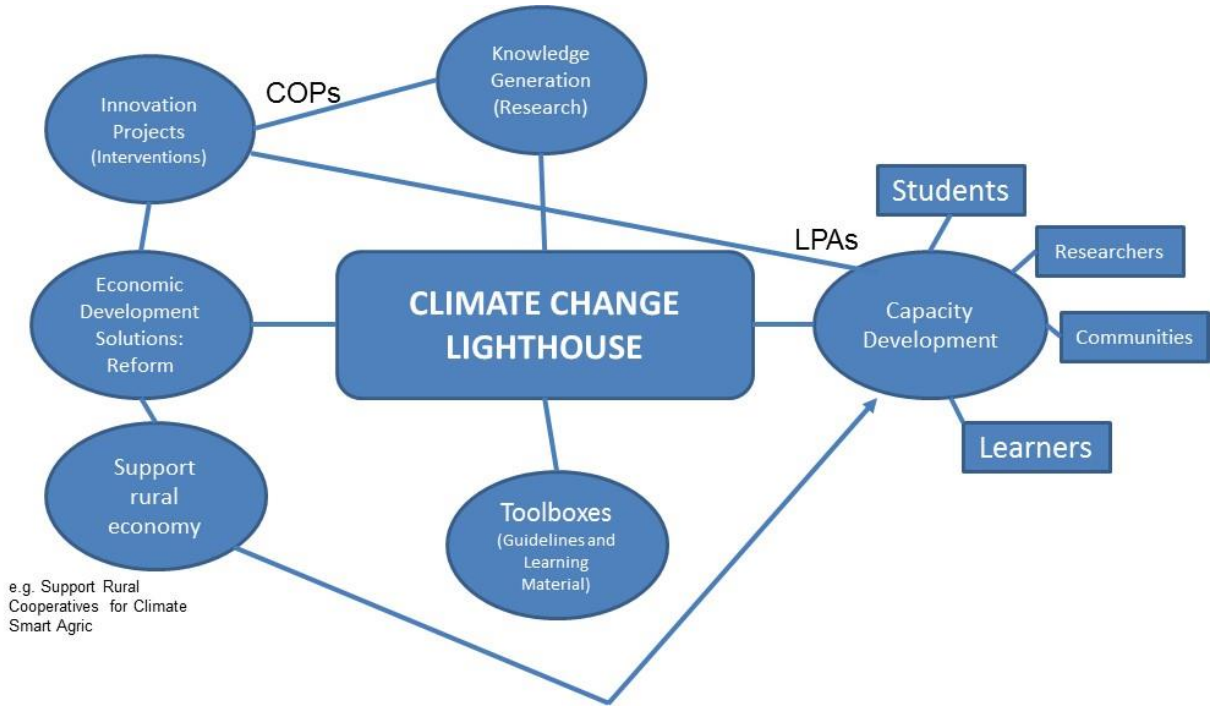


Figure 12. Climate change capital

Both national and international stakeholders are expected to contribute significantly in terms of knowledge creation, funding and strategic direction. The knowledge generated will upscale into adaptation intervention projects/actions and mitigation guidelines (Figure 13) in support of a climate-resilient economy. This will include sector and site-specific responses determined and guided by need, together with national policy perspectives (NDP/NCRP, Green Economy, and LTAS) and integration of climate response into IDPs. Each KSA may have a focal point to guide climate change projects. The outcome is expected to be a climate-resilient society with improved adaptive capacity contributing to climate-smart development that does not compromise economic and social development.

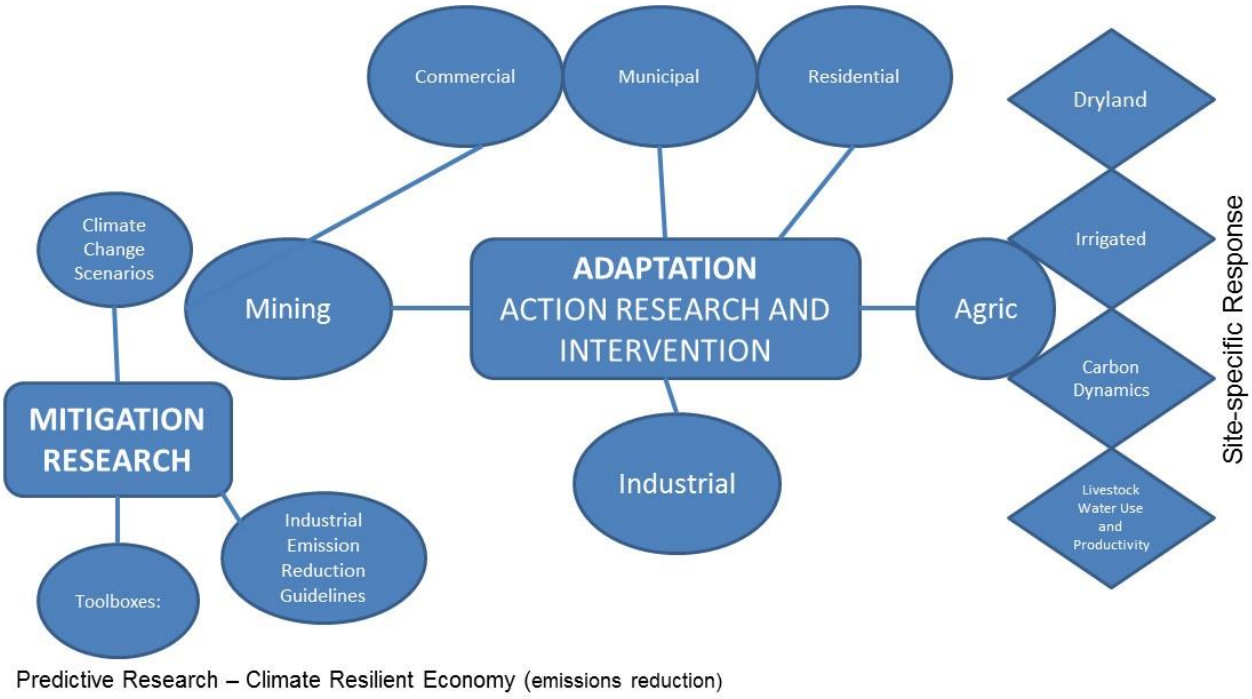


Figure 13. Representation of a climate-resilient society through coordinated cross-sectoral and water-linked climate change response

6.3 Water–Energy–Food Security

It is well documented that energy generation requires water, often in large volumes, for fuel production, mining, hydropower and power plant cooling. Conversely, energy is also needed for pumping, treating and distributing water as well as for collection, treatment and discharge of wastewater. Together, water and energy are needed for food production.

It is these mutual interconnections that are now being increasingly referred to as the water–energy–food nexus (Figure 14). The water–energy–food nexus was first brought to the attention of global leaders at the Davos World Economic Forum through the Global Risks (2011) report, of which South Africa was a part. Although there is census that the three sectors of water, energy and agriculture are linked, more work is still needed to explain their interdependence. Water, energy and food are essential for human wellbeing, poverty reduction and sustainable development.

This recognition is in tandem with South Africa's vision of a better life for all. The world's food, water and energy resources are already experiencing significant stress and shortfalls, and global projections indicate that demand for freshwater, energy and food will increase significantly over the next decades due to: economic development; population growth; urbanisation; growing demand for food and diversified diets; climate change; and resource degradation and scarcity. While global awareness with regards to water, energy and food challenges has been highlighted in different forums, their interdependency, i.e. the water–energy–food nexus, is still addressed in a fragmented manner within sectoral boundaries, and South Africa is no exception in this regard.

There is a need for water, energy and food security sectors of the South African Government to move towards policy convergence as opposed to the current 'silo' approach, in which water, energy and agriculture decisions have historically been made independently of each other. Policymakers need to ensure that cognisance is taken of cross-sectoral impacts and inter-sectoral linkages when formulating policies and strategies within the water, energy and agriculture sectors. Scientists have urged that understanding the complex relationships between water, energy and food systems has become critically important to the development of a sustainable and secure future for nations and regions.

The WRC seeks to motivate that there is a need for the nexus approach to be adopted by the water, energy and agriculture sectors in South Africa in order to achieve coherence in policy. The co-benefits and trade-offs should always be considered in order to formulate and design resilient strategies. The relationships between these systems go beyond simple water and carbon footprinting, analysing water supply chains or new energy supply sources, and designing climate adaptation strategies in relation to water consumption or its impacts on land availability and food prices.

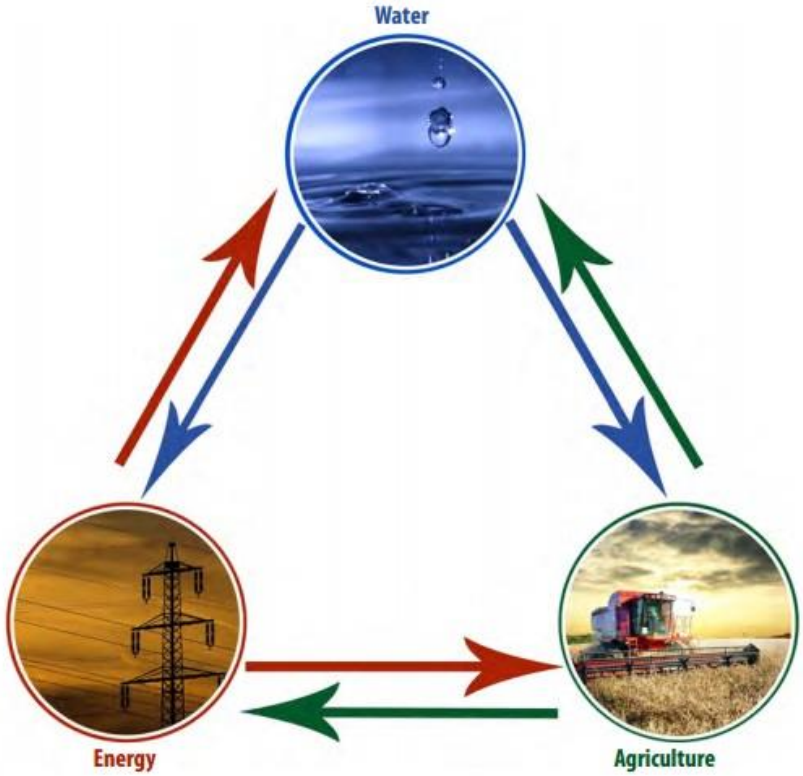


Figure 14. The Water–Energy–Food nexus

Achievements of the Water–Energy–Food Nexus Lighthouse thus far include a review of Nexus activities in the context of South Africa, while taking into account global perspectives. Some of the key focus areas were: (i) a brief analysis of the water and energy policies of South Africa, guided by legislation; (ii) analysis of agriculture and water use in the context of food security; and (iii) the potential consequences of climate change on the water, energy and food nexus, with respect to the South African climate change policy. Based on these activities a paper entitled '*Water–Energy–Food nexus: towards policy convergence in South Africa'* was submitted to the journal *Water SA* and it is currently under review. The aim of developing this paper was to stimulate debate raise awareness on this topic across sectors. In addition, the coordinator responsible for the Water–Energy–Food Nexus presented a paper entitled 'The water sector: future constraints and competing demand, water resources of South Africa' at the World Bank Water–Energy Workshop in Sandton, Johannesburg, from 29–30 April 2015.

In the 2015/16 financial year, the Water–Energy–Food Nexus Lighthouse is coordinating and facilitating more than 25 projects across KSAs. Some of the recently completed projects are: (a) Water use of cropping systems adapted to bio-climatic regions in South Africa and suitable for bio-fuel production; (b) Improving livestock carrying capacity with rainwater harvesting and conservation on grasslands, for extensive and/or intensive livestock production and biogas

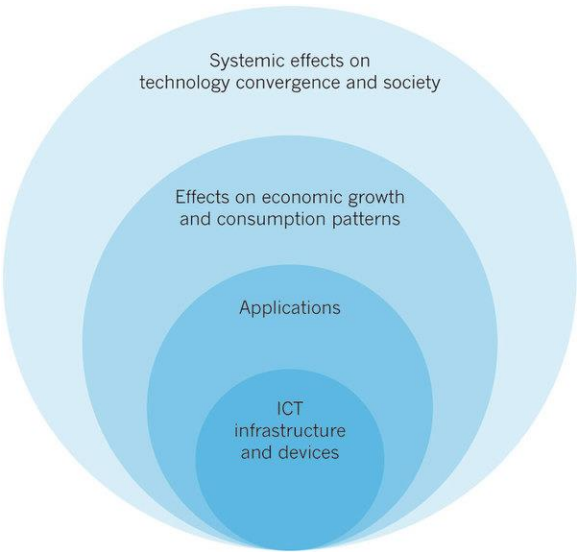
generation from manure in rural areas of South Africa; (c) Conduit hydropower pilot plants; (d) Long-term forecasts of water usage for electricity generation: South Africa 2030; and (e) Energy efficiency in the water industry: A compendium of best practices and case studies. Some of the key research projects in this Lighthouse will be implemented with partners as part of information dissemination, knowledge exchange and the science–policy interface.

6.4 Information-Communication-Technology (ICT) in the water sector – the new enabler?

The purpose of this new Lighthouse is to stimulate and use the developments in the ICT environment as an enabler of efficient and improved water management. Over the past decade ICT systems and their applications have been on the increase in the water sector. In this short space of time ICT has demonstrated itself as a potential solution for many operations and challenges in the water sector. Over the past five years there has been a substantial increase in ICT usage in the South African water sector. Broadly, the applications currently implemented, in development or envisaged can be categorised into the following areas:

- Customer management
- Operational management
- Financial and control management

In all of these areas, ICT applications are used to collect information, streamline information flow and improve work processes. The majority of the systems highlighted as successful showed two key aspects, namely, the system was integrated into existing structures and the municipalities had made financial commitments to maintain the system.



The wide distribution and reach of mobile communication and its innovative products, even reaching the most rural environments, has demonstrated and created a powerful platform for the use of ICTs. The cell phone is fast becoming far more than a mere communication tool. Cell phones are beginning to be used for data collection, mobile payment and crowd-sourcing initiatives to improve governance, and other applications are offering a new way of using technology to improve access to services and service delivery. The water sector is seeing an increase in ICT applications (Figure 15), mainly for the purpose of improving data collection, information flow between decision makers, and engagement with the wider public. The availability of information about current conditions in a particular situation on a timely basis is

crucial for decision making in water management. For instance, flood and drought management is a dynamic process, changing daily, weekly, monthly or yearly, depending on weather conditions and how ecosystems respond to climate variability. ICT provides a unique opportunity to obtain information in near-real-time about a number of physical and environmental variables such as temperature, soil moisture levels, rainfall, and others through sensors and communication networks, and can thus contribute to providing more accurate information, supporting sound decisions and responses. Similarly, monitoring of water quality with remote-sensing equipment offers the immediate opportunity to manage a wide variety of water quality variables, thus improving the regulation of our water environment and reducing intervention times. Smart metering technologies can provide and reduce many administrative burdens, with the information in near-real-time offering details on water use which can reduce operational cost and risks, locate leakages and ensure better control over water demand. ICT platforms offer great opportunities to improve participation of all users of water and to influence responsible behaviour change. Applications have the potential to influence local regulation and monitoring of water infrastructure and quality.

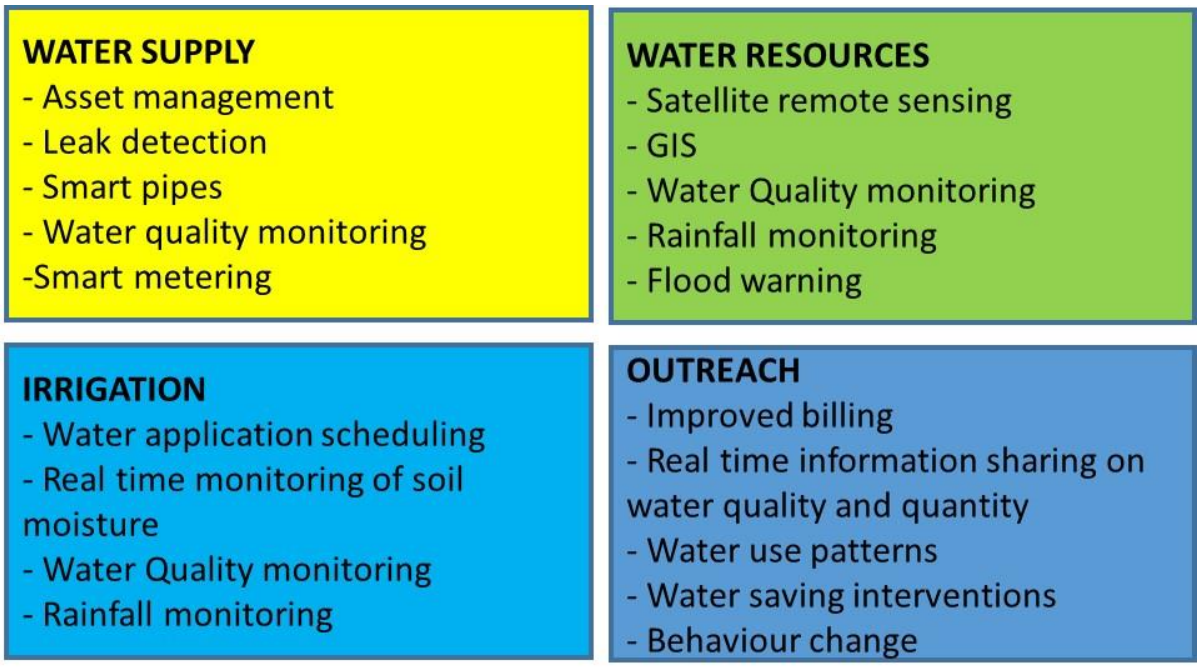


Figure 15: Some potential areas for application of ICTs

The WRC strategy recognizes the need to support innovation and capacity development in the water-related ICT field. As highlighted, effective management of water is becoming more and more important against the growing challenges and constraints in the supply of clean, fresh water. As an enabler it offers greater integration of different activities, as well as contributing to economic growth and efficiency.

6.5. Water Quality and Health

A new lighthouse that was conceptualised and established in the in the Second Quarter of the 2015/16 financial year, the Water Quality and Health Lighthouse has already hit the ground running. This lighthouse was deemed a necessary based on the number of open proposals that the WRC was faced with across all KSAs where the water value chain from resource to tap can impact on humans, animals, plants and the ecology. As a result, a Short Term Research Project was conducted to determine the status quo of water quality and health. The study assessed the funding efforts of the WRC in this area over the last decade. What was clear was the consistent but not coordinated effort of the WRC in funding the area of water quality and health. In the end, the transdisciplinary nature of the subject was found to resonate with each KSA and various Thrusts hence the consideration to develop a Lighthouse.

Current work includes the finalization of the status quo report for the chemicals' aspects. A short term study will be conducted to determine the status quo on the pathogen aspects. The products of both studies will then be used to formulate the WRC Water and Health Strategy which will have targets and goals for research and development which will have various timeframes including immediate, short-, medium and long-terms.

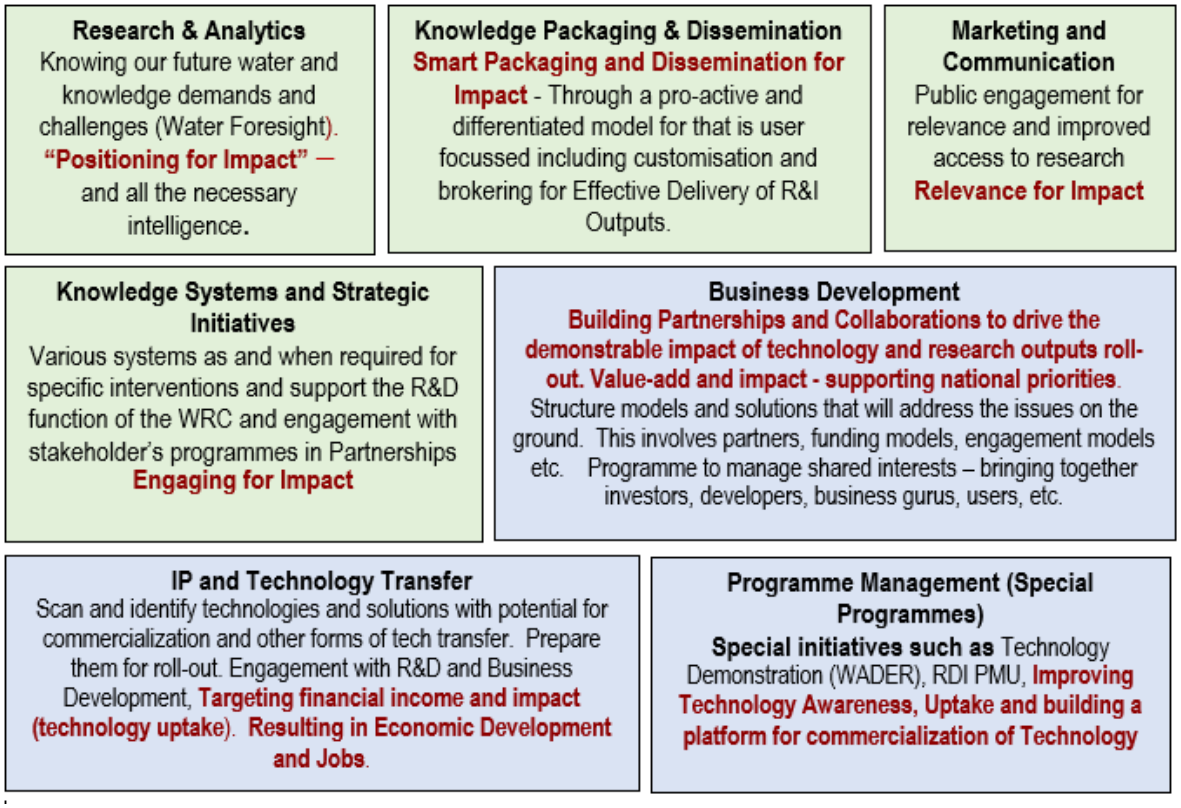
In terms of supporting the DWS, the Lighthouse already has three projects in three (3) KSAs (1, 3 and 4) where the existing Water Quality Guidelines are being revised and updated. The focus of the new guidelines, in consultation with the DWS and other stakeholders is focussed on the risk-based methodology. This principle is widely accepted internationally and enables the guidelines to be localised and specific for the various water uses as well as the different water management areas/ catchments of South Africa. Furthermore, building on the existing guidelines, the review is focussed on updating the guidelines in line with the NWA (Act 36 of 1998) but also included the development of a technology demonstrator where the guidelines can be in an on-line format. Where necessary, new variables are added and with the availability of new data, more cause and effect studies are able to inform the nature of risk associated with the different levels/ concentration of specific variables.

The link of water quality and health with the variable climate conditions is of most importance and in this regard, there is a call to develop monitoring, modelling as well as predictive tools that can enhance the research and development products linked to the water quality and health. In the same space, considering the current drought, there are already calls for consultancies to test the concept of relating the variable climate and hydrology with water quality and in particular health of humans, animals, crops and the ecology.

7. IMPACT AND INNOVATION

As part of its organisational re-orientation, the WRC has developed the Impact and Innovation (I&I) branch, which comprises the two units of a) Business Development and Innovation (BD&I), and b) Knowledge Dissemination, Marketing and Communications (KDM&C). While the KDM&C unit already exists, the BD&I does not, and the focus early in the 2016/17 FY will be to clearly refine the roles and responsibilities for the new unit as well as redefine these for KDM&C.

The diagram below shows the scope of this new unit:



7.1 What does 'impact and intervention' mean?

Research impact has traditionally been defined at the WRC as 'the demonstrable contribution that excellent research makes to society and the economy'. Research impact encompasses all the ways that research-related products and skills benefit individuals, organisations and nations. These include: improved global economic performance (and specifically the economic competitiveness of South Africa), increasing the effectiveness of public services and policy, and enhancing quality of life and public health. A defining characteristic of impact is that it must be *demonstrable*. It is not enough just to focus on activities and outputs that promote research impact, such as organising a conference or publishing a report. We must be able to provide evidence of research impact, for example, that it has been taken up and used by policy makers and practitioners, and has led to improvements in service delivery or business. Above all, research must be of the highest quality: we cannot have impact without excellence.

7.2 Why make an impact?

The primary reason for the renewed focus on achieving impact is that, as a public entity, we form part of a Government that strives to improve the lives of its citizens. As such, we have a role to play in achieving Government objectives. Additionally, we are increasing our emphasis on the

need for evidence of economic and social returns from our investment in research. Demonstrable impact helps to verify that research is important – that it is worth investing in and using. Evaluating our impact also enables us to see what works and why. These lessons can then be implemented both by the WRC and our future researchers.

High-quality research has the potential to enhance social and economic wellbeing across all sections of society. By ensuring that decisions on policy and practice are informed by evidence, research can help to:

- Improve the effectiveness and sustainability of public, private and third sector organisations
- Improve social welfare and cohesion
- Increase economic prosperity, wealth, and job creation
- Enhance cultural enrichment and quality of life

To maximise the impact of our research, we need to engage with our key user groups. This can provide substantial benefits for the quality of our own research, including:

- *Feedback* to help shape our research agenda and improve methodologies
- *Relevance*, ensuring our research is meaningful, timely and useful
- *Human capacity development*, recruiting participants, for example, for Reference Groups or surveys
- *Recognition*, developing new skills and raising our profile

We aim to achieve maximised research impact, and this can include socioeconomic impact, academic impact, or both. Socioeconomic impact is the demonstrable contribution that excellent research makes to society and the economy, of benefit to individuals, organisations and the nation. Academic impact is the contribution that excellent research makes to advances across and within disciplines, including significant advances in understanding, method, theory, and application. The impact of research can be *instrumental* (i.e. influencing the development of policy, practice or service provision, shaping legislation, altering behaviour), *conceptual* (contributing to the understanding of policy issues, reframing debates), or *capacity building* (through organisational and personal skill development).

To plan impact effectively we need to:

- Identify our key partners and stakeholders, for example, other researchers, public sector, business/industry
- Identify how they will benefit from our research – types of impact might include: improving social welfare and/or public services, influencing policy, contributing to industrial competitiveness

- Identify how we will ensure they have the opportunity to benefit, for example, through organising public events, conferences, interaction with the media, sharing of intellectual property

7.3 Maximising impact

Several key factors are vital for generating impact. These include:

- Excellent leadership and research management support
- Portfolios of research activity that build good reputations with research users
- Established partnerships with research users and other stakeholders
- Involving potential users at all stages of the research, including working with user groups
- Well-planned public engagement and knowledge exchange platforms, including the use of product strategies which tailor communication products to the needs of users
- Understanding and targeting barriers to and enablers of uptake

The environment in which we communicate our messages has a bearing on uptake and impact. If we try to promote our findings at a time when policy makers or practitioners are not open to such ideas, this reduces the scope for impact. However, if our communication is timed to coincide with the development of relevant policy issues then it will stand a better chance of making an impact. It is therefore essential to maintain communication and engagement with research users. For example, an awareness of policy and practice debates and initiatives will help us to time the communication of our work most effectively to achieve the best end results.

The extent to which the content of our research fits with the context in which it is disseminated will have a bearing on its capacity to generate impact. Building ongoing relationships with our research users is key to ensuring that any research communication is relevant as well as timely.

7.4 Assessing research impact

Determining the impact of research is not a straightforward task. Policy and service development is not a linear process, and decisions are rarely taken on the basis of research evidence alone. This makes it difficult to identify the role that an individual piece of research has played. The timing of evaluation also presents challenges. An evaluation occurring too soon after the research ends may mean that any impact has yet to fully develop; too late, and the impact may no longer be traceable as people involved have moved on. We are exploring new methods for assessing research impact on policy and practice.

The only way to answer the question, 'were our activities successful?' is to build in impact assessment from the beginning of each project. Effective assessment is about *improvement*. It offers an opportunity to demonstrate how well the interventions worked but also to identify areas that need to be improved. It should also explore the entire portfolio – from the early planning stages through to final delivery.

Good impact assessment needs a clear set of objectives. The usual starting point is to evaluate the activities of each project, as laid out at the proposal stage. This will help determine if the project achieved what it set out to achieve. We also wish to evaluate other, broader issues: For example, have there been any unexpected outcomes, whether positive or negative? Has the research changed any of the participants (audience and researchers)?

The assessment might explore how the project could be improved or seek to identify any aspects that were particularly effective. This learning can be very useful for other researchers undertaking public engagement – knowing what works (and what doesn't) can save time and improve practice generally.

The WRC's own assessment of the uptake and impact of WRC-funded research as an entire portfolio might also stimulate research into public engagement. For example, it might identify which types of engagement activities work well for particular audiences and new ways to engage with audiences that are difficult to reach.

8. BUSINESS DEVELOPMENT

A key element of the WRC's strategy in this planning cycle is an expanded and redefined business development strategy. Business Development (BD) is defined as the creation of long-term value for the water sector from our external stakeholders, markets and partnerships.

The key drivers for BD are:

1. Value creation
2. Strong and effective partnerships (development of new and maintenance of old)
3. Excellent project and programme management
4. Access to funds
5. New markets
6. Retaining and managing excellence in talent
7. Effective systems and processes support
8. Realisation of impact

A situational analysis of business development models within the WRC shows that currently there are 8 models that are operational within the organisation:

1. The Levy-Funded Model
2. The CSR Model
3. The Public Partnership Model (P^2)
4. The Public Private Partnership Model (P^3)
5. The Dissemination and Extension Services Model
6. The Implementing Agent Model
7. The Demonstrator Model
8. The Multi-Partnership Multi-Funding Model

The Levy-Funded Model

This model is the traditional WRC levy-funded model (Figure 16). This model uses an open call and directed call process to generate relevant, innovative and needs-based projects for the water sector. The directed-call process uses reviewers consisting of sector-, domain- and discipline-based experts to review and/or develop a Terms of Reference for the call, which is followed by the use of reviewers to evaluate the proposals for selection. In addition, the WRC uses sector strategies, policies and global and scientific trends to evaluate relevance, innovation, and scientific credibility. Key outputs from the selected projects are the development of water sector capacity through the production of Masters, PhD and other degrees, and the generation of new knowledge, products and services for the water sector. The expectation from this model is that through the technical management of the project and the careful selection of reference group members the knowledge, products or services generated will eventually be taken up by the sector and translated into innovative solutions. However, if the latter steps of translation do not occur, impact may not be realised.

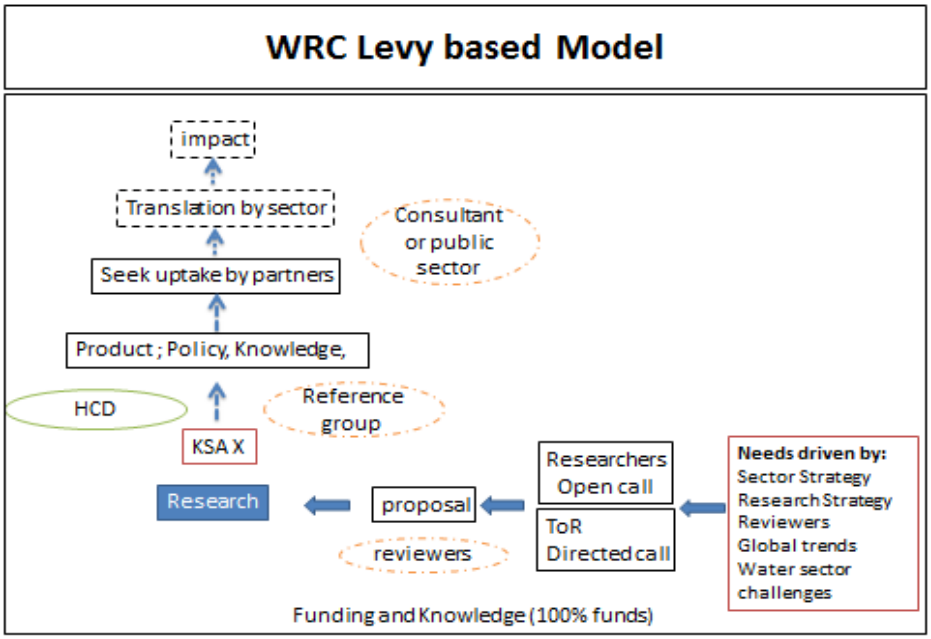


Figure 16. The traditional WRC levy-funded model (HCD = human capital development; ToR = Terms of Reference)

The CSR (Corporate Social Responsibility) Model

The model (Figure 17) is initiated by the Companies Act and the requirement to show social investment into communities. It is used by companies as a marketing tool. In this model the funding can be provided by the business partner and the WRC CSR funds or the WRC can act as the knowledge partner through the provision of materials, training or services to communities. This BD model has huge potential to be replicated and expanded within the WRC.

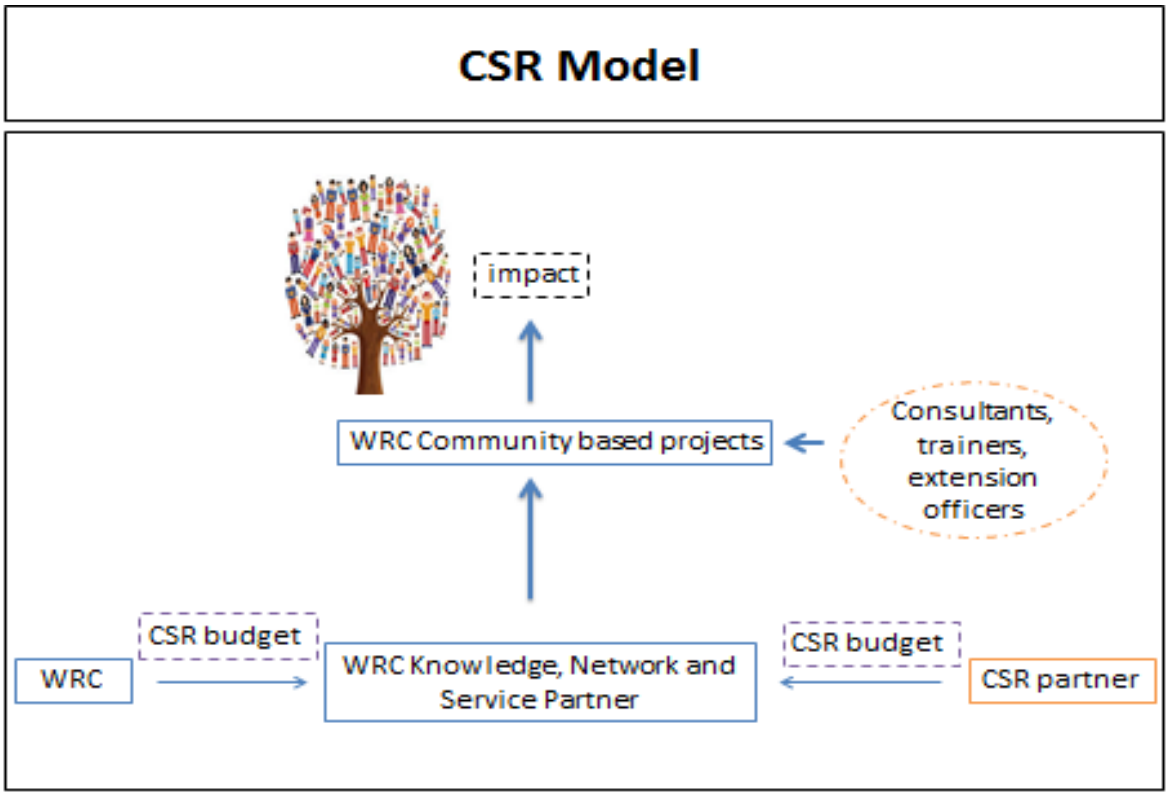


Figure 17. The WRC CSR Model

The Public Partnership model (WRC P^2 model)

The public sector partnership model (Figure 18) is a common model used by each KSA within the WRC and is based on specific relationships developed with different government departments and their directorates. In this model the WRC could play three critical roles, i.e., funding, knowledge and/or project management partner. The funding mechanisms include 100% external funding, 100% internal funding or a co-funding agreement. Impact can be realised by the development of a product for direct use or the development of knowledge which is then translated through various multi-stakeholder engagements into policy, regulation, strategy or guidelines.

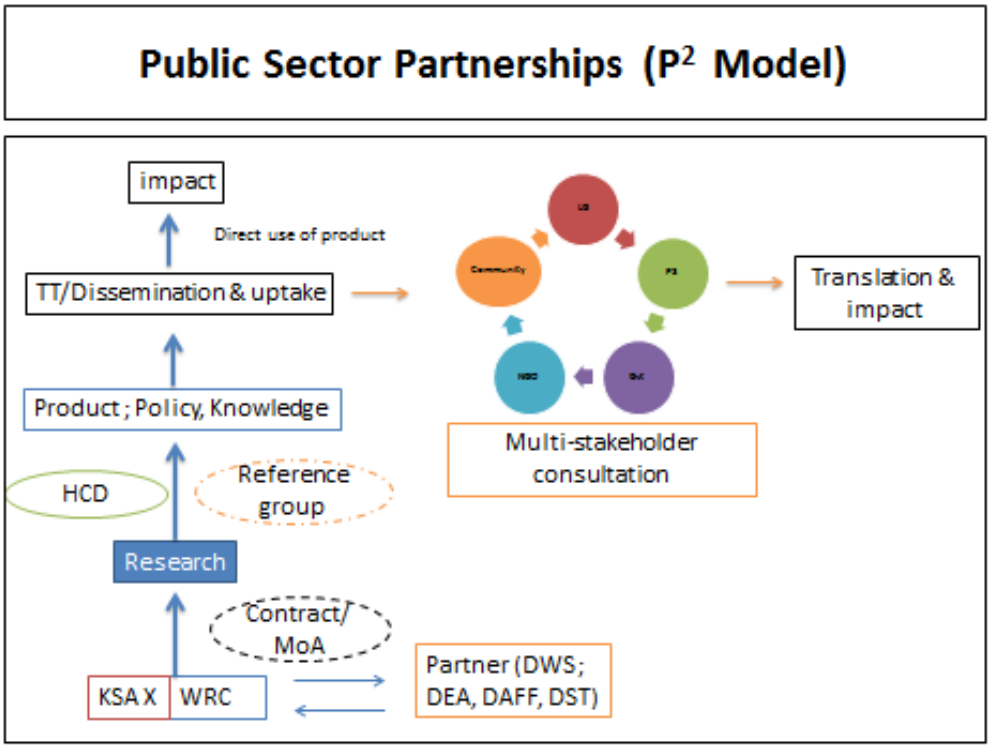


Figure 18. The P^2 Model

Note: In certain circumstances the WRC is approached to use funds, which are obtained by various public sector enforcement entities from penalties incurred due to non-compliance, for research purposes. These arrangements can be simple arrangements linked to research projects and with simple reporting requirements. In other cases the reporting requirements may be substantial. In the latter case, the funds may be refused due to capacity and organisational limitations in meeting the clients auditing and reporting requirements. Thus, the BD strategy will need to evaluate this type of funding arrangement, its value and how best to accommodate such partnerships.

The Public Private Partnership Model (WRC P^3 Model)

A P^3 model (Figure 19) can be designed at the start to ensure impact and this model is only as strong as the common vision set and achieved by both partners. This model can be initiated via a Memorandum of Agreement (MoA) that has a committed budget allocation and a joint research committee (JRC) to oversee the selection and progress of projects. The projects selected can either be co-funded (where both partners agree to a centralised management of funds) or funding can be split into research funding by the WRC and capex and in-kind funding by the partner (separate management of funds). In this model the industry partner uses the WRC knowledge base to design specific ToRs that can be directly applicable to that industry partner and the WRC and the researcher uses the industry expertise to develop a knowledge product that can be directly used. The reference group provides guidance on the scientific credibility of the

research. The product developed through this model is normally tested at one site and, if successful, rollout can occur to the other sites easily and the impact of the research is thereby multiplied. Another advantage of this model is the ability to design within the project a HCD component to train industry staff.

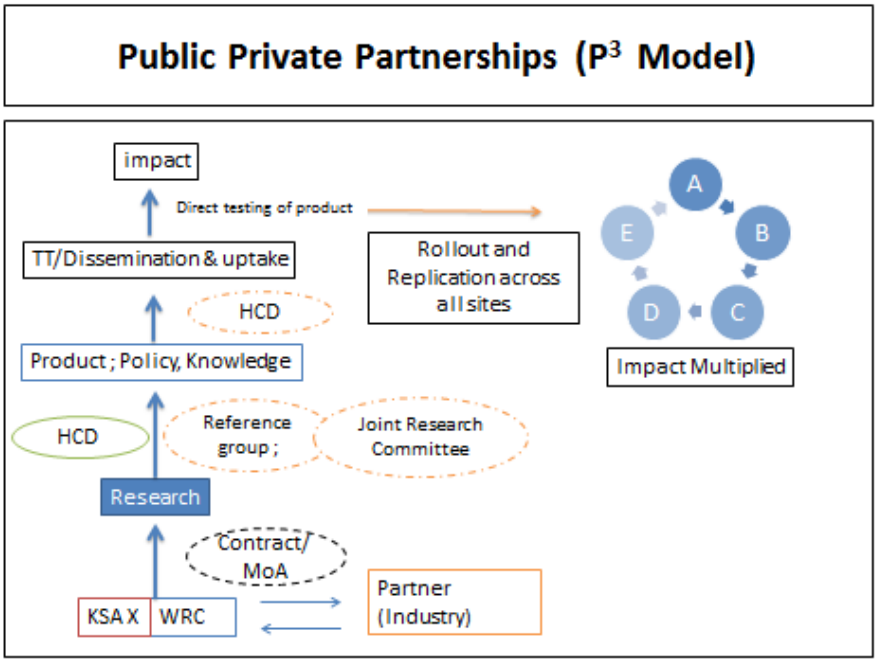


Figure 19. The P³ Model (TT = technology transfer)

The Dissemination and Extension Services Model

This model (Figure 20) maximises impact by forming specific partnerships to mass-produce existing WRC products for increased dissemination into communities. This model can either simply produce extra material for dissemination by the partner (A) or in future offer extension services to the funding partner (A+B). The B component of the model would require the WRC building in the cost to hire extension officers/ trainers or service providers to fulfil community outreach activities. Thus, the added opportunity with this model is the creation of new skills, jobs, awareness and a wider coverage of the population receiving WRC knowledge products. The impact of this model is significant.

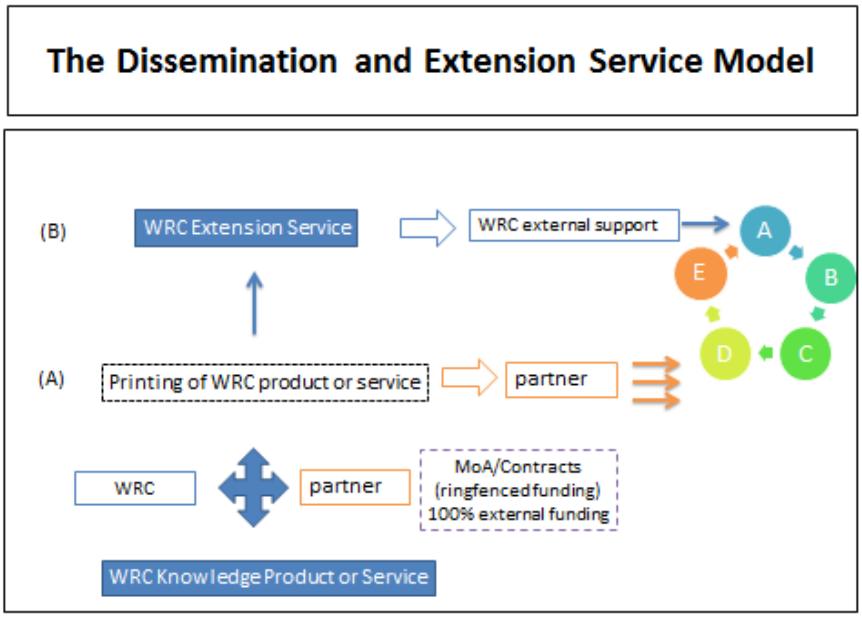


Figure 20. The Dissemination and Extension Service Model

The Implementing Agent Model

The IA Model (Figure 21) can be divided into two groups: a) is linked to the management of projects on behalf of the national funding partner where the WRC may serve as an IA or secretariat, and b) is linked to the WRC serving as an IA on behalf of a national and international funder. In the first variation, the outcomes expected are clearly defined in the contract or MoA. In variation (b) the WRC plays a reporting role to the funders, a facilitation role to the tech development partners which may be national or international, and a management and technology evaluation oversight role with implementation partners. The IA model B is much more complex to manage, requires significant engagement at all stages of the project, and can be subject to major risk around finance, liability and time delays.

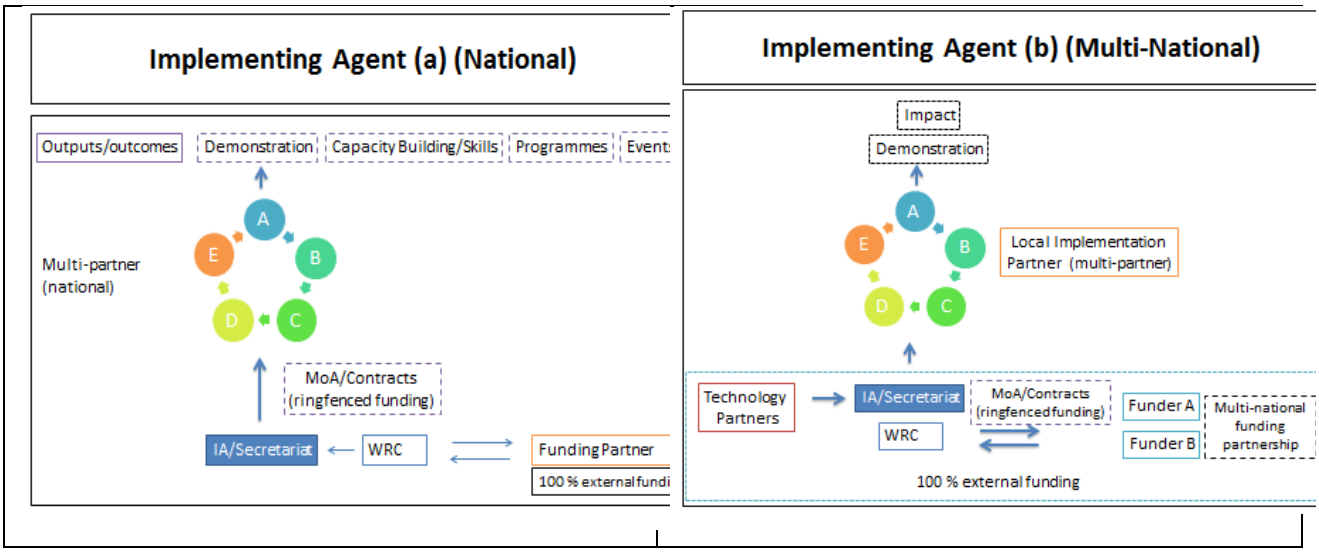


Figure 21 (a) Implementation Agent Model (a) and (b)

The Demonstrator Model

The Demonstrator Model is divided into two groups: (a) National and (b) International. The experiences from the national model show that it can operate using the principles of taking promising WRC-funded innovation into demonstration via the traditional WRC levy fund route and seeking co-funds (inclusive of in-kind contributions) to demonstrate at scale (Figure 22). This model can also take promising WRC innovation or water sector innovations into demonstration via the WADER platform. The latter is not a funding platform but facilitates and co-ordinates relevant stakeholders to co-own and co-fund a demonstrator where the outcomes are shared to allow "buyers" to gain confidence in the performance of the technology and researchers and start-ups to evaluate pre-commercialisation potential of their technology. It is highly likely that in future the services offered by the WADER model will converge and all water demonstrators may move through this platform.

The International Demonstrator Model (Figure 23) is based on a multi-national partnership arrangement where the Department of Science and Technology, in partnership with the WRC, funds the SA researchers and technology developers and the EU funds the European partners on promising technologies. The benefit of this partnership is a wider exposure of SA innovation which could provide an increased chance for uptake and commercialisation internationally.

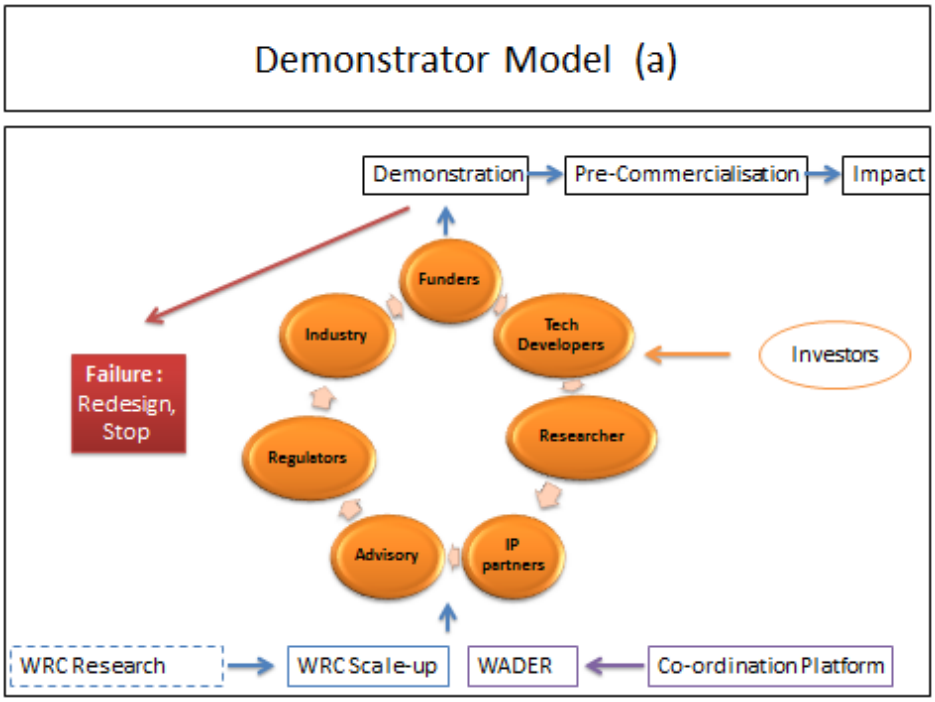


Figure 22. The National Demonstrator Model (a)

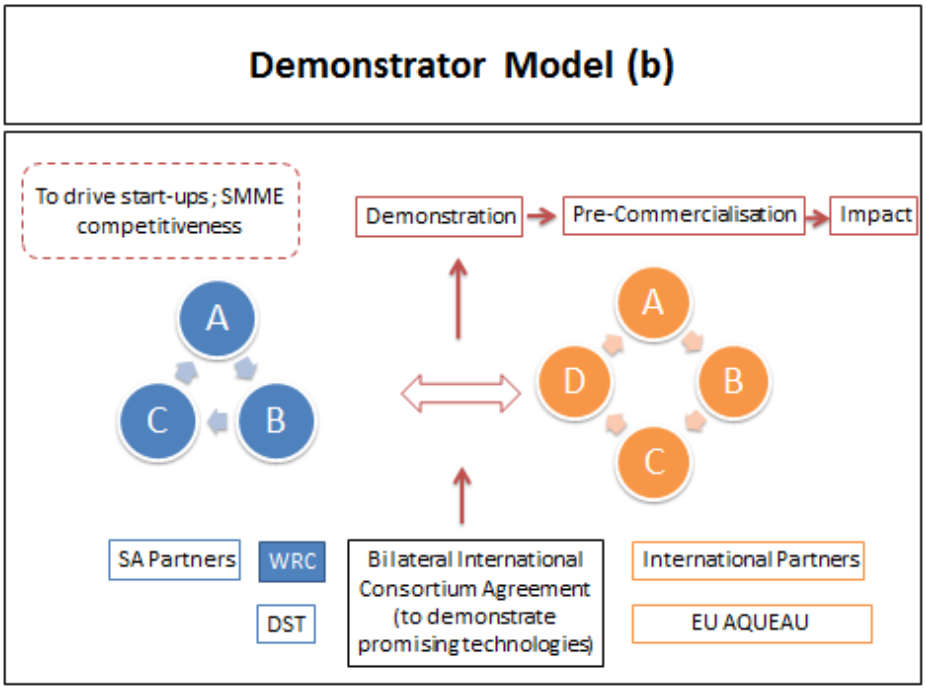


Figure 23. The International Demonstrator Model (a)

The International Multi-Partner Multi-Funder Model

This model (Figure 24) is fairly new within the WRC and involves the WRC being the SA partner in a large EU programme (e.g. Horizon 20/20, Acqueau) supported project, where each country funding body contributes funds towards their country researchers. The partnership follows a typical call>proposal>review>shortlist>selection and implementation process where each country is involved in each step and contributes national experts to the review phase. This requires significant support in the consortium formation phase and in the case of SA requires a co-funding partner due to the size of the project.

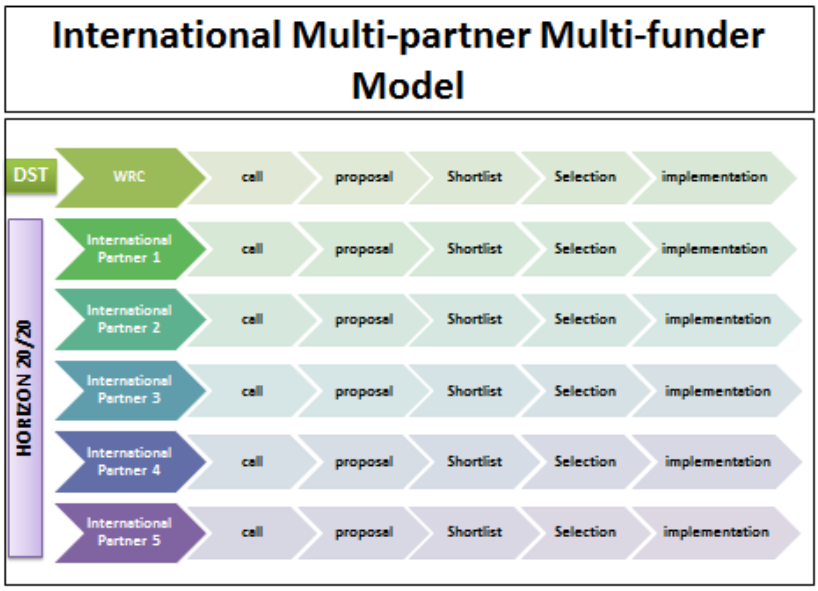


Figure 24. The International multi-partner multi-funder model

Summary

These eight models show that the WRC has a number of BD models in operation and thus the opportunities for growth and expansion are significant. While some of the models are well established within the WRC, others are evolving and are highlighting key risks such as reputational, financial, audit and management risks. Thus, it is important that the WRC's form and function evolves as well to ensure effectiveness, efficiency, sustainability and impact.

9. KNOWLEDGE MANAGEMENT

The focus on knowledge management (KM) in this iteration of the WRC's five-year planning cycle builds on the previous year's focus on the WRC Information Management Model as well as the

Knowledge Management Model created in previous years. In this planning cycle, the emphasis will be on the implementation of the KM operational plan.

9.1 What is KM in the WRC context?

Knowledge management refers to an integrated system or programme designed to create, capture, share and leverage knowledge towards the success of the organisation. This is easier said than done because instituting a knowledge management programme requires many changes and support at all levels of the organisation.

Furthermore, there are different forms of knowledge to contend with and understand. Knowledge can be tacit or explicit, which requires different strategies to capture each type. Another challenge is to distil the practice of knowledge management into one neat concept.

The goal of knowledge management is a practical one, to improve organisational capabilities through better use of the organisation's individual and collective knowledge resources. These resources include skills, capabilities, experience, routines, and norms, as well as technologies.

Prost AJ, mentions that, unlike experts, knowledge products such as software, patents and CD-ROMs do not automatically create organisational capabilities. In most cases, their potential can be realised only through human action. Therefore, the 'fit' of acquired knowledge products is extremely important. New ideas and new knowledge can take effect only if they are at least somewhat compatible with the old. The less familiar a new idea is, the more likely that it will be rejected.

In response, the objective of the WRC KM Model is to follow a building-block model (See Figure 25) to plan and integrate the activities within the WRC and the outreach from the WRC to have maximum impact.

The WRC will build its KM Model on three elements: (1) WRC knowledge use; (2) solutions exchange; and (3) knowledge brokerage (See Figure 26).

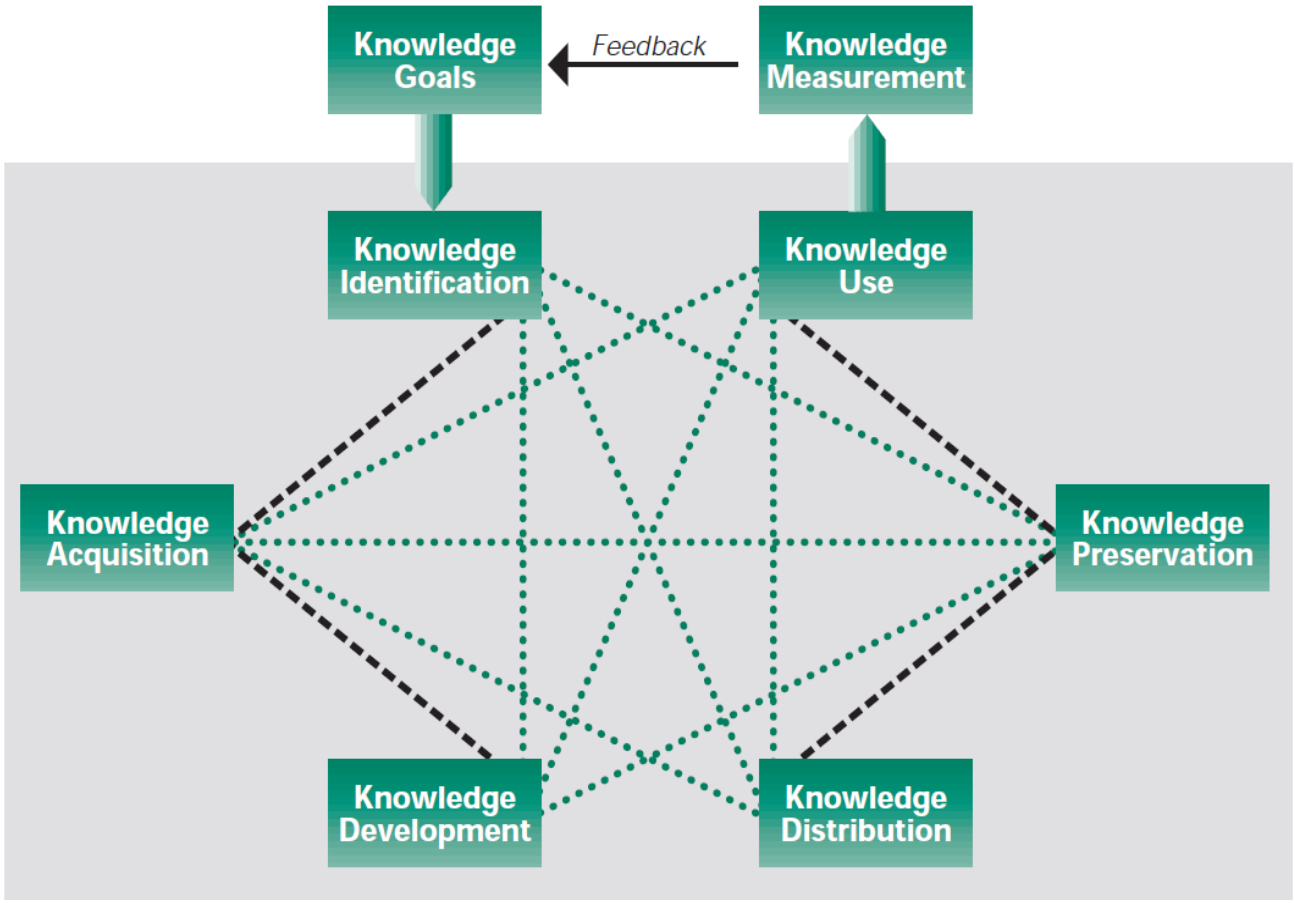


Figure 25. Knowledge Management Framework

Source: Gilbert J Frost **http://genevaknowledgeforum.ch/downloads/prismartikel.pdf**

The output from this approach is that it will provide a dynamic platform for the WRC to develop and implement knowledge management interventions and strategies which integrate activities and enhance impact. Some of the key elements the model will incorporate are as follows:

- Knowledge infrastructure and systems
- Knowledge extension services – these enable the WRC to respond and provide the sector with purposefully developed products such as market analysis, business intelligence, trends and forecasts
- Knowledge support services – these enable the WRC to drive large-scale demonstration initiatives on behalf of the sector, such as scaled-up pilots, field-based application, special research initiatives (e.g. SRFA)
- Knowledge network services – these enable the WRC to play an important hosting service for key dissemination and coordinating activities around sharing of lessons and best practice (e.g. WRC Municipal Roadshow series; FETWater network)

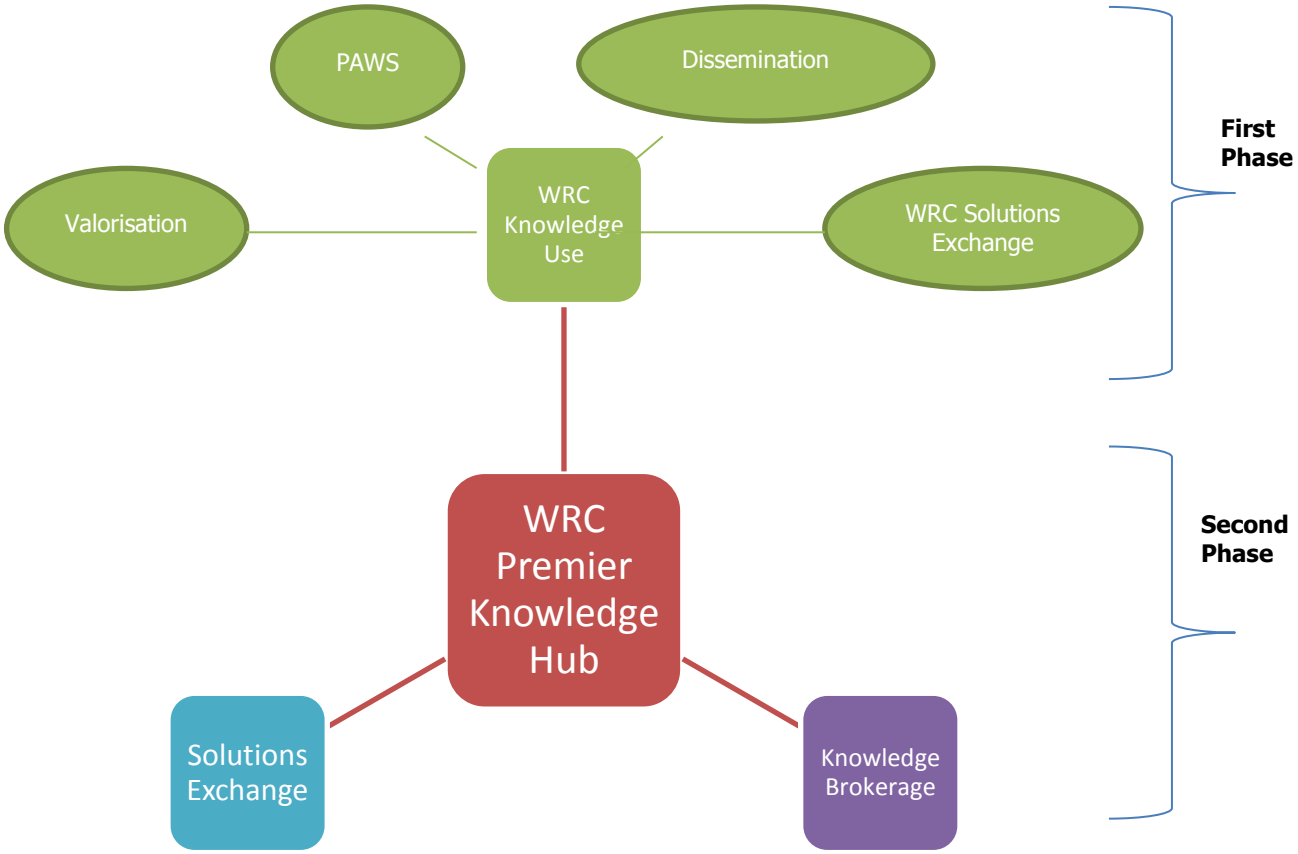


Figure 26. WRC Knowledge Management Model

PART C: STRATEGIC OBJECTIVES

This section covers the objectives identified to achieve the WRC's strategic outcome-oriented goals outlined in Section 4. The strategic objectives that have been identified are related to and discussed within the context of the approved budget and programme structure referred to as the WRC's Key Strategic Areas (KSAs). Table 5 summarises the WRC's strategic objectives, which are expanded upon in each KSA. These objectives are met through the building of relevant knowledge as depicted in Figure 27.

Table 5. The WRC's Strategic Objectives[1]

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE

[1] The WRC's Annual Performance Plan provides a more comprehensive list of institutional Key Performance Areas (KPAs) along with baseline information.

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
To enhance knowledge across the water knowledge and innovation cycle	Initiate new research projects
	Finalise projects
	Communicate scientific findings and WRC-generated knowledge
To support human capacity building in the water sector	Encourage participation of students in WRC research projects
	Encourage public engagement through workshops, dialogues and other water-related events
	Encourage participation of PDI as project leaders
	Increase participation of women as project leaders
	Encourage participation of HDIs as lead organisations in WRC research projects
To develop new products and services (new innovations)	Encourage development of innovations, and new products and services
	Strive to take existing WRC products and services to more advanced stages of development
To support community empowerment	Increase the number of community-based research projects
	Support SMME's in water-related R&D domains
To support transformation and redress	Involve and support PDIs in WRC research projects
	Promote research that supports the reduction of poverty and inequality, and the reallocation of water
To develop sustainable solutions	Ensure that WRC research contributes to sustainable solutions for the water sector
	Promote the uptake and communication of WRC research in the form of manuals, guideline documentation and other supporting materials
To inform policy and decision making	Support policy makers with research-based knowledge
	Improve the tactical dissemination and targeting of policy and ministerial briefs and engagement around prioritised issues

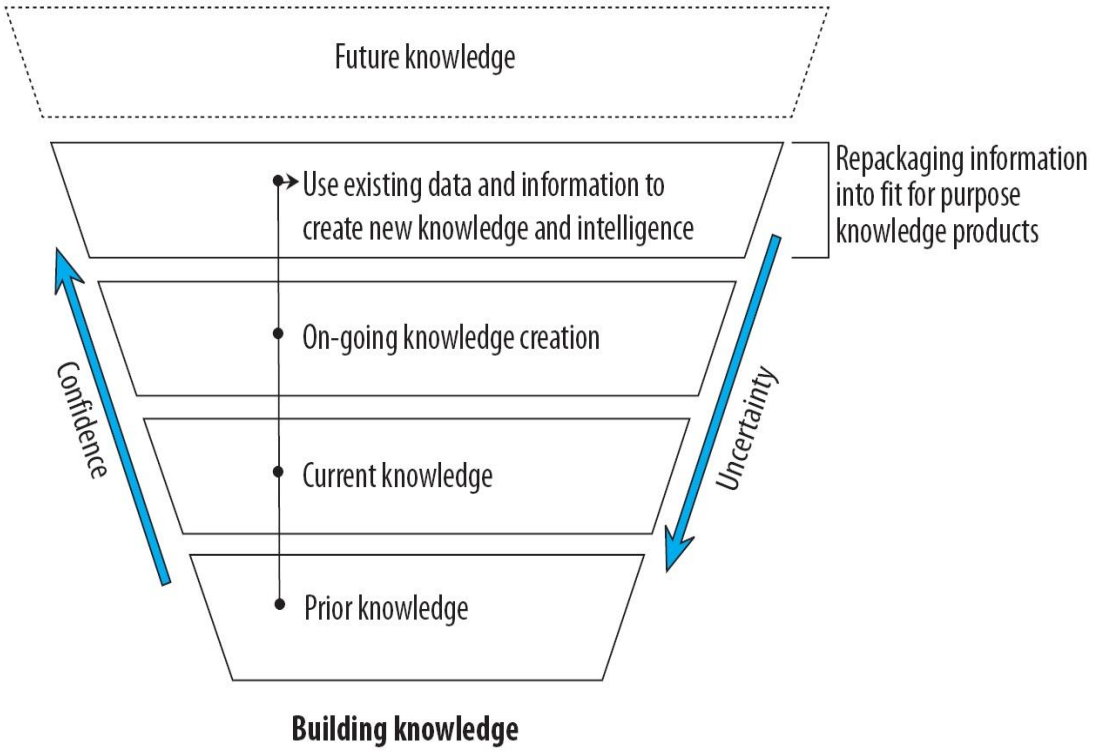


Figure 27. Building relevant knowledge which feeds into the WRC Knowledge Tree and WRC Lighthouses

10. KSA 1: WATER RESOURCE MANAGEMENT

Scope

Water resources include a watercourse, surface water, estuary, or aquifer. Water resources are best managed at a hydrological boundary which could be a whole catchment or basin, sub-catchment or an urban catchment. Water resources are hence geographically-based units that can be managed in an aggregated or disaggregated manner. Integrating and coordinating the management of the different scales of water resources is essential for good management which requires good systems understanding of a catchment which is made up of an assemblage of components forming a complex unitary whole. These components are: biophysical, ecological, social, economic and institutional dimensions that are interconnected. They are affected by various external drivers that pose pressure on the state of the water resources creating positive or negative impacts to which the resource responds creating a cyclic chain effect on the state of the resource.

The main current global and local change drivers are climate change, population growth and increased urbanisation. Driven by rapid industrialisation in the developing world, food production, energy demand, population growth, climate change and the environment, it is estimated that 50% of the global population will live with chronic water stress by the year 2025. Not only will

the limited availability of freshwater lead to chronic water stress, but poverty, unequal access, wars, migration and unsustainable consumption patterns will also be major contributors to the water crisis.

The health of rivers and aquifers is under pressure from economic activities and a changing climate. Water is necessary for drinking, for sustaining goods and services of its ecosystems, for food production and for industrial activities for economic growth, and it is also the receptor of our waste products. Point sources of pollution from current industries and old abandoned mines continue to pose serious threats to our water resources as well as an increased demand from urban centres and peri-urban concentrated dwellings. Urbanisation increases risks related to ecological disruptions, pollution, climate change and environmental disasters caused by extreme weather events. Communicable diseases in these densely-populated areas would be a common feature impacting on the quality of water in rivers. The urban poor in peri-urban areas are affected by increasing living costs, especially food prices, inadequate services risking social stability and the desired integrated management of the resources. As urban populations grow, multi-stakeholder processes for inclusive governance become more pressing.

These global challenges can affect the management of domestic water resources, such as demand far exceeding available freshwater resources, increased competition between sectors and deteriorating water quality. In many areas of the country, dwindling water supplies, longer and more frequent droughts, poor water quality, and rising demand for water are creating increased risks for water managers and industrialists alike.

Over the past four years, the focus of this KSA has been on better understanding the drivers, pressures, state of the resources, impacts and responses by society within a systems view of socio-ecological complexity. This focus will continue, albeit with an added risk lens (Figure 28). An additional focus will be applied to knowing and understanding, targeting and managing the risks in, for example, water quality, water planning, water allocation, shale gas exploration, water security, large infrastructure, asset management, information systems, enforcement and compliance, wastewater discharge risks to water bodies, etc.

The emphasis on risk stems from the realisation that there is relatively adequate knowledge of the problems faced and their respective characterisations. What is missing is engagement of the decision makers in taking up this knowledge and applying it in managing these problems. It is believed that when these issues are shared from a risk perspective, knowledge transfer can be more targeted, the need for specific knowledge made clearer to the decision maker, and action prompted more readily. The envisaged approach will evolve gradually, from first characterisation of the risks and identifying the boundary conditions, and will apply as guiding principles the adoption of a participatory approach within an adaptive paradigm.

Further, there will be an increased focus on the 42 years of existing research outputs that need to be used in assessing risks and identifying adequate mitigation approaches aimed at targeted outcomes and impact. Over the next five years, research outputs, coupled with enhancing the understanding of characterised risks through targeted communication per sector, and robust dialogues and other stakeholder engagement mechanisms, should result in the desired outcomes and impact.

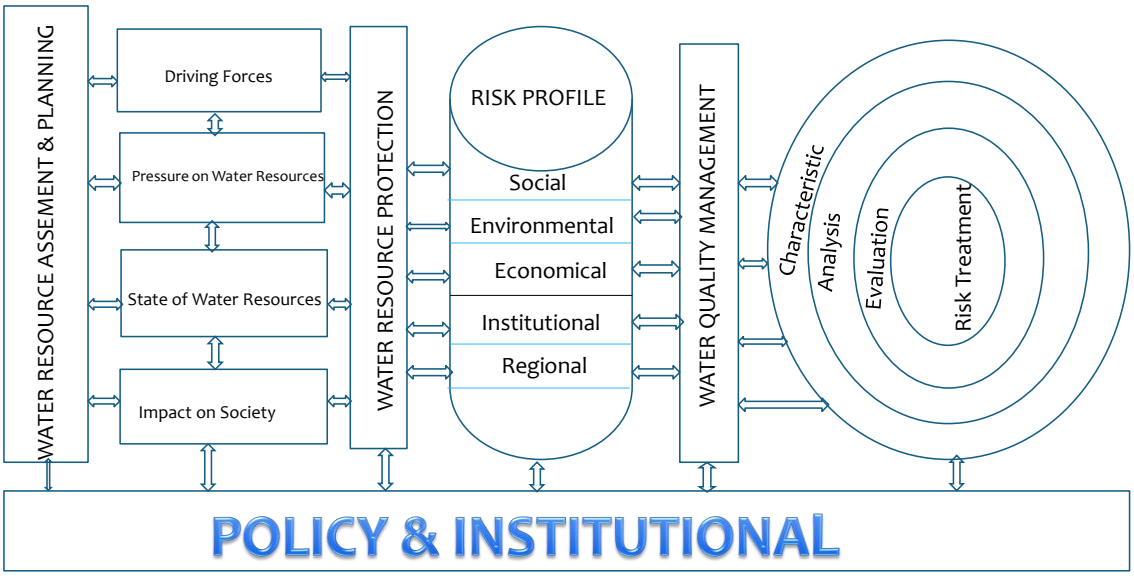


Figure 28. KSA 1 Portfolio Framework

Risk identification, analysis and evaluation will be conducted within all thrusts to establish the risk, building on the numerous investigations of the state of water resources and the pressures exerted upon them. Risk mitigation and/or treatment will comprise policy and societal responses, developed in a participatory fashion with feedback loops for adaptive responses. This KSA will use and support the knowledge base for addressing the above risks through four thrusts as defined in the above diagram. Climate change and climatic variability will be integrated into the different programmes of the respective thrusts.

Because of this broad scope, all of the WRC Knowledge Tree goals are strongly and directly, as well as indirectly, served by this KSA. Previous research will inform the research agenda for the next five years. Integration, transdisciplinarity, synthesis, adaptive management, absorptive capacity, and requisite level of simplicity will be the principles that will guide the future research approach. Emerging research areas are around water security and trade-offs between water, food, energy and the environment, the need for an equity framework and revised tenure systems

for water, complete value chain assessments, from water resources to raw water supply, tap water supply, wastewater treatment and back to freshwater systems or the coast. This should create stronger links with KSAs 2, 3 and 4 through most of the defined WRC flagship programmes.

KSA 1 Strategic Objectives

The WRC's strategic objectives for KSA 1 are indicated in Table 6.

Table 6. KSA 1 Strategic Objectives

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
To establish better freshwater governance aimed at facilitating equitable, productive and sustainable use of water resources among all users	Water governance reforms have had a fair chance of implementation thus far. The focus of this objective will gradually shift in the next five years from the 'what' to the 'how', and to evaluation of progress. Typical areas related to water management reforms and the related governance aspects that will be covered include: governance at the national level, water sector legal frameworks and broader institutional arrangements, transparency and accountability, civil society participation and the equitable provision of access and services.
To develop a deeper scientific understanding of the hydrological cycle (and inter-linkages) in order to promote systematic water assessment and planning	This thrust focuses on developing a scientific understanding of the hydrological cycle (and inter-linkages) in order to promote systematic water assessment and planning. This thrust will promote better understanding of the variability of the quantity and quality of water available for use and development (relying on the water quality thrust below) as well as the climatic changes and variability that can pose risks to development. Recent changes in national water resource infrastructure management, awareness of the poor state of the aged water resource infrastructure and increased knowledge of water resource planning needs are expected to receive attention, through the support of competent and sustainable solutions. Sound water resource assessment and planning can only be achieved with reasonably accurate and consistently recorded and processed data and information.
To consolidate the vast amount of existing water quality–related research outputs in priority domains and to transfer this knowledge whilst being alert to emerging issues	There is a need to consolidate the preceding 40 years of water quality work in order to determine the state of the science in South Africa, specifically with regard to the main pollutants from industry, mining, agriculture and domestic use. It is also important to link these aspects with other KSAs to determine if there are available solutions which can be used in pilot studies and to remediate poor water quality. The inclusion of citizen science in projects such as miniSASS in schools and Adopt-a-River in communities will go a long way toward the improvement of water resources in the country. Emerging issues and existing pollutants require enhancement of the current monitoring framework based on scientific research. The basic monitoring requirements should be identified and linked to the DWS data management requirements. Models can be developed and scenarios can be run based on the available data to determine the risk to users, the environment and law enforcers and compliance agencies.
To contribute research towards a reliable supply of good quality water for the health, and	While the previous objective looks mainly at the quality of the water within our systems, this objective focuses on protecting water resources, by reducing the quantity of harmful materials reaching water resources, within a

environmental, social and economic wellbeing of the country	broader framework for all uses. Broadly, research in this thrust focuses on the generation of knowledge and understanding of catchment processes, climate change and variability, and land use activities that influence the quality and quantity, negatively or positively, of the water resources.

11. KSA 2: WATER-LINKED ECOSYSTEMS

Stakeholders and communities require an environment that is safe to live in and water resources that are fit for use. Therefore, the WRC, through this KSA, will continue to generate knowledge and develop tools or technologies that assist society and managers to sustainably use water and associated resources while at the same time advancing the protection of these critical resources. The products of this research portfolio are used to ensure that everybody in South Africa can experience a safe environment to live in. This KSA has been at the forefront of funding fundamental research that has established the causal effect of human activities on water quality and aquatic ecosystem health, and has worked with different stakeholders to disseminate and transfer research outputs to policy makers and water resource managers. The KSA will use the 2016/17 financial year to consolidate its implementation of the strategy initiated in 2013/14 of the cycle. Several programmes and research projects are already promoting the sustainable use of ecosystem services and causing society to realise the value of their natural (ecological) infrastructure.

The implementation of the KSA strategy, which reflects the mission and objectives of the WRC, adequately addresses a wider scope of R&D issues relating to water and ecosystems. The portfolio addresses five key issues that are important in managing and utilising water resources and ecosystems: our environment that constantly changes (ecosystems and global change), the process, function and structure driving ecological systems (ecosystem processes), management tools and frameworks that we can use to benefit from aquatic ecosystems (ecosystem management), the sustainable utilisation of our natural infrastructure (ecosystem utilisation), and the means to correct degraded water resources or the whole environment so that they can provide ecosystem services needed by the society (rehabilitation and remediation) (Figure 29).

The 2016/17 research strategy has been crafted to support and advance the key objectives articulated in the WRC Knowledge Tree, national legislation, national strategies and priorities and Government Outcomes, South Africa's international obligations, new scientific trends, and other stakeholders' views and needs. The KSA needs to extend more of its R&D output to the broader South African society, in order to capacitate all stakeholders in making knowledge-based decisions that encourage protection and sustainable use of ecosystems. The KSA will continue its focus on exploring different avenues and opportunities that R&D outputs provide in the market for ecosystem services (natural capital). The WRC Knowledge Tree advocates for the production of new products and services and the promotion of sustainable solutions from R&D. To advance these objectives, the KSA will assist researchers and communities to utilise the WRC's R&D

outputs to create new products and services and thus create new markets and industries. This is important in South Africa and Africa because there are natural resources in our ecosystems that are factors of endowment that through research and development can be used to create new jobs and markets. This thrust will continue to play an important role in supporting programmes geared towards rural development and livelihoods. Through this thrust the WRC will continue to work with green businesses and other such initiatives to support their bottom line and to improve their sustainability index (profitability, social and environmental aspects). This will be enhanced through focused research on green innovations.

The KSA programmes and initiatives support sustainable development principles as stated in the National Strategy for Sustainable Development (NSSD1), National Water Resource Strategy 2, NDP, RDI and many other related strategic guides. There is a call for research towards mechanisms required in order to meet the targets outlined in the post-2015 sustainable development goals (SDG) - agenda. Particular focus will be on meeting biodiversity conservation targets and water security. The sustainable development principles are enshrined in the South African Constitution and advocate a whole-system approach. According to those principles, natural resources must be used sustainably, socio-economic systems should be included since they are dependent on ecosystems, and basic human needs must be met to ensure that resources necessary for long-term survival are not destroyed for short-term gain.

Among other thrusts, the KSA will continue to implement the R&D thrust on Ecosystems and Global Change (Thrust 5) which was introduced in the 2013/14 financial year. This thrust will complement the WRC's Climate Change Lighthouse, which is led by this KSA. The projects supported in this thrust enable the KSA to apply knowledge from climate and global change studies to the planning and management of water resources. This research output will provide an analysis of the trade-offs resulting from either development or protection options that affect specific ecosystems or water resources. Therefore research on carbon sequestration, atmospheric deposition, understanding and avoiding vulnerability transfers to promote adaptive co-management will receive urgent attention. Further call for proposals (directed) will be made to enrich and direct research towards this Lighthouse. These will cover areas, such as carbon economics, and appropriate capacity building. The other key thrust that will receive attention in 2016/17 includes areas of restoration, remediation and rehabilitation due to increasing levels of ecosystem degradation. KSA 2 will continue its prominent role, nationally and internationally, in the field of restoration. The areas of resource accounting and management of natural ecosystems through sustainable beneficiation will receive more attention in order to encourage communities to look after their resources – i.e. a bottom-up approach. The areas of biotechnology will therefore receive prioritization, as well as eco-tourism. The global community is more inclined to use of technology, therefore this KSA will pay more attention to development, testing and application of technology in real-time data acquisition, particularly the use of cellular phones. In short, the areas of innovation and impact will receive stronger attention from KSA 2 in this planning cycle. The protection of ecosystems from further degradation, through value adding, such as developing medication from aquatic plants, with beneficiation and patent, and targeting

local communities in job creation, while enhancing natural capital integrity, will be emphasized. The greatest challenge in this field is not only securing researchers from PDI groups, but also transforming the research agenda where the focus is purely on biodiversity protection without paying attention to benefiting marginalised societies and the economy through entrepreneurship development.

Partnership will always be at the centre of innovation and piloting of sustainable solutions as resources are a key to impactful research. The KSA will continue to encourage scenario development studies that focus on prediction and understanding of the consequences of decisions that are taken with respect to specific aquatic ecosystems. For instance, it is not yet fully understood what the consequences will be if a water resource (river) class is upgraded or downgraded; this requires a thorough analytical process guided by societal, economic, and environmental needs, for South Africa and SADC. To enhance our knowledge in this area, the WRC has partnered with the DWS to initiate a directed project in this area, which started in April 2015. Further developments will be in the field of Resource Quality Objectives for wetlands, improving the understanding required for these as has already been done in the case of rivers. Another area receiving attention will be how to incorporate temperature in ecological Reserve determinations, particularly in the context of climate change and adaptation. The KSA will continue to support projects that address challenges relating to population dynamics (such as migration), climate change (adaptation and mitigation), and determination of ecological thresholds, especially for rare and sensitive ecosystems in South Africa and Africa. The National Freshwater Ecosystem Protected Area (NFEPA) Atlas produced by the WRC has indicated some of the key ecological points that South Africa should protect, or utilise with caution, to ensure sustainability. On the other hand, the NFEPA has had its shortfalls demonstrated when used at the scale of individual sites, which is not a use it was designed for. To avoid misuse of this critical tool, further work on improving accuracy will be considered in 2016/17, in collaboration with SANBI/DEA.

The coastline (including estuaries) and its ecosystems are a unique part of our environment that support many human activities relative to their limited area. Coastal ecosystems also hold great economic value, with coastal goods and services estimated to contribute 35% of South Africa's GDP. In order for coastal economic and social opportunities to be maximised, while conserving coastal resources, development needs to be ecologically, socially and economically sustainable. The coastal and estuarine ecosystem must be viewed as a whole system and managed as such. Research on this critical ecosystem has not been conducted in coordination with research on the broader landscape in South Africa, whereas such a coordinated effort is needed to realise integrated water resource management and attain sustainable development.

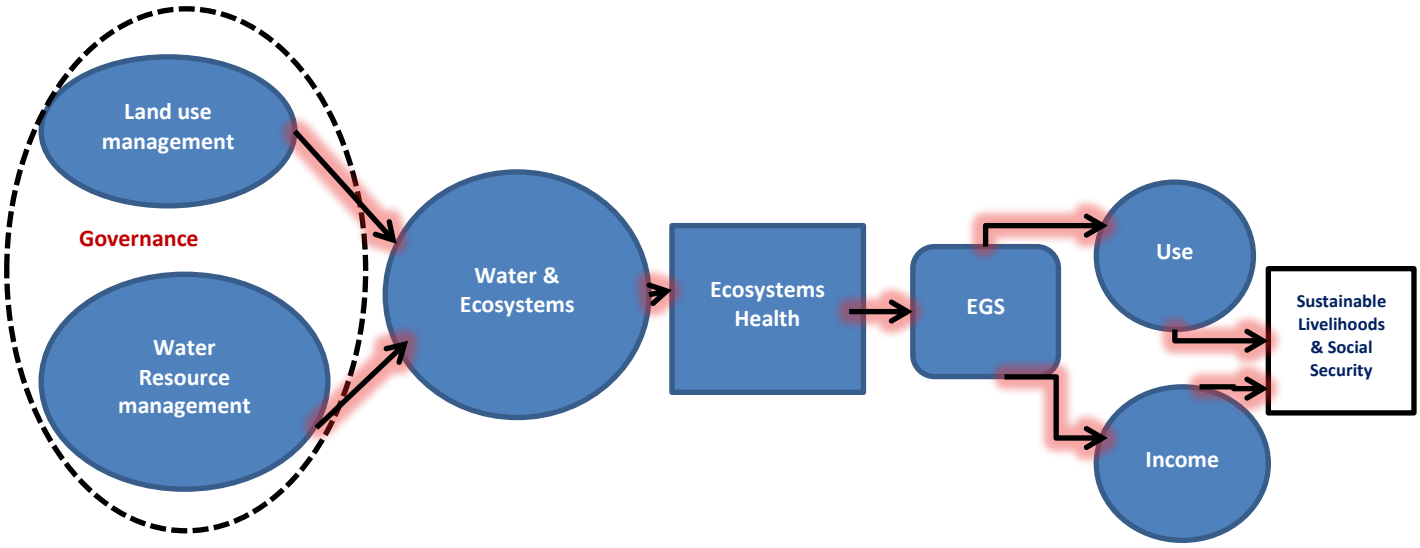


Figure 29. Illustration of the key factors that ensure delivery of aquatic ecosystem services

While many countries have been generating coordinated knowledge about their various ecosystems for years, the WRC and other institutions have, for some time, concentrated on advancing our understanding of the impact of catchment management on the estuarine aquatic environment only. WRC-funded research has enabled DWS to successfully conduct ecological Reserve determination studies (quality and quantity) for many estuaries in South Africa, and most of the estuaries have been assigned an ecological class, which is required for the evaluation and granting of water use licences. The KSA will continue to use directed calls to guide researchers into all key priority research areas. A limited open call for proposals will also be published in the upcoming research cycles. The envisaged ratio of directed to undirected projects will be 55%:45% and will be revised each year in accordance with the progress made in addressing the priority areas.

The KSA will continue to promote the participation of PDI, women, disabled persons and youth in R&D projects. The KSA's interventions will be undertaken to promote transformation and redress in our society, to empower communities, to enhance human capacity development, and to ensure that there is sustainable development in the country. The following interventions that are congruent with the WRC strategic objectives will be used:

- Action research that capacitates women, the disabled and youth as key role-players in the research projects
- Identification and support of community R&D initiatives that advance suitable water resource (ecosystem) utilisation
- Special projects that support post-doctoral students, especially in historically-disadvantaged universities (with an interest in water research and ecosystem management)
- Joint partnerships between communities, local and national Government and corporate business to advance sustainable ecosystem use and development

- R&D SMME support

The WRC Lighthouses will be used by the KSA as a vehicle for knowledge dissemination and transfer, most notably, the Climate Change Lighthouse.

KSA 2 Strategic Objectives

The WRC's institutional strategic objectives for KSA 2 are indicated in Table 7.

Table 7. KSA 2 Strategic Objectives

STRATEGIC OBJECTIVE	DESCRIPTION OF OBJECTIVE
To enhance the understanding of knowledge in ecosystems health and conservation of biodiversity	Initiate new research projects addressing use and protection of aquatic ecosystems in a sustainable manner. These will entail better identification and inventory as well as use of technology in monitoring. A bottom-up approach, participatory or action research and adaptive management are some of the key approaches that will be used to facilitate new knowledge uptake. Partnerships are key. Restoration and resilience are people-centred activities; collective identity and action are key towards a shared vision as a basis for technical products for enhancing ecological infrastructure. The protection of natural capital will require proof of the value-add to people's livelihoods and other benefits. To realize these objectives needs strong investment in students, preferably at MSc and PhD level. They will be involved in the research projects to ensure that a new cohort of researchers is produced. The Lighthouses provide an opportunity to develop capacity at the community level. Policy and management is influenced through partnerships with DWS and DEA in project implementation and by producing ministerial, policy, and technical briefs. Conferences and dialogues are used to share and disseminate knowledge.
To generate knowledge that informs ecosystem management and the implementation of policy and legislation	
To transfer the knowledge to appropriate end-users through the development of innovative tools and methods that support social and economic requirements	
To generate innovative approaches that can be used in rehabilitation and restoration of ecosystems	
To develop innovations and knowledge that demonstrate the actual value of ecosystems and support to people's livelihoods	
To improve understanding of the connectivity between land, water, atmosphere and people	

12. KSA 3: WATER USE AND WASTE MANAGEMENT

Scope

The Water Use and Waste Management KSA focuses on water use and waste management in the domestic and industrial (including mining) water sectors. The strategic emphasis of KSA 3 is to enable effective water services institutions; provision of basic water supply and sanitation for improved quality of life and poverty alleviation (water value chain); protection of water resources; and reliable and equitable supply of water for sustainable socio-economic development. Some of the key factors that influence and impact KSA 3 projects are urbanisation, industrialisation, economic growth, human capacity development, and market drivers for new technologies (Figure 30).

The KSA is divided into six thrusts to meet the sectoral and WRC five-year strategy needs. The prioritised research areas which support Government Outcomes (6, 7, 9 and 9) and the WRC Knowledge Tree outcomes are:

- Improvement of water services institutions – institutional realignment
- Infrastructure – operations and maintenance, and capacity and skills
- Water quality – emerging pollutants, with special reference to their magnification during water reuse
- Financial sustainability of water services – cost recovery (tariffs, subsidy and financing)
- Climate change – preparedness and resilience of water services
- Water services landscape – informal areas and rural systems
- Industrial – brines, acid mine drainage and desalination
- Water–energy(–food) nexus (renewable energy and energy efficiency)
- Beneficiation – integrated technology use for water, energy, nutrient, and product recovery, and an industrial ecology approach to waste and water
- Water security – reclamation, 'new' water, direct potable reuse
- New developments (especially in Thrusts 2, 4 and 5) and their path to the marketplace
- Sanitation innovation

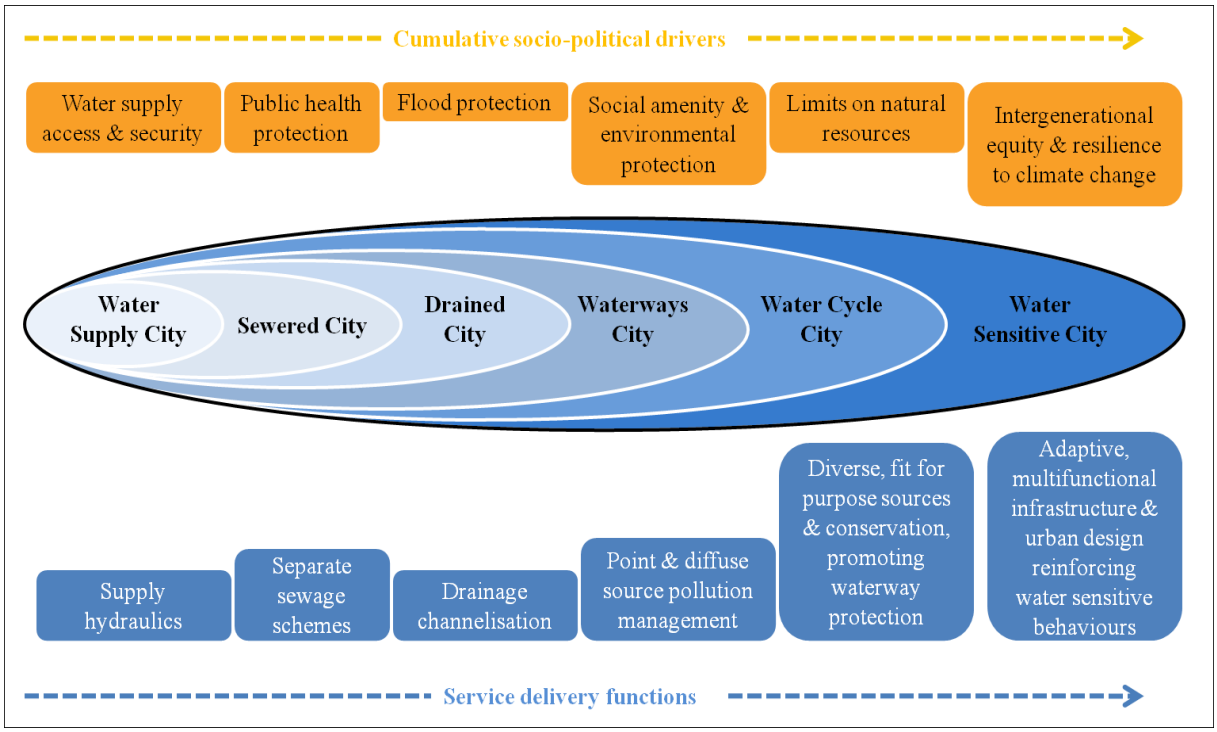


Figure 30. KSA 3 drivers (Source: Brown et al., 2007 ISBN: 978-0-9804298-2-4)

Considering the emerging challenges, research in this KSA will continue to focus on greater innovation and development of cutting-edge technologies to respond to the issues of poor water and wastewater treatment works operation and maintenance, competency and capacity constraints, direct water reuse, energy efficiency, climate change constraints, and emerging contaminants in drinking water quality. The KSA will also continue to engage with its sector partners to understand and navigate the market drivers and brakes that determine the uptake of innovative technologies and know-how, such as long market-entry times, Government support, increasing confidence and reducing uncertainty through demonstration, minimising barriers to entry, and engaging with the early adopters of new technologies. The KSA continues to support projects which contribute to policy and decision-making within the water services domain. It builds on knowledge gained to provide guidance on a framework for sanitation governance and decision support tools for wastewater risk evaluations, and seeks to influence policy by supporting research into the social, institutional and economic implications of water reclamation. KSA 3 supports several technology-based solutions which range from 'blue sky' research to applied research aimed at developing innovative processes and technologies for water and wastewater treatment and reuse. These projects specifically contribute to WRC Knowledge Tree outcomes of sustainable development solutions and products and services for economic development.

KSA 3 has taken special efforts to support promising and leading-edge technologies up to the pilot stage, and then to partner with relevant organisations such as DST, industry, entrepreneurs and local government to demonstrate applicability which leads to adoption in time. Demonstration projects in progress support conduit hydropower, pour-flush latrines, algal high-rate ponding, and point-of-use water treatment technology. Additionally, the KSA is partnering with DST and the Gates Foundation in demonstrating cutting-edge sanitation technologies emanating from the Gates Sanitation Grand Challenge. In line with national priorities, the KSA has launched four technology demonstration projects tackling the issue of acid mine water treatment.

The Knowledge Tree outcomes of human capital development, transformation and redress, and empowerment of communities are evaluated for relevance within each project and strongly supported where applicable. The KSA strives to maintain active research programmes at key universities and research institutions so that basic and applied research can provide leading-edge technologies and an appropriate and diverse expert pool to meet future water sector needs.

The KSA supports projects that are strongly linked to the WRC Lighthouses. The adaptive climate-change technologies and approaches for local government are a component that feeds into the Water-Sensitive Design and Climate Change Lighthouses, while several projects in Thrust 1 relate to the Freshwater Governance Lighthouse. Research continues on projects that integrate agriculture and, hence, food security, in designing low-cost sanitation technologies in social housing schemes, thereby closing the water and nutrient loop. This fits into the Water–Energy–Food Security Lighthouse and in time will be relevant for integration into the Green Village, as will a major new activity within KSA 3: the Sanitation Research Fund for Africa (SRFA). The SRFA is supported by 2.5 million USD from the Bill & Melinda Gates Foundation and currently contains a set of 10 projects investigating topics such as wastewater sludge handling and beneficiation, and pit latrine characterisation. The WRC has added 18 000 USD to the fund and the contracts have been placed in seven African countries (Ethiopia, Kenya, Malawi, RSA, Uganda, Zambia, and Zimbabwe).

KSA 3 Strategic Objectives

The WRC's institutional strategic objectives for KSA 3 are indicated in Table 8.

Table 8. KSA 3 Strategic Objectives

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
To support the efficient functioning of water service institutions and their viability in order to sustain water services in rural and urban areas	The focus is to address strategic research aspects related to policy issues, institutional reform, regulation, infrastructure management, operations and maintenance, sanitation (stormwater, sewerage and on-site sanitation), water-related competencies and capacity required for the strengthening of water institutions (water service providers, water service authorities, water boards, national departments) in providing sustainable water services.
To develop innovative technologies, processes and procedures that address aspects related to bulk water supply, water treatment technology, distribution and water quality	The provision and supply of affordable and reliable water, of sufficient quality and quantity for domestic and economic (industrial/commercial and mining) activities, remain continuous challenges. Linked to water supply is the all-important aspect of the protection of human health.
To develop technologies and systems that optimise the full wastewater and sanitation services chain in the municipal (domestic) sector	The need for innovative technologies and solutions is recognised as we prepare for the future – achieving more stringent effluent discharge standards, developing acceptable non-waterborne sewerage solutions, reliable treatment of ever-increasing high-strength domestic wastewater, and informing future policy.
To quantify water use and waste production, predict impacts (risks) over the short-, medium- and long-term, and develop and apply methods of prevention, minimisation, reuse, recycle, recovery and beneficiation with the aim to provide appropriate, innovative and integrated solutions for water efficiency and waste management for industries	
To provide appropriate, innovative and integrated solutions to water use and waste management in the mining sector	Future operations will almost exclusively take place in water-scarce regions (e.g. Waterberg, Eastern Limb) and their development will require reallocation of already stretched resources through, e.g., improved water demand and water conservation management. Additional priorities will include brine handling, biological sulphur compound transformation and aversion of future impacts.

13. KSA 4: WATER UTILISATION IN AGRICULTURE

Scope

Within the next 5-year planning period of CP16, the strategic direction in KSA 4 will be determined by the innovation cycle to achieve application and exploitation of the available

research output. For this purpose, increasing attention will be given to knowledge dissemination targeting a range of end users in agriculture. The actual impact of existing and new research output will be increased through public and private partnerships and establishing Africa-wide as well as international linkages.

The strategic research focus is therefore on increasing the system of knowledge for efficient use of water for production of food, forage, fibre, and fuel crops; improving food security, reducing poverty and increasing the wealth of people dependent on water-based agriculture; and ensuring sustainable water resource use. The requirements of present and future generations of subsistence, emergent and commercial farmers are addressed through creation and application of water-efficient production technologies, practices, models and information systems within the following five interrelated sub-sectors of agriculture:

- Irrigated agriculture
- Rain-fed agriculture
- Woodlands and forestry
- Grasslands and livestock watering
- Aquaculture and fisheries

The challenge for applied research is contributing to finding sustainable solutions for water use in agriculture, with priority given to innovative new products which support economic development and inform decision-making for private business and public policies. In the process of undertaking these research projects, the composition of research teams endeavours to increase representivity of Black and female researchers. Post-graduate students are trained to improve the expertise of human capital and encourage young scientists to choose a career in water research, while on-farm and participatory action research leads to empowerment of individuals and groups in rural communities.

Accordingly, a holistic systems approach is followed for knowledge creation and dissemination to enable people to utilise water in a sustainable way for food production and improved livelihoods (See Figure 31). Research projects are managed within the innovation cycle to ensure that scientific research is applicable and socially beneficial. Key issues being addressed are the productivity of water use for crops and livestock, poverty reduction and wealth creation in rural areas and prevention of resource degradation. These efforts are aligned to the Vision for 2030 of the National Development Plan; the outputs for Outcomes 7 and 10 in the Programme of Action announced by the Presidency; core water strategies of the NWRS-2; measures in the framework for the New Growth Path; the Green Paper on National Strategic Planning; the DAFF Integrated Growth and Development Plan; the National Agricultural Research and Development Strategy; and the Comprehensive Africa Agricultural Development Programme of NEPAD. Reports by the FAO and Save the Children further emphasise that food production is essential to achieve better

nutrition and health for improved human and economic performance. The focus of the WRC research effort is consequently on reducing poverty, unemployment and inequality.

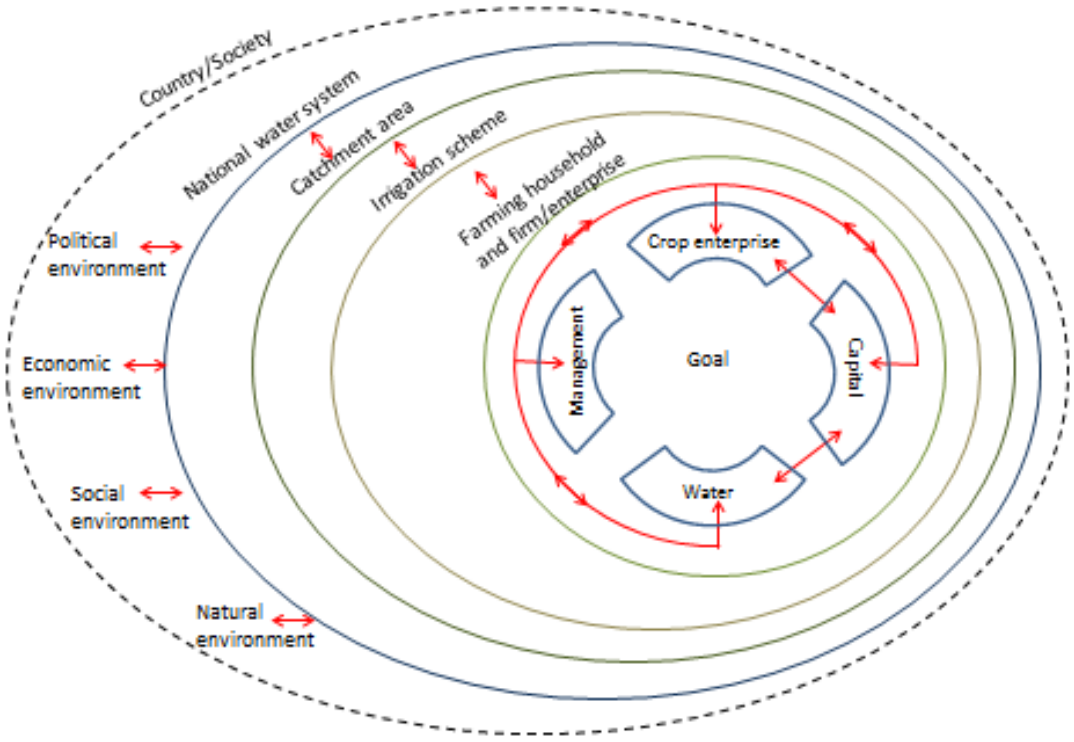


Figure 31. Schematic representation of the national water system with interrelated sub-systems from farming to irrigation scheme to catchment level (Source: Backeberg, 2000)

Work will continue to fill knowledge gaps that exist in the utilisation of water in agriculture, in accordance with the following key priorities of the research portfolio:

- Increasing the productivity of rainwater and irrigation water for crop and livestock production
- Uplifting rural economies through commercial food production and reducing income inequalities
- Quantifying the water footprint and identifying employment opportunities in food value chains
- Eradicating hunger and reducing poverty

- Improving food security, nutrition and health
- Generating alternative sources of renewable energy
- Preventing soil and water degradation and pollution
- Adapting farming systems to climate change

This KSA will work towards achieving a balance between projects in irrigated and rain-fed agriculture, agro-forestry and aquaculture, to promote farmer involvement in poor rural communities through participatory action research, and to take research projects further toward practical application of results with technology transfer activities. Building on the baseline of completed projects, the priority themes previously approved for research starting in 2016/17 are as follows: determining the water footprint of selected fibre and fuel crops; water use for food and nutrition security at the start-up stages of food value chains, supporting gender relations and early childhood development for poor households in rural and peri-urban areas; water use of selected sub-tropical fruit orchards; ultra-violet (UV) treatment of irrigation water to ensure food safety; use of winery wastewater as a resource for irrigation of vineyards in different environments; rain-fed water use and entrepreneurial development for establishing small farming businesses, employment creation for youth and poverty reduction; assessment of the effectiveness of policies and strategies for water governance in the case of smallholder irrigation farming; scenario development of future prospects for management of limited and declining quality agricultural water, increasing urbanisation of food consumers, higher energy costs and volatile food prices as influenced by changing climate, policies and economic circumstances; and modelling water flows with change in land use management in selected river catchments.

Based on a stakeholder consultation workshop held in July 2015, the following priority themes are recommended for research and technology transfer proposals of projects as from 2017/18: requirements of technology and practices for agricultural water management by women and youth in rural areas; irrigation and drainage management to reduce the impact of non-point source pollution of waterborne agricultural chemicals; water use in food value chains of indigenous crops with special focus on production and post-harvest handling as well as water use of indigenous fruit tree crops; water footprint of wine and table grapes; measurement of pollution to determine the increase or decrease of microbial contamination and the impact on food safety; reuse of recycled/reclaimed/treated water recovered from domestic, industrial and mining uses for irrigation water conservation practices; technology and practices for climate-smart agriculture with rainwater harvesting and conservation; water contamination, breakdown of waterborne microbial pathogens and impact on food safety; inclusion of indigenous crops in the crop choice for rainwater harvesting and conservation practices in homestead food gardening and communal cropland cultivation; developing a guideline for rain-fed production of underutilised indigenous crops based on available models to estimate water use within selected bio-climatic regions; knowledge dissemination and technology exchange regarding selected themes in agricultural water research to encourage uptake of available knowledge

The output of most of these projects will mainly contribute to the WRC Lighthouses on Water–Energy–Food Security, the Green Village, Climate Change and Freshwater Governance.

KSA 4 Strategic Objectives

In execution of the WRC's mandate and functions, the strategic objectives for research on and development of Water Utilisation in Agriculture are indicated in Table 9.

Table 9. KSA 4 Strategic Objectives

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
To increase the biological, technical and economic efficiency and productivity of water use	The primary objective is to increase national and household food security, improve livelihoods of people and increase efficient growth as well as equitable distribution of wealth on a farming, community and national level. The major challenge is to produce more food with the same or less water. This requires empowerment and capacity building for all farmers, especially women, with knowledge and practical skills for correct investment, marketing, production and financing decisions and actions. In this process, hunger must be eradicated, poverty reduced, new small farming businesses established and existing profitable farming enterprises maintained. Over the long term, sustainable agricultural activities and employment opportunities in rural and urban areas must be achieved, which implies obtaining benefits for people who are presently using water for food production, without compromising future benefits in food value chains.
To reduce poverty through water-based agricultural activities	
To increase profitability of water-based farming systems	
To ensure sustainable water resource use through protection, restoration and reclamation activities	

14. KSA 5: KNOWLEDGE DISSEMINATION, MARKETING AND COMMUNICATIONS

Scope

This KSA aims to provide strategic direction to the national and international cooperation, events and communication, marketing and branding, and knowledge management goals of the WRC. It also provides the necessary dissemination function to relevant stakeholders of research outputs and impact, and strategically positions the WRC within the local and international water sectors through its marketing and branding initiatives.

The strategic focus for KSA 5 in this planning cycle is to proactively coordinate the WRC's knowledge management, marketing and communications functions with an emphasis on maintenance of appropriate systems, research uptake and knowledge dissemination. It will also

aim to expand the research-on-research portfolio, and strengthen the social science portfolio of the WRC.

Objectives

The primary objective of this KSA is to coordinate the WRC's knowledge management strategy and includes:

- Supporting the continuous improvement of the public and political profile of the WRC by enhancing the credibility and relevance of the WRC through strategic positioning and strengthening stakeholder relations
- Coordinating the marketing and communication activities of the WRC including the media engagement, parliamentary liaison, strategic communication and marketing
- Providing the instruments to track, measure and report on the impact of the WRC in research and human capital development
- Coordinating local and international dialogues and other stakeholder events/activities led by the WRC
- Sharing and disseminating knowledge through a proactive and differentiated model that is user-focused, including user information (who is doing what, who needs what and who has what) and effective delivery of R&I outputs.

In the execution of the WRC's mandate and functions, the objectives for KSA 5 (Table 10) are as follows:

Table 10. KSA 5 Strategic Objectives

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
To improve knowledge uptake with the aim to increase implementation	This strategic objective will comprise of the development and implementation of the WRC's Communication Strategy in order to: enhance sector involvement in the WRC research process; strengthen awareness of the mandate and role of the WRC in the South African water sector; establish working relationships with industry, decision makers and key stakeholders; strengthen relationships through formal memoranda of understanding; provide knowledge in a format that is fit-for-use; deliver multimedia presentations to inform various target groups about the WRC and its accomplishments, to mention but a few.
To position the WRC as a premier knowledge resource for all water-related issues, locally and internationally, in order to enhance effective uptake of research	To ensure that the WRC remains at the forefront of knowledge creation, dissemination and uptake, this implies the coordination of strategic local, continental and international partnerships, and the facilitation of dialogues which render the WRC a significant international player and a recognised asset to South Africa. It also implies the increase in the credibility and relevance of the WRC locally and globally through the sharing and dissemination of relevant knowledge

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
	in the water sector and within the WRC, and the development of knowledge-sharing mechanisms/instruments to support the objectives of the WRC in terms of uptake of research.
To provide strategic research advice related to the water sector, R&D capacity, knowledge flow and ultimate impact	Provide strategic research advice related to the water sector, R&D capacity, knowledge flow and ultimate impact.

15. KSA 9: BUSINESS DEVELOPMENT AND INNOVATION

Scope

The scope of this KSA is to coordinate the WRC's Business Development and Innovations portfolio in order to realise impact for the water sector:

- Develop new business opportunities with private, public and donor (national and international) partners
- Maintain strong partnerships with existing organisations in order to develop a sustainable funding stream
- Evaluate, package, and demonstrate via partnerships, water-related innovations (technology)
- Evaluate, package, and demonstrate via partnerships, Lighthouse opportunities
- Manage the IP portfolio
- Develop metrics and instruments to track, measure and report on the impact of WRC research development and innovation
- Share and build expertise in water-related technology and innovation rollout
- Strengthen networks and develop differentiated partnerships to support technology rollout
- Mine, scan and provide advisory support and services to the sector by developing a strong intelligence network
- Support and lead business development and innovation forums

Objectives

This KSA aims to provide strategic direction and support to developing and maintaining strong and effective business partnerships which allows the WRC to enhance impact by seeking funds and collaborative partnership that enhance uptake of water-related knowledge and innovations.

Key focus areas within this planning cycle are:

a) Develop and manage a Business Development and Innovation Strategy

b) Develop new business partnerships and collaboration

c) Provide leadership in technology demonstration and rollout

d) Drive operational excellence around partnerships

e) Define, evaluate and review impact

16. RISK MANAGEMENT

The WRC's risk management framework is made up of a risk assessment which identifies internal and external risks to the WRC and details an implementation plan for their mitigation. Executive management and the Board undertake the risk assessment annually in November. After completion of the assessment and approval by the Board, quarterly reviews of the document evaluate the progress against the plan and identify any new risks.

The WRC Board and management team identified 12 risks as outlined in Table 11 below.

Table 11. Summary of WRC Risk Register

Risk name	Link to strategic objective
Inadequate availability, continuity and growth of adequate research expertise to deal with complexity in the water sector, both institutionally and externally	• To support human capacity building in the water sector • To enhance knowledge across the water knowledge and innovation cycle • To support community empowerment
Financial sustainability	• Financial sustainability & corporate well-being • To develop new products and services (new innovations) • To develop sustainable solutions
Constraints in keeping up with changes and trends in water research	• To enhance knowledge across the water knowledge and innovation cycle • To develop sustainable solutions • To inform policy and decision making • To develop new products and services (new innovations) • To support community empowerment
Insufficient uptake of research	• To enhance knowledge across the water knowledge and innovation cycle • To develop sustainable solutions • To inform policy and decision making • To develop new products and services (new innovations) • To support community empowerment
Inadequate financial systems supporting operations	• Financial sustainability & corporate well being
The role of the WRC in research, development and innovation within SADC, Africa and Globally	• To develop sustainable solutions • Financial sustainability & corporate well being

Risk name	Link to strategic objective
Lack of business continuity / disaster	• Financial sustainability & corporate well being
Relocation to new premises and costs associated with the relocation	• Financial sustainability & corporate well being
Fraud and corruption	• Financial sustainability & corporate well being
Poor quality or compromised researched outputs	• To develop new products and services (new innovations) • To enhance knowledge across the water knowledge and innovation cycle • To develop sustainable solutions • To inform policy and decision making
Losing competitive edge	• To enhance knowledge across the water knowledge and innovation cycle
Non-compliance to Acts, Regulations, Legislations, Policies and Procedures	• Financial sustainability & corporate well-being • To inform policy and decision making

17. BUDGET AND FINANCIAL STRATEGY

In the WRC's budget estimates over the five year review period we have taken a conservative approach (linked to inflation) when estimating the WRC income growth. This is based on the emerging trend of a general reduction in water consumption volumes due to a number of factors including drought. The WRC aims to have a substantial impact on the sector through improved technologies and efficiency measures. Research undertaken in water conservation and demand management are critical in the sector where water losses are exceptionally high. Furthermore, the WRC undertakes pilot studies and demonstrations in order to ensure that theoretical solutions are tested. Due to the scientific nature of the research, the cost of equipment required is impacted by the scientific inflation which is much higher than the general inflation rates that are used in the budget estimates. In order to assist the WRC and augment its budget, the Minister has approved additional funding, above the water research levies, through the DWS in order to conduct research on behalf of the department.

The WRC's aim over the review period is to emphasize and strengthen the WRC research funding and research support activities while striving to improve internal processes. The budget reflects the WRC's commitment to improve its internal processes that supports it core process of knowledge creation, sharing, dissemination and transfer. Therefore the budget reflects a change in the ratio between the WRC's investment in research & development funding and other support costs (human resource costs and fixed costs).

2015/2016

The original budget for the 2015/16 reflected a total revenue estimate of R311.3 million which was revised to reflect a revenue estimate amounting to R279.1 million. This represents a decrease in the revenue amounting to R32.2 million that is mainly due to the expected reduction in the realized leverage income earned for the financial year. Annual Financial Statements are prepared using the accrual basis of accounting as per the Standards of GRAP. However, in respect of leverage funded projects, the original budget as based on cash received from leverage projects rather than the actual realization of income based on achievement of deliverables. Cash received in respect of leverage funded projects are regarded as funds received in advance (liability) until the time of realisation of deliverables. However, cash received is still regarded as a valuable operational measure and indicator. Further, additional funding is expected to be received from the DWS, as per the approval of the Minister of Water and Sanitation for the 2015/16 year amounting to R1 million.

The revision in expected revenue directly impacts the amount of research expenditure expected to be spent. This is reflected in the ratio of the WRC's investment in research & development funding which decreased from 76.5% to 72.6% of the total expenditure.

2016/2017

The revenue is expected to increase in line with inflation for the 2016/17 period. This is lower than the historical revenue trends due to lower expected consumption volumes.

In order to improve the effectiveness of delivery on research projects, we budgeted for the full implementation of the board approved organizational structure and plan to relocate to premises within the Science, research and innovation hub. The budgeted costs in the 2016/17 year is expected to increase with R2 million and R14.6 million for fixed costs and human resource costs, respectively.

2017/2018 to 2020/21

The revenue estimates over the remaining five year period (2017/2018 to 2020/21) has increased year on year in line with inflation and also takes into account the lower expected consumption volumes. Further, additional funding is expected to be received from the DWS, as per the approval of the Minister of Water and Sanitation for the 2017/18 year amounting to R1.5 million.

The largest portion of the budget will be invested in Research & Development Funding which will grow over the remainder of the five year period (2017/2018 to 2020/21) in line with inflation. For the remainder of the five year period (2017/2018 to 2020/21) the increase in respect of operational expenditure is also expected to normalize in line with inflation.

The following tables (Tables 12–16) outline expenditure trends in the WRC's budget and how these can be expected to evolve over the five-year period. Tables 12–16 are subject to Ministerial approval

Table 12. Summary of the budget for the five year period

DESCRIPTION	Original 2015/16 (R)	Revised 2015/16 (R)	2016/17 (R)	2017/18 (R)	2018/19 (R)	2019/20 (R)	2020/21 (R)
Levies	194 798 306	201 437 814	213 121 207	225 482 237	238 560 207	252 396 699	267 035 708
Interest Received	5 722 200	7 367 748	7 824 549	8 278 373	8 758 517	9 266 512	9 803 970
Leverage	92 318 690	67 512 169	71 697 923	75 856 403	80 236 599	84 757 970	89 673 932
Other	587 710	2 739 598	671 244	660 648	698 649	739 170	782 041
Transfer of Unspent Committed Project Funds	17 907 147	0	0	0	0	0	0
TOTAL INCOME	**311,334 053**	**279 057 329**	**293 314 923**	**310 277 361**	**328 253 972**	**347 160 351**	**367 295 651**
Fixed Costs	4 741 855	7 111 734	9 208 482	9 349 573	10 012 850	9 089 384	9 185 554
Running Costs	10 364 127	10 740 655	11 304 235	11 859 482	12 442 275	13 053 996	13 696 096
Human Resource Costs	53 784 248	53 784 248	68 376 453	72 342 288	76 538 140	80 977 353	85 674 039
Research & Development Funding	238 270 577	202 531 988	198 950 737	210 995 632	223 390 481	238 680 803	253 095 665
Corporate Expenditure	2 761 155	2 865 585	2 960 880	3 059 720	3 193 093	3 015 518	3 165 088
Capital Expenditure	1 412 091	2 023 119	2 514 136	2 670 666	2 677 133	2 343 297	2 479 209
TOTAL EXPENDITURE	**311 334 053**	**279 057 329**	**293 314 923**	**310 277 361**	**328 253 972**	**347 160 351**	**367 295 651**

Table 13. Financial Indicators for the five year period

DESCRIPTION	Original 2015/16	Revised 2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
INCOME							
Growth in Total Income		-10.4%	5.1%	5.8%	5.8%	5.8%	5.8%
Growth in Levies		3.4%	5.8%	5.8%	5.8%	5.8%	5.8%
Other							
Fixed costs as % of total expenditure	1.5%	2.5%	3.1%	3.0%	3.1%	2.6%	2.5%
Running costs as % of total expenditure	3.3%	3.8%	3.9%	3.8%	3.8%	3.8%	3.7%
HR costs as % of total expenditure	17.3%	19.3%	23.3%	23.3%	23.3%	23.3%	23.3%
Other costs as % of total expenditure	1.3%	1.8%	1.9%	1.8%	1.8%	1.5%	1.5%
Research Ratio	76.5%	72.6%	67.8%	68.1%	68.0%	68.8%	69.0%

Table 14. Research & Development Funding per Operating Branch

	RESEARCH AND DEVELOPMENT (R)	INNOVATION AND IMPACT (R)	TOTAL (R)
2015/16 – Original	230 474 356	7 796 221	238 270 577
2015/16 - Revised	184 104 158	18 427 830	202 531 988
2016/17	180 470 288	18 480 449	198 950 737
2017/18	191 525 093	19 470 539	210 995 632
2018/19	203 820 733	19 569 746	223 390 479
2019/20	217 829 774	20 851 029	238 680 803
2020/21	230 914 317	22 181 350	253 095 666

Table 15. Research & Development Funding per Key Strategic Area

	WATER RESOURCE MANAGEMENT KSA1 (R)	WATER LINKED ECOSYSTEM KSA2 (R)	WATER USE AND WASTE MANAGEMENT KSA3 (R)	WATER UTILIZATION IN AGRICULTURE KSA4 (R)	KNOWLEDGE DISSEMINATION KSA5 (R)	EMPOWERMENT FUND (R)	OTHER LEVERAGE FUNDED PROJECTS * (R)	TOTAL (R)
2015/16 – Original	48 785 320	26 880 338	50 216 350	37 446 197	7 796 221	2 700 000	64 446 151	238 270 577
2015/16 - Revised	42 592 475	23 920 092	48 834 935	34 525 664	18 427 830	2 226 707	32 004 284	202 531 988
2016/17	41 901 597	23 532 923	47 963 900	33 663 477	18 480 449	2 187 406	31 220 986	198 950 737
2017/18	44 480 884	24 978 146	50 914 378	35 731 009	19 470 539	2 318 650	33 102 026	210 995 632
2018/19	47 318 887	27 550 749	53 595 014	37 814 250	19 569 746	2 457 769	35 084 063	223 390 479
2019/20	50 665 053	29 487 063	57 394 315	40 495 259	20 851 029	2 605 236	37 182 848	238 680 803
2020/21	53 717 660	31 261 596	60 841 658	42 924 657	22 181 350	2 761 550	39 407 197	253 095 666

* This represents the FetWater, Bill & Melinda Gates Foundation, Blue/Green Drop, DST GATES, DST GBS, Wader, Sanic, IPRDP and Acqueau leverage-funded projects.

Table 16. Research & Development Funding in % terms per Key Strategic Area

	WATER RESOURCE MANAGEMENT KSA1	WATER LINKED ECOSYSTEM KSA2	WATER USE AND WASTE MANAGEMENT KSA3	WATER UTILIZATION IN AGRICULTURE KSA4
2015/16 – Original	30%	16%	31%	23%
2015/16 - Revised	28%	16%	33%	23%
2016/17	28%	16%	33%	23%
2017/18	28%	16%	33%	23%
2018/19	28%	17%	32%	23%
2019/20	28%	17%	32%	23%
2020/21	28%	17%	32%	23%

8 APPENDIX 1: KEY PERFORMANCE INDICATORS MULTI-YEAR PERFORMANCE PLAN

The WRC value proposition is to contribute to South Africa's increased water security in order to improve the quality of life of our people as well as improve South Africa's international competitiveness through water R&D. Further, in accordance with our core principles, i.e., investment in the multiplier effect, research concentration, diversification of research philosophy, and increased partnerships, the WRC portfolio is designed to get more out of each project than it has done in the past.

In spite of the fact that real scientific inflation in greater than 20%, due to South Africa's reliance on imported scientific equipment and consumables, the WRC manages to fund more than 90 new projects each year. While the projected numbers in the later years of this planning time frame, are relatively static, e.g., the number of new projects, because of the limitation of resources, our design parameters will ensure that we have increased research productivity, outputs and outcomes from each of the projects as compared to previous years. In addition, while the WRC is working towards guaranteeing a minimum number of students participating in our research projects each year, at predominantly PhD and Masters levels, the WRC, together with its research leaders and partners, will constantly be seeking opportunities to increase these numbers so that we can make a substantive contribution to dealing with the current shortage of high-level skills in the water and science sectors.

Research Portfolio

Objective	Indicator	Target 2015/16	Target 2016/17	Target 2017/18	Target 2018/19	Target 2019/20	Target 2020/21
To enhance knowledge through new research	The number of new research projects initiated in the financial year	81	87	85	85	85	85
To complete and finalise research projects scheduled in the financial year	The number of research projects completed in the financial year	85	84	85	85	85	85
To continuously accommodate students as active participants in WRC projects	The number of students supported on WRC-funded research projects	500	400	500	500	500	6600
To increase emphasis on projects that have a direct impact on the lives and livelihoods of communities through water-related interventions and build sufficient capacity to assist with the post-project sustainability of those interventions	The number of community based research projects initiated in the financial year.	9	24	20	20	20	20
To enhance economic development in communities by supporting small, medium and micro enterprises (SMMEs) in the water research and development sector	The number of SMMEs as lead organisations in the research projects initiated in the financial year	19	27	23	23	23	23
To focus on growing the involvement of previously disadvantaged individuals by increasing the number of project leaders from the designated groups	The number of project leaders from the designated group in research projects initiated in the financial year	45	57	51	51	51	51
	Number of projects initiated in the financial year with Historically Disadvantaged Institutions as	18	10	10	10	10	10

	participating organisations in WRC projects						
Objective	**Indicator**						
To increase the number of new innovations/products and services produced from WRC research	The number of innovations/products and services produced from WRC research in the financial year	19	23	23	23	23	23
	The number of new innovations, products and services that have been implemented/ demonstrated /piloted in the financial year	11	13	13	14	14	14
To ensure that the WRC increasingly contributes to sustainable solutions for the water sector by creating knowledge products and events that disseminate knowledge produced from WRC research	The number of dialogues held in the financial year	15	18	20	20	20	20
	The number of manuals and guidelines published in the financial year	26	26	28	30	30	30
	The number of issues of *the* Water Wheel published in the financial year	6	6	6	6	6	6
	The number of issues of *Water SA* published in the financial year	4	4	4	4	4	4

	The number of conferences/workshops/summits held in partnership with other organisations or exclusively by the WRC in the financial year	19	20	25	25	25	25
To support policy- and decision-makers with research-based knowledge	The number of policy briefs produced and distributed to relevant Government departments and other entities in the financial year	12	14	14	14	14	14
	The number of ministerial briefs produced by the WRC and received by the Minister's Office in the financial year	12	14	15	15	15	15
	The number of WIN-SA publications produced and distributed to relevant institutions and municipalities in the financial year	30	30	35	35	35	35

Financial Portfolio

Objective	Indicator	Target 2015/16	Target 2016/17	Target 2017/18	Target 2018/19	Target 2019/20	Target 2020/21
To maintain income growth	The total amount of leverage income for the financial year	67 512 169 million	71 697 923	75 856 403	80 236 599	84 757 970	89 673 932
	The total number of contracts initiated in the financial year with other organisations that increase leverage funding.	11 contracts to be signed in the financial year	4 contracts	8 contracts	13 contacts	13 contracts	13 contracts
To improve the response to internal audit results	The percentage of internal audit queries fully addressed	All internal audit findings fully addressed	All internal audit findings fully addressed	All internal audit findings fully addressed	All internal audit findings fully addressed	All internal audit findings fully addressed	All internal audit findings fully addressed
To improve the response to external audit results	The achievement of a unqualified audit report vs a qualified audit report	The WRC to achieve an unqualified audit report	The WRC to achieve an unqualified audit report	The WRC to achieve an unqualified audit report	The WRC to achieve an unqualified audit report	The WRC to achieve an unqualified audit report	The WRC to achieve an unqualified audit report
	The percentage of external audit queries fully addressed	All external audit findings full	All external audit findings	All external audit findings full	All external audit findings full	All external audit findings full	All external audit findings full

		addressed	full addressed	addressed	addressed	addressed	addressed

Employee Portfolio

Objective	Indicator	Target 2015/16	Target 2016/17	Target 2017/18	Target 2018/19	Target 2019/20	Target 2020/21
To maintain a healthy staff diversity profile for the financial year	The percentage of employees from the designated groups	90% targeted for the year (90% of total number of employees to be from the designated groups)	90% targeted for the year (90% of total number of employees to be from the designated groups)	90% targeted for the year (90% of total number of employees to be from the designated groups)	90% targeted maintained for the year (90% of total number of employees to be from the designated groups)	90% targeted maintained for the year (90% of total number of employees to be from the designated groups)	90% targeted maintained for the year (90% of total number of employees to be from the designated groups)
	The percentage of employees who are Black	75% targeted for the year (75% of the total number of employees to be Black)	75% target for the year (75% of the total number of employees to be Black) 56% targeted for the year (56% of the total number of employees	75% targeted for the year (75% of the total number of employees to be Black) 56% targeted for the	75% targeted for the year (75% of the total number of employees to be Black) 56% targeted for the	75% target maintained for the year (75% of the total number of employees to be Black)	75% targeted for the year (75% of the total number of employees to be Black)

	The percentage of employees who are female	56% targeted for the year (56% of the total number of employees to be female	to be female)	year (56% of the total number of employees to be female)	year (56% of the total number of employees to be female**)**	56% targeted for the year (56% of the total number of employees to be female)	56% targeted for the year (56% of the total number of employees to be female)
To Improve employee development and growth in the financial year	Completion of personal development plans (PDP)	100% of personal development plans completed	100%	100%	100%	100%	100%
	The number of training courses held in-house	8	10	12	12	14	14
	The number of external training courses attended	20	20	28	28	28	28

18. APPENDIX 2: LIST OF RESEARCH PROJECTS TO BE INITIATED IN THE 2016/17 FINANCIAL YEAR

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
1	1004320	KSA 1	OPEN	Dr Jennifer Molwantwa	Risk assessment on mixtures of nano- and macro-scale emerging contaminants in freshwater and wastewater systems using experimental and modelling techniques	University of Pretoria	270 000.00	4 000 000.00	5
2	1004343	KSA 1	OPEN	Dr Brilliant Petja	Impact of the predictability of continental tropical lows on hydrological modelling: current state and future projections.	University of Pretoria	174 000.00	719 800.00	3
3	1004353	KSA 1	OPEN	Ms Eiman Karar	Science Diplomacy for Transboundary Water Resource Management	Quantitative Evidence Research Consultancy Services cc	170 000.00	340 000.00	2
4	1004357	KSA 1	OPEN	Mr Wandile Nomquphu	Further Development and Assessment of an Integrated Water Resources Accounting Methodology for South Africa	University of KwaZulu-Natal	500 000.00	1 800 000.00	3
5	1004365	KSA 1	OPEN	Ms Eiman Karar	Historical and status quo evaluation and proposed policy considerations for judicial revision (appeal and review) of administrative actions under statutory water resources management in South Africa	VULAMANZI WATER LAW ADVISERS	300 000.00	300 000.00	1
6	1004371	KSA 1	OPEN	Mr Wandile Nomquphu	Developing practical documents to aid design and construction of liquid retaining structures and making research provision for the next revision of SANS 10100-3	University of Stellenbosch	130 000.00	1 500.000.00	4
7	1004397	KSA 1	OPEN	Dr Jennifer Molwantwa	Assessment of potentially toxic elements and their species in selected water systems in Limpopo province	University of Limpopo	502 000.00	1 037 000.00	3
8	1004435	KSA 1	Directed	Dr Jennifer Molwantwa	Emerging and Persistent Contaminants/ Pathogens: Development of Early Warning Systems and Monitoring tools	UNISA	500 000.00	2 000 000.00	3
9	1004437	KSA 1	OPEN	Mr Wandile Nomquphu	Economic Study of Assurance of Supply Requirements for Water Resource Management	WRP Consulting Engineers (Pty) Ltd	380 000.00	760 000.00	2

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
10	1004453	KSA 1	OPEN	Dr Shafick Adams	Sentinel-3 Validation for Water Resources Protection (S3VAL)	CyanoLakes	264 710.00	430 500.00	2
11	1004478	KSA 1	OPEN	Dr Shafick Adams	Ideas toward water sensitive settlements	Envirosource	196 000.00	380 000.00	2
12	1004480	KSA 1	OPEN	Dr Brilliant Petja	Integrated land use and water use in Water Management Areas, with a view on future climate and land use changes	CSIR	600 000.00	2 000 000.00	3
13	1004483	KSA 1	Directed	Dr Jennifer Molwantwa	Emerging and Persistent Contaminants/ Pathogens: Monitoring Methods Development	University of the Western Cape	500 000.00	1 635 000.00	3
14	1004490	KSA 1	OPEN	Dr Brilliant Petja	An integrated early warning forecast system for wet seasons and their relationship to flooding events: A predictability study in support of hydrological applications	CSIR	450 000.00	900 000.00	2
15	1004508	KSA 1	OPEN	Dr Shafick Adams	The Karst Vadose Zone: Influence on recharge, vulnerability and surface stability	University of Pretoria	250 000.00	1 000 000.00	3
16	1004530	KSA 1	OPEN	Dr Shafick Adams	Incorporating environmental fate models into risk assessment for pesticide registration in South Africa	CSIR	250 000.00	1 000 000.00	3
17	1004544	KSA 1	OPEN	Dr Shafick Adams	The hydrogeology of Groundwater Region 41: Eastern Great Karoo	Geowater IQ(Pty) Ltd	135 000.00	270 000.00	2
18	1004554	KSA 1	OPEN	Dr Shafick Adams	The viability of urban stormwater ponds as water resources in Cape Town	University of Cape Town	300 000.00	950 000.00	3
19	1004568	KSA 1	OPEN	Mr Wandile Nomquphu	Participatory Hydrological Modelling for collective exploration of water resource protection, restoration and water use management options in the western Algoa water management area.	Living Lands	450 000.00	1 400 000.00	3

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
20	1004622	KSA 1	OPEN	Dr Shafick Adams	Longer-term feasibility study of in-situ iron and manganese removal by ozonation: a novel approach to protecting groundwater supply schemes	Council for Geoscience	700 000.00	2 200 000.00	3
21	1004626	KSA 1	OPEN	Ms Eiman Karar	The incorporation of the economics of ecosystems and biodiversity in pricing water and its management	Prime Africa Consultants cc	300 000.00	1 100 000.00	3
22	1004628	KSA 1	OPEN	Ms Eiman Karar	Water allocation for productive use - policy and implementation: A case study of the black emerging farmers in the Breede-Gouritz catchment Management Area, Western Cape, South Africa	Cape Peninsula University of Technology	350 000.00	700 000.00	2
23	1004637	KSA 1	OPEN	Mr Wandile Nomquphu	Development and application of a dynamic water balance model to evaluate possible interventions to improve water security in Kgetlengrivier Local Municipality	University of Johannesburg	340 285.00	602 270.00	2
24	1004664	KSA 1	Directed	Dr Shafick Adams	Water Resources Protection: A review of the state-of-the-art and research and development needs for South Africa.	Umvoto Africa (Pty) Ltd	400 000.00	400 000.00	1
25	1004665	KSA 1	OPEN	Dr Jennifer Molwantwa	Nanosensors for oceans and atmospheric research	University of the Western Cape	150 000.00	300 000.00	2
26	1004675	KSA 1	OPEN	Dr Shafick Adams	Hybrid Water Supply Systems and Conjunctive Use in the Context of Water Sensitive Settlements: A Case Study of Sekhukhune District Municipality, Limpopo Province	Vaal University of Technology	300 000.00	1 000 000.00	3
27	1004686	KSA 1	Directed	Ms Eiman Karar	Water future allocations trade off scenarios	ISS	500 000.00	1 000 000.00	2
28	1004714	KSA 1	Directed	Ms Eiman Karar	CMA water allocation process requirements and their enforcement	The Pegasys Institute NPC	500 000.00	1 000 000.00	2
29	1004318	KSA 2	OPEN	Mr Bonani Madikizela	Environmental water temperature guidelines: bridging the gap between research and implementation	Freshwater Research Centre	543 600.00	1 500 000.00	4

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
30	1004335	KSA 2	OPEN	Mr Bonani Madikizela	Linking rotenone policy support for river rehabilitation by alien fish removals with capacity development by developing a concept for integrating aquatic-ecosystem monitoring in short-term post graduate research projects with particular emphasis on HBUs.	SA Institute for Aquatic Biodiversity	407 000.00	1 443 200.00	3
31	1004336	KSA 2	OPEN	Mr Bonani Madikizela	Refinement of the Revised Desktop Reserve Model	Rivers for Africa eFlows Consulting (PTY)	500 000.00	1 000 000.00	2
32	1004342	KSA 2	OPEN	Mr Bonani Madikizela	Phase 2: Pharmaceutical for Melasma and other human ailments from South African aquatic plants	University of Pretoria	600 000.00	2 358 960.00	5
33	1004377	KSA 2	OPEN	Dr Brilliant Petja	The development of a Bayesian model of the ecosystem and mouth dynamics for Temporary Open/Closed Estuaries (TOCEs).	University of Zululand	400 000.00	1 000 000.00	3
34	1004381	KSA 2	OPEN	Dr Brilliant Petja	Assessment of carbon storage in wetlands	EON Consulting	400 000.00	880 000.00	2
35	1004412	KSA 2	OPEN	Mr Bonani Madikizela	The utilization of water hyacinth (Eichornia crassipes) from Hartbeespoort Dam in biogas and bio-fertilizer production, as a solution to water weed challenges	ARC	300 000.00	500 000.00	3
36	1004422	KSA 2	OPEN	Mr Bonani Madikizela	Metal bioaccumulation in freshwater fish of Flag Boshielo Dam: mechanisms and risks to human health	University of Limpopo	400 000.00	1 000 000.00	3
37	1004484	KSA 2	OPEN	Mr Bonani Madikizela	Establishing remote sensing toolkits for monitoring freshwater ecosystems under global change	CSIR	500 000.00	2 300 000.00	3
38	1004524	KSA 2	OPEN	Mr Bonani Madikizela	Enabling more responsive policy and decision-making in relation to wetlands through improving the quality of spatial wetland data in South Africa	SA National Biodiversity Institute (SANBI)	600 000.00	1 500 000.00	3
39	1004570	KSA 2	OPEN	Mr Bonani Madikizela	Demystifying Wetland Resource Quality Objectives (RQOs): the development of a refined procedure for determining wetland RQOs, and the development of a wetland RQOs implementation manual	Institute of Natural Resources NPC	375 000.00	1 000 000.00	3
40	1004580	KSA 2	OPEN	Dr Brilliant Petja	Determining the hydrological functioning of the Palmiet wetlands in the Eastern and Western Cape of South Africa	Institute for Water Research	350 000.00	500 000.00	2
41	1004656	KSA 2	OPEN	Mr Bonani Madikizela	Developing a refined suite of tools for assessing the Present Ecological State of wetland ecosystems	Freshwater Research Centre	400 000.00	1 500 000.00	4

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
42	1004663	KSA 2	OPEN	Dr Brilliant Petja	Atmospheric deposition impact assessment	EScience Associates (Pty) Ltd	500 000.00	900 000.00	2
43	1004668	KSA 2	OPEN	Mr Bonani Madikizela	Development and application of passive samplers for determining the fate of toxic metals in Wetlands polluted by mining activities	University of Witwatersrand	200 000.00	760 000.00	3
44	1004316	KSA 3	OPEN	Dr Valerie Naidoo	Photo-PROTEA	University of the Western Cape	350 000.00	700 000.00	3
45	1004332	KSA 3	OPEN	Dr Valerie Naidoo	MATHEMATICAL MODELLING FOR MASS BALANCE OF TRACE METALS AND ORGANIC COMPOUNDS IN WASTEWATER TREATMENT PLANTS IN GAUTENG PROVINCE /n	University of Johannesburg	325 000.00	995 000.00	3
46	1004341	KSA 3	OPEN	Dr Jo Burgess	Managing saline coal mine water in Mpumalanga using irrigation	University of Pretoria	500 000.00	5 300 000.00	5
47	1004349	KSA 3	OPEN	Dr Valerie Naidoo	Development of a two-stage Nitritation-Anammox process for improved ammonia removal from wastewater	Durban University of Technology	500 000.00	1 850 000.00	3
48	1004358	KSA 3	OPEN	Dr Nonhlanhla Kalebaila	Modelling advanced oxidation of persistent chlorohalogenated pollutants in aqueous systems	University of Pretoria	200 000.00	200 000.00	2
49	1004364	KSA 3	OPEN	Dr Valerie Naidoo	Modelling advanced oxidation of persistent chlorohalogenated pollutants in aqueous systems	University of Johannesburg	400 000.00	1 000 000.00	3
50	1004393	KSA 3	OPEN	Dr Nonhlanhla Kalebaila	Electrochemical Unit Operations in Industrial Wastewater Treatment: The Development of Electrocoagulation and Photoelectrochemical Oxidation Reactors based on Novel Nanocomposite Electrodes	UNISA	300 000.00	600 000.00	3
51	1004396	KSA 3	OPEN	Dr Sudhir Pillay	An assessment of fungal occurrence in treated drinking water in Johannesburg West and implications to public health	University of Cape Town	250 000.00	500 000.00	2

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
52	1004398	KSA 3	OPEN	Dr Valerie Naidoo	User interface design of Communal Ablution Blocks (CABs) in urban South Africa	University of Cape Town	450 000.00	1 800 000.00	4
53	1004443	KSA 3	OPEN	Dr Valerie Naidoo	Reclamation of industrial process water from solid and liquid effluents, through integrated bio-energy production	University of Stellenbosch	400 000.00	1 000 000.00	3
54	1004456	KSA 3	OPEN	Dr Jo Burgess	Water recovery from flue gas evaluation	University of the Western Cape	600 000.00	3 350 000.00	4
55	1004487	KSA 3	OPEN	Mr Jay Bhagwan	Leakage characterization of bulk water pipelines	University of Cape Town	350 000.00	1 335 000.00	3
56	1004459	KSA 3	Directed	Dr Nonhlanhla Kalebaila	Establishing the frequency and causes of contamination and intrusions in water distribution systems	University of Cape Town	300 000.00	750 000.00	2
57	1004467	KSA 3	OPEN	Dr Valerie Naidoo	Optimising the use of fish to harvest algae from industrial effluent treatment ponds	Rhodes University	275 000.00	550 000.00	2
58	1004482	KSA 3	OPEN	Dr Sudhir Pillay	Piloting and refining a school sanitation management model	Partners in Development (Pty) Ltd	300 000.00	1 000 000.00	2
59	1004493	KSA 3	OPEN	Dr Jo Burgess	Brine Systems and Treatment Processes /n	University of Cape Town	627 175.00	2 004 283.00	3
60	1004496	KSA 3	OPEN	Dr Jo Burgess	An Assessment to determine if Pit Lakes are a solution to Coal Mine Closure in South Africa	GCS Water and Environment (Pty) Ltd	400 000.00	1 100 000.00	3
61	1004505	KSA 3	Directed	Dr Nonhlanhla Kalebaila	Guidance on drinking water supply systems performance assessment and optimisation	Water Group Holdings (Pty) Ltd	300 000.00	1 000 000.00	2

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
62	1004510	KSA 3	OPEN	Dr Valerie Naidoo	Performance assessment of DEWATS constructed wetlands	University of KwaZulu-Natal	328 500.00	834 500.00	3
63	1004546	KSA 3	OPEN	Dr Jo Burgess	Resource efficient and socially responsible approaches for the integrated management of mine waste: Understanding the opportunities, enablers, barriers and risks	University of Cape Town	644 073.12	1 277 837.23	2
64	1004551	KSA 3	OPEN	Mr Jay Bhagwan	An investigation into the impact of sludge return flows on South African wastewater treatment works	Royal HaskoningDHV (Pty) Ltd	400 000.00	1 200 000.00	3
65	1004560	KSA 3	OPEN	Dr Sudhir Pillay	Drying and pasteurization of faecal sludge using solar thermal energy	University of KwaZulu-Natal	310 000.00	657 000.00	2
66	1004581	KSA 3	OPEN	Dr Nonhlanhla Kalebaila	Smart Bio-nanocomposites for Organic Dye Remediation	UNISA	300 000.00	900 000.00	3
67	1004589	KSA 3	OPEN	Mr Jay Bhagwan	Assessing the affordability of water to the residential sector based on consumption	PDG	461 000.00	861 000.00	2
68	1004595	KSA 3	OPEN	Dr Nonhlanhla Kalebaila	Antibiotic resistant bacteria and genes in raw and drinking water: Implications for water production and water quality monitoring	North-West University	190 000.00	1 286 000.00	3
69	1004613	KSA 3	OPEN	Mr Jay Bhagwan	Impact of Behavioural Messaging on Water Consumption and Technology Uptake: Evidence from a Randomized Experiment in South Africa	University of Cape Town	300 000.00	2 000 000.00	2
70	1004616	KSA 3	OPEN	Dr Sudhir Pillay	Treatment and reuse potential of urine and faecal fractions from urine diversion dehydrating toilets in eThekwini Municipality	University of Kwazulu-Natal	127 000.00	328 000.00	2
71	1004648	KSA 3	OPEN	Dr Valerie Naidoo	Securing Water Sustainability through Innovative Spatial Planning And Land Use Management Tools - Case Study Of Mogalakwena Local Municipality	i@consulting	500 000.00	2 000 000.00	3

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
72	1004654	KSA 3	OPEN	Mr Jay Bhagwan	A review, alignment and reform of the national and international water supply and sanitation monitoring and reporting requirements: Alignment of the Water and Sanitation Functions to Respond to new National (NDP; NWRS2) and International (SDG) obligations	Sustento Development Services cc	418 080.00	893 900.00	2
73	1004672	KSA 3	OPEN	Dr Jo Burgess	Development and application of new materials for selective removal of trace elements from mine wastewater	University of the Witwatersrand	294 750.00	862 250.00	3
74	1004673	KSA 3	OPEN	Dr Valerie Naidoo	The implications of chemical composition of different types of greywater for seed germination and growth of crop plants.	University of Kwazulu-Natal	135 000.00	345 000.00	2
75	1004676	KSA 3	OPEN	Mr Jay Bhagwan	Mitigating the impact of electricity disruption on water supply – Case study of the City of Tswane	Umfula Wempilo Consulting	350 000.00	800 000.00	2
76	1004693	KSA 3	Directed	Dr Nonhlanhla Kalebaila	Development of resource guidelines on greywater use and management	University of Kwazulu-Natal	300 000.00	300 000.00	1
77	1004707	KSA 3	Directed	Dr Nonhlanhla Kalebaila	Development of resource guidelines for rainwater harvesting	CSIR	344 000.00	344 000.00	1
78	1004337	KSA 4	Directed	Dr Gerhard Backeberg	Modelling of water flows with change in land management in selected river catchments	University of KwaZulu-Natal	520 000.00	6 000 000.00	5
79	1004346	KSA 4	OPEN	Dr Sylvester Mpandeli	Improving on-farm irrigation water and solute management using simple tools and adaptive learning	University of Pretoria	500 000.00	2 000 000.00	3
80	1004445	KSA 4	OPEN	Dr Gerhard Backeberg	Quantifying the water use of multiple-use tree combinations for alternative land-use options in water stressed catchments.	University of Pretoria	646 140.00	2 248 000.00	3
81	1004383	KSA 4	OPEN	Dr Sylvester Mpandeli	Water use for food and nutrition security at the start-up stage of food value chains	University of KwaZulu-Natal	500 000.00	3 866 271.00	4

No	Proposal No.	KSA	Open /Directed	Research Manager	Project Title	Lead Organisation	1st Year Budget 2016/17	Total Budget	Project Duration
82	1004390	KSA 4	Directed	Dr Sylvester Mpandeli	Use of winery waste water for irrigation of vineyards in different environments	ARC	500 000.00	4 000 000.00	6
83	1004451	KSA 4	OPEN	Dr Gerhard Backeberg	Salt accumulation and waterlogging monitoring system (SAWMS) development	University of Stellenbosch	480 000.00	2 386 000.00	3
84	1004452	KSA 4	Directed	Dr Sylvester Mpandeli	Water use of avocado and macadamia orchards:	University of Pretoria	500 000.00	5 000 000.00	5
85	1004555	KSA 4	OPEN	Dr Sylvester Mpandeli	Assessment of the effectiveness of policies and strategies for governance of smallholder irrigation farming in KwaZulu-Natal Province, South Africa	University of KwaZulu-Natal	400 000.00	3 000 000.00	4
86	1004565	KSA 4	OPEN	Dr Sylvester Mpandeli	Assessing the water footprints of selected fuel and fibre crops in South Africa	University of the Free State	400 000.00	3 000 000.00	5
87	1004591	KSA 4	OPEN	Dr Gerhard Backeberg	Review and Update the South African Irrigation Design Manual and Irrigation User Manual	ARC	500 000.00	1 830 000.00	4

19. APPENDIX 3: WRC MATERIALITY FRAMEWORK IN TERMS OF TREASURY REGULATIONS 28.1.5

1 Definitions

Accounting Authority	-	Board of Directors
Executive Authority	-	Minister of Water and Sanitation
Entity	-	Water Research Commission
PFMA	-	Public Finance Management Act (Act 1 of 1999 as amended by Act 29 of 1999)
Treasury Regulations	-	Public Finance Management Act, 1999: amendment of Treasury Regulations in terms of section 76 as published in Government Gazette No. 7372

2 Introduction

In terms of Treasury Regulation 28.1.5, the accounting authority must develop and agree a framework of acceptable levels of materiality and significance with the relevant executive authority in consultation with the external auditors.

Framework

Fiduciary duties of the accounting authority (PFMA section 50)	Quantitative (Amount)	Qualitative (Nature)

(1) The accounting authority must - (c) On request, disclose to the executive authority responsible for that public entity or the legislature to which the public entity is accountable, all material facts, including those reasonably discoverable, which in any way influence the decisions or actions of the executive authority or that legislature.	Any fact discovered of which the amount exceeds the determined materiality figure as calculated in Annexure A.	1. Any item or event of which specific disclosure is required by law. 2. Any fact discovered of which its omission or misstatement, in the Board's opinion, could influence the decisions or actions of the executive authority or legislature.
Annual Report and Financial Statement (PFMA section 55)	**Quantitative (Amount)**	**Qualitative (Nature)**
(2) The annual report and financial statements referred to in subsection (1) (d) must – (a) Fairly present the state of affairs of the public entity, its business, its financial results, its performance against predetermined objectives and its financial position as at the end of the financial year concerned:		

(b) Include particulars of – i. Any material losses through criminal conduct and any irregular expenditure and fruitless and wasteful expenditure that occurred during the financial year; ii. Any criminal or disciplinary steps taken is a consequence of such losses or irregular expenditure or fruitless and wasteful expenditure; iii. Any losses recovered or written off; iv. Any financial assistance received from the state and commitments made by the state on its behalf; and v. Any other matters that may be prescribed.	1. Losses through criminal conduct – any loss identified. 2. Losses through irregular / fruitless / wasteful expenditure – if the combined total exceeds the planning materiality figure used by the external auditors for the year under review.	Any identified loss through criminal conduct.
Annual Report and Financial Statement (PFMA section 54)	**Quantitative (Amount)**	**Qualitative (Nature)**
(2) Before a public entity concludes any of the following transactions, the accounting authority for the public entity must promptly and in writing inform the relevant treasury of the transaction and submit relevant particulars of the transaction to its executive authority		

for approval of the transaction: (b) Participation in a significant partnership, trust, unincorporated joint venture or similar arrangement;	Not applicable	Any participation, outside of the approved strategic plan and budget.
(c) Acquisition or disposal of a significant shareholding in a company;	Not applicable	Any acquisition or disposal, outside of the approved strategic plan and budget.
(d) Acquisition or disposal of a significant asset;	Not applicable	1. Any asset that would increase or decrease the overall operational functions of the WRC, outside of the approved strategic plan and budget. 2. Disposal of the major part of the assets of the WRC. Any business activity that would increase or decrease the overall operational functions of the WRC, outside of the approved strategic plan and budget.
(e) Commencement of cessation of a significant business activity.	Not applicable	

3 Authorisation

This framework has been approved by the Board on 29 January 2016.

Chairperson of the Board

Annexure A

1.1 Determination of Materiality

5.1.1. Materiality Basis

		2014/15 Actual	
Materiality bases	**% Used**	**R**	**Materiality (R)**
Gross Income	**0.625%**	**R 262 376 379**	**R 1 639 852**
Gross Expenditure	**0.625%**	**R 238 700 530**	**R 1 491 878**
Total Assets	**1.250%**	**R 260 082 640**	**R 3 251 033**
Net Deficit for the Year	**6.250%**	**R 23 675 849**	**R 1 479 741**

5.1.2. Materiality basis selected and the reasons therefore

Gross income consists mainly of levies received from DWS, Rand Water and Umgeni Water. This has shown steady growth over the past three years. Gross expenditure can fluctuate for a variety of reasons and did not show consistency over the past three years. Net profit/(loss) is derived from gross income and gross expenditure.

Assets consist mainly of investments and cash, which are not operating assets of the WRC itself. The WRC is not a capital-intensive business. Therefore this would not be considered an appropriate basis for calculating materiality.

Because of the uneven pattern in gross expenditure and net profit/(loss), gross income is regarded as the most appropriate basis for the calculation of materiality.

5.1.3 Justification of percentage used

A moderate percentage was used based on planning done in prior year audits which had assessed risk as medium. The audited figures as at March 2015 have been used as this constitutes the most reliable, verifiable and objective information available to use.

5.1.4 Materiality figure

Thus the most appropriate indicator for the purposes of setting materiality is Gross income. For this reason, materiality has been selected at 0.625% of gross income which amounts to R1 639 852. In the previous financial year, materiality was set at R 1 282 294. The increase in the materiality figure is considered to be reasonable given the fact that the WRC is growing in size. Gross income increased by 28% from 2013/14 to 2014/15. In addition the risks associated with Supply Chain Management and Finance is expected to decrease due to the capacity building and internal controls implementations during the year. This will ultimately result in a higher materiality figure.

APPENDIX 4: WRC RISK REGISTER

Water Research Commission

	Link to strategic objective	Risk name	Root causes of the risk	Potential consequences of the risk	Potential Impact (worst case scenario)	Likelihood of risk occurring if no controls are in place	Inherent risk exposure with no controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Mitigating action plans to further address the residual risk exposure
1	To support human capacity building in the water sector To enhance knowledge across the water knowledge and innovation cycle To support community empowerment	Inadequate availability, continuity and growth of adequate research expertise to deal with complexity in the water sector, both institutionally and externally	Insufficient skills and competencies in the country. Inadequate capability and capacity of partners, systems and processes available to ensure the development of skills, human capacity, capability and knowledge uptake in the water sector. Low number of graduates and post graduate production in SA Limited career and research training opportunities Current funding model for HEI (higher education	Insufficient capacity to either identify or take advantage of opportunities Under- performance in the areas of emerging water management challenges Poor research and inadequate research outputs to service the water sector Harm to reputation Research outputs not dealing with the complexity and trans-disciplinary nature of water problems Not meeting stakeholders needs	Serious	Likely	Moderate	Partnerships and collaboration with other organisations that have the capability. Capacity building as part of research contracts and research prioritisation in particular post graduate student support to develop skills in the water sector Engagement and strengthening of relationships with research partners to facilitate implementations Support publication and exposure of students and training material and marketing research careers (through schools, universities etc.) Lobby for increased	CEO	Satisfactory	Priority 4	

			institution) is inadequate Insufficient number of appropriately supervised projects Lack of a multi-sectorial research coordination. Lack of collaboration between vested parties.					research funds through DWS and DST and other players. Strengthening of the lighthouse programme, social sciences inter disciplinarily programme and other trans-disciplinarily research programmes to address to complexity in the water sector Technical, policy and ministerial briefs to ensure faster exposure to research outcomes. Periodic strategic review of research portfolio Strengthening and monitoring of the Knowledge Tree objectives.				

2	Financial sustainability & corporate well-being To develop new products and services (new innovations) To develop sustainable solutions	Financial sustainability	Limited income streams (insufficient funding and diversity of income) Weaknesses in the administration of research levies Competition from public and private sector Levy increase is below research scientific average inflation Lower consumption due to drought resulting in reduction in levy income	Reduction in research outputs Negative impact on stakeholder trust relationships due to cash flow and funding challenges Limited ability to grow the research portfolio Reduction in level of levy income Challenges in managing cash flow Insufficient budget to implement the strategic plan and operation of WRC	Critical	Almost certain	Extreme	MOA (memorandum of agreement) of monthly payments with DWS Escalation provisions for funding Governed by legislation, government gazette Diversified levy agencies (DWA, RW and UW) Significant leverage income to offset dependency Regular interaction with shareholder (Department of Water Affairs) and stakeholders on funding issues Strategy to further diversify funding Prioritisation of available	CEO	Weak	Priority 1	Renewal of the MOA with the DWS Diversification of the funding streams

								funds Stretching of resources Regular meetings with funders Adherence to legislation (collection of income - WRA)				
3	To enhance knowledge across the water knowledge and innovation cycle To develop sustainable solutions To inform policy and decision making To develop new products and services (new innovations) To support community empowerment	Constraints in keeping up with changes and trends in water research	Inadequate capability and mechanisms of end users to utilise research output and implement findings Lack of long term planning Inadequacy of funding and insufficient investment in research Small size of the water research community of practice especially the HDI and PDI and insufficient researchers doing cutting edge research	Inability to take advantage of developments and contribute to improved water management and development outcomes in the country Possible reduction in funding Inappropriate research outputs Reputational damage/ credibility decline Deterioration of stakeholder relationships due to needs not being met Limited impact on research, development and innovation	Critical	Likely	High	Involvement of end users and stakeholders in design and rollout of research projects to enhance knowledge Engaging partners in cutting edge technology and research (TIA, SASOL,SALGA) Packaging of research to various stakeholders Capacity building as part of research contracts and research prioritisation (including post docs) Support publication and exposure of students and training material by means of a development programme for individuals Innovation and Impact branch created in the WRC to bring business development and	Chief Executive Officer	Good	Priority 4	

								innovation into the Research and Development space.				
4	To enhance knowledge across the water knowledge and innovation cycle To develop sustainable solutions To inform policy and decision making To develop new products and services (new innovations) To support community empowerment	Insufficient uptake of research	Institutions not clearly identified at beginning of research process and not involved in development of research questions and results Insufficient communication between researchers across disciplines as well as researchers and the end users to facilitate the uptake of research Limited engagement with the sector nationally and internationally	Inability to take advantage of developments and contribute to improved water management and development outcomes in the country No or little new knowledge created Poor uptake on implementation of results Limited impact on research, development and innovation	Critical	Likely	High	Development of policy and ministerial briefs to influence decision making and development of manuals, guidelines and support tools, e.g. dialogues, symposiums and conferences for implementation and development Direct support for IP development and commercialisation. Incorporation of research uptake and interventions into WRC research proposal template and CP and periodic strategic review of research portfolio Innovation and Impact branch created in the WRC to bring business development and innovation into the Research and Development space.	Chief Executive Officer	Good	Priority 4	
5	Financial sustainability & corporate well being	Inadequate financial systems supporting operations	Inadequate financial operating system. Inadequate monitoring capacity at various levels	Inadequate budgeting and monitoring and reputational damage. Unfavourable audit	Serious	Likely	Moderate	Operating financial system (i.e. Pastel, FMS, etc.) Improving operating protocols on a continuous basis	CFO	Satisfactory	Priority 4	

			Inadequate record management system supporting financial transactions.	opinion. Collapse of the financial management system.				Levels of approvals and delegations Internal audits Bolstering the monitoring capacity Updating governance and protocols in respect of SCM and establishment of a SCM unit				
6	To develop sustainable solutions Financial sustainability & corporate well being	The role of the WRC in research, development and innovation within SADC, Africa and Globally	Insufficient interaction with the international community, especially other African countries. WRC management team and researchers funded by the WRC constrained to keep up to date with international research developments. Insufficient recognition of the WRC by research partners. Inadequate dissemination of research findings and marketing of WRC internationally	Loss of credibility in the international water research field Reduction in ability to attract donor funding Negative impact on possible partnerships with international or non South-African research institutions Limited potential to lead on African solutions Insufficient research output (output might not consider other relevant practices) Difficult for WRC to create African footprint	Serious	Likely	Moderate	Improve the implementation of the WRC international strategy Attendance of international conferences etc. Involvement in global, African and SADC level projects. Interaction with stakeholders on SADC, Africa and global involvement. Conducting Southern Africa wide projects with donor partners and new donor funded relationships in Southern Africa Contracts in place with researchers to	Chief Executive Officer	Satisfactory	Priority 4	

			Limited financial instruments to support African research partnership Perception of WRC as competition to donors Budgetary constraints to promote the profile of the WRC More focus on research as primary mandate of the WRC which leads to insufficient business development and innovation	WRC can be regarded as a poor contribution to the national system of innovation, i.e. limited market ready products (derived from research and subsequent development and innovation). Loss of intellectual property				acknowledge the WRC. Innovation and Impact unit established in the WRC to focus on business development and innovation				
7	Financial sustainability & corporate well being	Lack of business continuity / disaster	Theft of computer hardware Power and water supply failure Fire, flood, hacking, negligence IT Viruses Hacking into the WRC information system Loss of hard copy information Poor security	Delays and disruptions in operations Possible loss of life / injury on duty Financial loss Loss of research results (reports/ loss of knowledge base - intellectual property) Harm to reputation Possible rework resulting in increased cost	Critical	Possible	Moderate	Offsite backups of core systems and data, Disaster Recovery site and plans Uninterrupted Power Supply Anti-virus software (renewed annually and daily updates) and Firewalls Insurance Emergency response teams Evacuation plans and	Executive Manager Corporate Services	Good	Priority 5	

			control (logical access and physical control) Failure of support services (Eskom, Post Office)	Legal implications				procedures Fully functional private network (van) Logical and physical access controls Fire proof strong room for research contracts (Offsite) Digitisation of documentation 3G and cell phone enablement 24 hour security with armed response Outsource courier service provider Annual simulation testing Uninterrupted+L10 water and power supply				
8	Financial sustainability & corporate well being	Relocation to new premises and costs associated with the relocation	Legislation not adhered to in respect of relocation to new premises and disposal of current premises Insufficient budget available to fund relocation and associated costs	Financial loss Operational inefficiencies Non- compliance with legislation	Critical	Possible	Moderate	Cost associated with lease of new premises included in budget submitted for ministerial approval Appointment of legal firm to evaluate processes followed in respect of relocation to new premises and disposal of current	CEO	Good	Priority 5	

								premises. Availability of funds in the WRC due to possible dis-investment of investment accounts			
9	Financial sustainability & corporate well being	Fraud and corruption	Ineffectiveness of fraud and corruption prevention systems Possible unethical behaviour Non adherence to policy and procedures Effectiveness of management oversight Opportunists (bribes, corruption, collusion)	Financial loss Operational inefficiencies Harm to reputation Inability to meet set performance delivery targets Increased pressure from stakeholders Loss of research results (reports/ loss of knowledge base - intellectual property)	Serious	Likely	Moderate	Financial and management (reconciliatory, supervisory, etc.) controls Monitoring daily cash balance Segregation of duties Audit trails Delegation of authority Change controls Fraud prevention plan implemented and work shopped annually 24 hour Fraud hotline Whistle blowing policy implemented Code of Ethics Establishment of a SCM unit	Chief Financial Officer	Good	Priority 5	
10	To develop new products and services (new	Poor quality or compromised researched	Decisions impacted by undue influence	Reputational damage	Serious	Unlikely	Insignificant	Decision protocols Contract Management	Executive Managers	Good	Priority 5	

	innovations) To enhance knowledge across the water knowledge and innovation cycle To develop sustainable solutions To inform policy and decision making	outputs	Poor control mechanisms Dishonest researchers	Implementation of wrong solutions based on false research results Loss of research results (reports/ loss of knowledge base - intellectual property)				Anti- fraud measures Multiple approver procedure. Requirement for declaration of interest, publications and intellectual property. Reference group peer review system Conference presentation for further technical peer review				
11	To enhance knowledge across the water knowledge and innovation cycle	Losing competitive edge	External changes Internal restructuring Rapid growth	Reputational damage Loss of leverage funding Loss of research partnerships and collaborations	Serious	Rare	Insignificant	Environmental scanning Recruitment policies/practices External reviews International engagement processes	CEO	Satisfactory	Priority 5	
12	Financial sustainability & corporate well-being To inform policy and decision making	Non-compliance to Acts, Regulations, Legislations, Policies and Procedures	Changes in legislation (not being monitored by the WRC as well as inability to adapt the rapid changes of legislation). Internal capacity to meet compliance demands Increasing compliance	Possible charges against Accounting Officer and/or staff Possible fines and litigation Harm to reputation Increased pressure from stakeholders Qualified audit report	Critical	Possible	Moderate	Good internal knowledge of the PFMA and other legislation and regulations applicable to the WRC Good relationship with Treasury and Auditor General secures continuous updates Ongoing training Assessment by means of	Company secretary	Good	Priority 5	

			reporting burden Insufficient knowledge of new applicable legislations Governance related issues such as appointment of new board members on timeously Changes affecting the WRC due to passing of the Appropriation Bill (not being monitored by the WRC as well as inability to adapt the rapid changes).	Loss of donor funding Focus too much on compliance rather than strategic issues Health and Safety liabilities resulting in possible injuries to staff/ suspension of activities				internal and external audits Appointment of a Compliance Manager and Health and Safety representatives Health and Safety awareness campaigns and reviews Establishment of SCM unit to ensure compliance to policies and procedures				