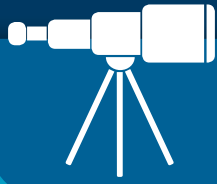


CORPORATE PLAN

2021/22 - 2025/26

50





VISION

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



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 and sanitation science sector
- empowers communities and reduces poverty
- supports the national transformation and redress project
- develops sustainable solutions and deepens water and sanitation research and development in South Africa, Africa and the developing world



VALUES

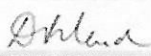
- A culture of learning and sharing
- Innovation and creativity
- Integrity and fairness
- A spirit of professionalism and service orientation
- Facilitating empowerment and social change
- Good governance

OFFICIAL

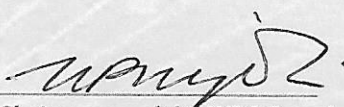
SIGN-OFF

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 2021/22 - 2025/26



Chief Executive Officer



Chairperson of the WRC Board

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LIST OF ACRONYMS

BD&I	Business Development & Innovation	IWRM	Integrated Water Resource Management
CEO	Chief Executive Officer	KSA	Key Strategic Area
CoGTA	Cooperative Governance and Traditional Affairs	MDG	Millennium Development Goal
CMA	Catchment Management Agency	NDP	National Development Plan
CP21	Corporate Plan for 2021/22 – 2025/26	NSI	National System of Innovation
CS	Corporate Services	NWRS	National Water Resource Strategy
CSR	Corporate social responsibility	O&M	Operations & Maintenance
DALRRD	Department of Agriculture, Land Reform and Rural Development	OECD	Organisation for Economic Cooperation and Development
DEFF	Department of Environment, Forestry and Fisheries	PDI	Previously Disadvantaged Individual
DHS	Department of Human Settlements	R&D	Research And Development
DIRCo	Department of International Relations and Cooperation	RDI	Research, Development And Innovation
DoH	Department of Health	SADC	Southern African Development Community
DMR	Department of Mineral Resources	SALGA	South African Local Government Association
DRDLR	Department of Rural Development and Land Reform	SANBI	South African National Biodiversity Institute
DSI	Department of Science and Innovation	SASTEP	South African Sanitation Technologies Programme
DTI	Department of Trade and Industry	SDG	Sustainable Development Goal
DWS	Department of Water and Sanitation	S&T	Science and Technology
GDP	Gross Domestic Product	TIA	Technology Innovation Agency
GWRC	Global Water Research Coalition	WEF	Water-Energy-Food
HCD	Human Capital Development	WIN-SA	Water Information Network South Africa
HEI	Higher Education Institution	WRA	Water Research Act
ICD	Institute for Communicable Diseases	WRC	Water Research Commission
ICT	Information & Communications Technology	WRO	Water Research Observatory
I&I	Innovation & Impact	W&S	Water and sanitation
IP	Intellectual Property	WSD	Water Sensitive Design
		WSA	Water Services Authorities
		WSP	Water Services Providers
		WWF	Worldwide Fund for Nature

EXECUTIVE

SUMMARY

COVERID-19 has made some known global risks seem less of an immediate concern and at the same time introduced a new set of uncertainties. When as businesses we were asked to identify the biggest risks of the coming decade, climate change was high on the list. But as we are now so distracted by the coronavirus pandemic, concerns about sustainability and the green transition have fallen down the agenda.

In their place, the COVID-19 risks have become a key concern. Uncertainties about the current virus outbreak are compounded by fears of further coronavirus waves in the future, leading to an economic downturn with a domino effect on supply chains, bankruptcies and the movement of people and goods across borders. We are in uncharted water when considering what the impacts might mean for jobs and lost livelihoods, and how this will impact different industries. In a year's time, are we likely to see just the largest firms surviving and a lot of the small- and medium-sized players disappearing?

Extreme weather events, failure of climate change mitigation and adaptation, and natural disasters still feature as the top three risks on the global risk register in terms of likelihood. The world is struggling with the rapid and painful transition from believing that water was plentiful and free (or, at the very least, inexpensive) to facing the impacts of water scarcity, poor water quality and the variabilities of hydrologic events resulting from climate change. The pandemic has further created an awareness of the challenges of access to clean water, as this is a vital part of the hygiene process to prevent the

spread of the virus. The poor have become even more marginalised due to a lack of access to the technology which enables continued connectivity.

The past can no longer be used to predict seasonal weather events and precipitation and therefore the sustainability of this unique resource is the core of the Water Research Commission's (WRC) primary purpose. The WRC's Corporate Plan for 2021/22 - 2025/26 (CP21) builds on the current strategy and will continue to address the challenges and opportunities relating to water and sanitation (W&S) in South Africa through its Research and Development (R&D) portfolio.

The WRC's project portfolio ties strongly to contributing to the attainability of most of the UN Sustainable Development Goals and with a new focus on the COVID-19 pandemic. This will see the WRC continue to develop products and services in the areas of water resources, ecosystems, water use, waste management and agriculture. The CP21 project portfolio further invests in the multiplier effect with the aim to overcome the 'cubed' challenge (poverty, inequality, and unemployment). The WRC's Knowledge Tree and Lighthouses provide critical guidance when selecting and allocating resources to projects and portfolios.

The knowledge, innovations and technologies from research and development feed into the Innovation and Impact (I&I) Branch, which ensures that all innovative ideas are given a chance to be developed, explored scientifically, and tested with the aim to enhance our resilience to water security risks.

Increasingly we have to put more emphasis on building partnerships for mutual benefit. New models for partnership in technology commercialising are beginning to prove their worth, and in 2021 the WRC



“

*The WRC prides itself in being
the leading funder of water
research in South Africa.*

will continue engage more partnerships, both local and global, using the proven models for fast-tracking innovations to applications. This will culminate in new projects being implemented during the coming year that will take the WRC to the next level of delivering on its mandate.

The I&I strategy for CP21 further builds on the innovation value chain by aiming to accelerate research, innovation and human capital development by focusing on the following six pillars: operational effectiveness and excellence; connectivity; business intelligence and support; partnerships with other organisations; business development and implementation.

The WRC has embarked on a business development and partnership strategy to create impact from WRC-managed research and to diversify its income streams as part of a risk reduction strategy to enhance financial sustainability, which has been identified as a key risk in the organisation. CP21 targets the filling of the gap in the water research, development and innovation value chain for South Africa. Investing in and leveraging support for water solutions, mechanisms and platforms that will contribute towards transforming the water sector, and support capacity building and knowledge sharing, is central to the WRC's business development and partnership efforts.

The WRC prides itself in being the leading funder of water research in South Africa. With this comes the ongoing development of the required financial planning, structuring and support tools to refine and better understand the WRC's funding requirements and funding sources that will provide support for the achievement of the WRC vision and strategic objectives. In CP21 the Finance strategy will focus on retaining the WRC's clean audit status and this means continued emphasis on financial reporting and compliance as core elements. This is important as it provides our partners and key stakeholders with assurance of the organisation's financial soundness.

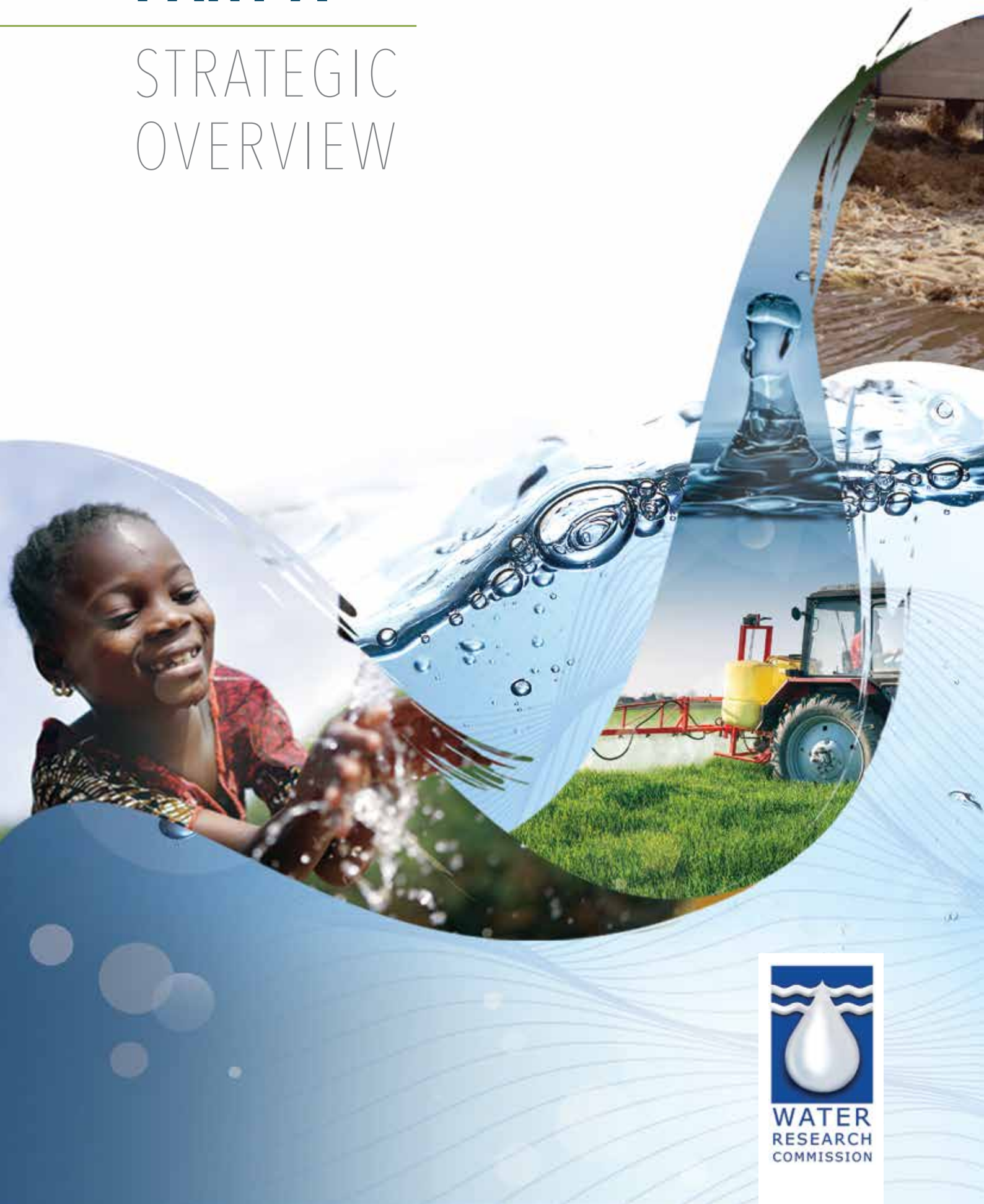
The WRC's current funding model is premised on a high reliance on levy income as its primary source of funding, and this is likely to continue in the foreseeable future.

However, the reality is that there are no guarantees regarding availability of funds and like other research institutions the WRC is faced with the uncertainty related to the various phases of the economic and business cycles. The CP21 strategy's increased focus on business development for income diversity is vital as a risk-reduction strategy, in which the focus will essentially be on increasing income sources – adding new products, services, customers and markets to the WRC portfolio.

CP21 builds on its strategic agenda of focusing on 'paradigm', 'people', 'partnerships' and 'positioning' – creating a continuum of impact that embeds our vision to have highly informed water decision-making through science and technology at all levels in all stakeholder groups. One of the WRC's stakeholder groups that is also prioritised in the strategy is its employees. The WRC's workplace is defined by technology and the employees who are using it, corporate social responsibility, legal and compliance, culture and the physical work environment. The Corporate Services (CS) strategy integrates these areas into the WRC's 'world of work', while striking a balance between current and future employee and business needs.

PART A

STRATEGIC OVERVIEW



01 | Introduction

Access to sufficient water and adequate sanitation of an appropriate quality is necessary for life, human dignity, economic growth and social development. This underpins the wellbeing and prosperity of South Africa and all 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.

1.1 THE PURPOSE OF THE WRC

The Water Research Commission (WRC), established through the Water Research Act, has the primary function of achieving 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 and the world.

This is achieved through a cycle of five actions, as shown in Figure 1.

Figure 1: Five actions of the WRC towards achieving its vision



Figure 2: Core principles of the WRC strategy

The four core principles of the WRC's strategy that move the five actions into outputs are:



02 | Strategic Outcome-Oriented Goals of the Institution

2.1 THE WRC KNOWLEDGE TREE

The four core principles of the strategy are implemented through the WRC's Knowledge Tree:

The WRC Knowledge Tree (Figure 3) is an investment in the multiplier effect which aims to:

- Empower communities
- Inform policy and decision making

- Develop innovative products and services for economic growth
- Enhance human capital development and the water and science sectors
- Promote transformation and redress
- Drive sustainable development solutions

These outcome-oriented goals are described in more detail in Table 1.

Figure 3: The WRC Knowledge Tree

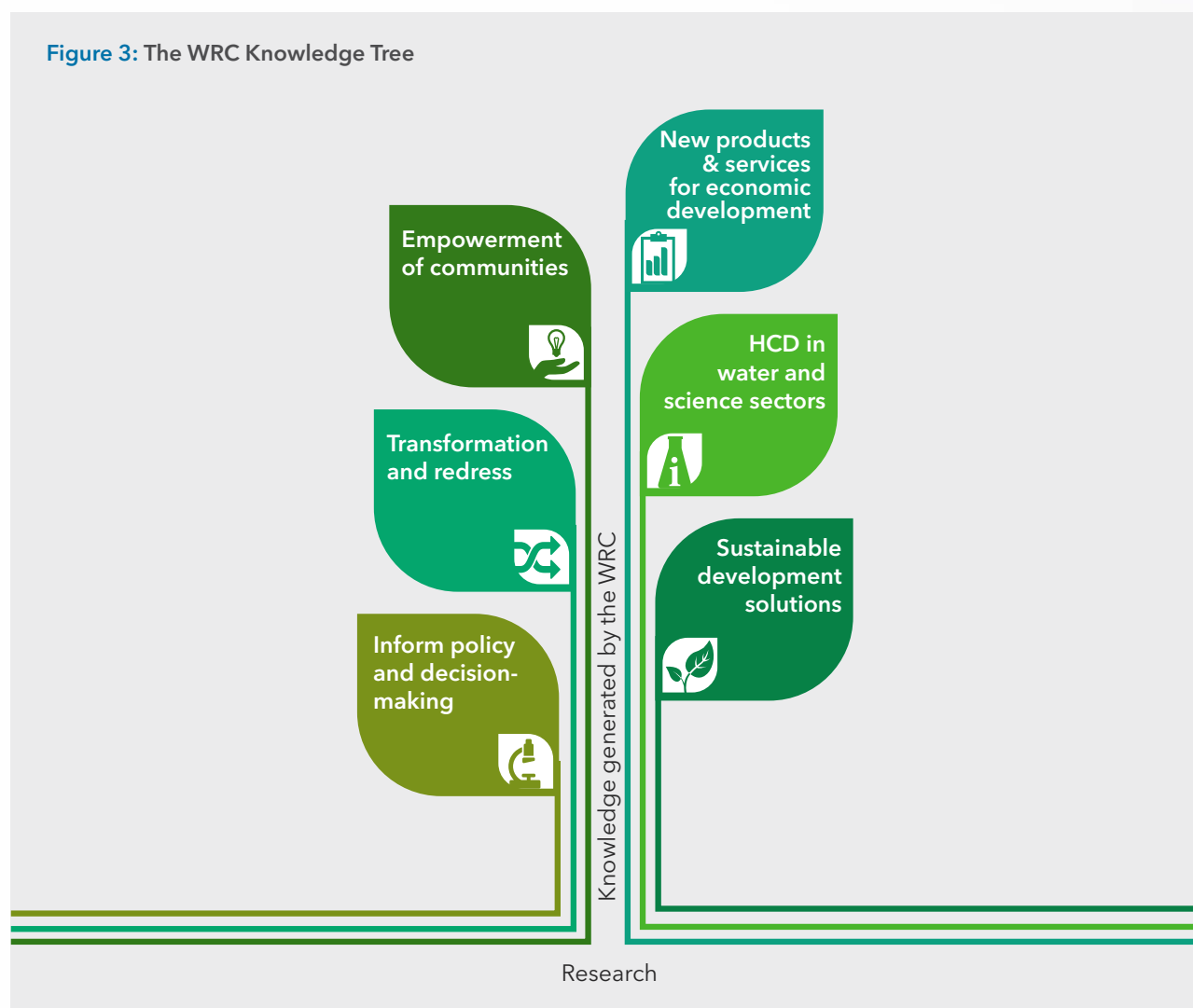


Table 1: The WRC's strategic outcome-oriented goals.



**Strategic outcome-oriented goal 1:
Inform policy and decision-making**

The WRC will inform policy and decision making by commissioning research projects that generate appropriate evidence-based knowledge that will guide decision making, influence the development of policy, practice or service provision, shape legislation and alter behaviour. In the 2021/22 financial year, with the information generated from its research, the WRC plans to produce 12 Policy and Ministerial Briefs to distribute to government departments that provide decision makers with research-based knowledge. This allows for a deeper understanding of policy issues and the reframing of debates with the use of appropriate knowledge. An example of a research project that was initiated in the 2020/21 financial year to inform policy and decision-making is 'Citizen Science for monitoring groundwater in the Hout Catchment, Limpopo'. This project intends to inform decision making regarding the use of groundwater so as to make practical decisions about its yields, use, protection, management and control in this area.



**Strategic outcome-oriented goal 2:
Develop new products and services for economic development**

With the knowledge generated from its research projects, the WRC is able to capitalise on projects that produce new intellectual property or have the ability to introduce innovations that create new or improved technologies, products and services that can be used in the real economy. The project on water use of marula (*Sclerocarya birrea*) tree crops in various agro-ecological regions and postharvest utilisation of its fruit and by-products will produce, apart from guidelines, various products derived from marula fruit, e.g., (i) carbonated soft drinks, and (ii) stock feed derived from stored marula wastes (e.g. peels), all of which will contribute to economic development.



**Strategic outcome-oriented goal 3:
Enhance human capital development (HCD)**

Each project that is selected and funded by the WRC is required to have high levels of student participation. The WRC each year strives to increase the number of post-docs, PhD and Masters students involved in its projects, which further increases development in the sector. The WRC also focuses on providing support to historically disadvantaged institutions through mentorship. Emphasis is also placed on building capacity in the science community in South Africa and the rest of Africa by encouraging black project leaders to manage WRC projects. In the 2021/22 financial year the WRC plans to involve more than 300 students in its project portfolio and to have more than 100 projects led by black project leaders.

Note: In terms of the achievement of the strategic outcome-oriented goals depicted by the WRC Knowledge Tree, the WRC manages a multi-year portfolio of projects numbering approximately 300 at any time (See Annexures).



Strategic outcome-oriented goal 4: **Empowerment of communities**

Each year the WRC strives to increase the number of projects that include communities who are not only the end-users of research but are also active participants in the research. The aim is to have a direct positive impact on the livelihood of the communities in which the research project is conducted, by transferring knowledge that builds capacity that will assist with post-project sustainability. In the 2021/22 financial year the WRC will initiate multiple community-based projects. An example of a community-based project that has been initiated is 'Assessment of barriers for improved uptake of irrigation water-efficient technologies by small-scale farmers in two selected provinces'. This research is being conducted over a three-year period in two small-scale irrigation schemes selected in the Eastern Cape and Mpumalanga. The research targets small-scale irrigators, extension agents, leading farmers and other key stakeholders that play an active role in the uptake and implementation of irrigation technologies that have the potential to improve productivity and profitability of crop production and water use. The following outputs and impacts are expected: (i) greater understanding of the dynamics, complexity and multifaceted environment of small-scale irrigation scheme operations; (ii) identification of 'agents of change' and their role in the uptake and implementation of irrigation efficiency technologies; (iii) identification of barriers and opportunities for the adoption of efficient irrigation technologies to improve productivity and profitability at scheme and farm level; (iv) possible lessons learned on how these barriers can be addressed and how to incorporate these lessons in future policy making.



Strategic outcome-oriented goal 5: **Promote transformation and redress**

Each year the WRC actively strives to increase the number of female and youth project leaders on its funded projects and, with the knowledge generated from the research, aims to promote socio-economic development by providing solutions that reduce poverty and inequality in communities. In the 2021/22 financial year the WRC plans to have 80 female project leaders in its portfolio, with 31 new projects being led by females. The WRC emphasis on food security will result in several projects being undertaken that aim to increase food security in communities.



Strategic outcome-oriented goal 6: **Drive sustainable development solutions**

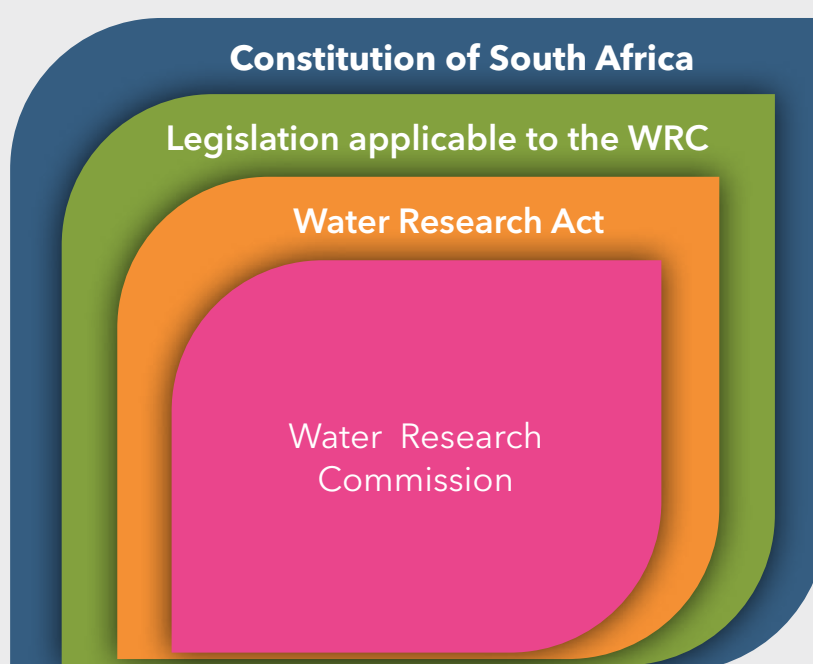
The WRC prioritises those projects that provide solutions for sustainable development. These projects must produce knowledge that contributes to providing sustainable solutions in the areas of environment, economy, and community. An example is the research project that was initiated in 2020/21 to determine peat loss and develop management and rehabilitation protocols for peatlands in South Africa. In South Africa, peatlands are groundwater-fed systems. The national, provincial and municipal authorities must be made aware of the importance of these systems and the critical balance between development and the availability of water for the country's long-term sustainability objectives. National peatland management guidelines, including rehabilitation and peat fire protocols, will be developed and will support South Africa's obligations to various multilateral environmental agreements, amongst others, Ramsar and UNEP.

03 | Legislative and Other Mandates

The WRC serves as the research and development partner of the sector leader, the Department of Water and Sanitation (DWS), and provides the sector

with knowledge and capacity to ensure sustainable management of water resources and enhance water services.

Figure 4: WRC legislative mandates



3.1 CONSTITUTIONAL MANDATE

The WRC is bound by the Bill of Rights contained within the Constitution (Figure 4) 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.

3.2 LEGISLATIVE MANDATE

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.

3.3 WATER RESEARCH ACT (ACT NO. 34 OF 1971 AS AMENDED)

The principal aim of the Water Research Act (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

3.4 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 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.

3.5 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.

3.6 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.

3.7 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.



04 | Alignment of WRC Strategy and Activities

4.1 NATIONAL WATER RESOURCE STRATEGY 2 (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 and empower the implementation of the National Water and Sanitation R&D agenda. 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 (DTI), Department of Economic Development (DED), Department of Environment, Forestry and Fisheries (DEFF), Department of Human Settlements (DHS), and the Department of Mineral Resources (DMR), 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 DSI, 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.

4.2 CONTRIBUTING TOWARDS ACHIEVING GOVERNMENT OUTCOMES AND NATIONAL DEVELOPMENT PLAN (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 Human Settlements, Water and Sanitation.

The WRC also applies the outcome-based approach developed by Government 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. 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 workplan 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.

4.3 ALIGNMENT WITH DWS STRATEGIC OBJECTIVES AND NATIONAL WATER & SANITATION MASTER PLAN

The National Water & Sanitation Master Plan (NWSMP) presents a solid affirmation and commitment from DWS to support water-related research, development and innovation. This is with a view to ensuring that there is 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, and the African continent. The DWS will thus continue to support efforts that position the country and its institutions as a global water knowledge node active across the whole water and sanitation innovation value chain.

The DWS with its relevant institutions has to construct, plant, and maintain a true Knowledge Tree which bears many desired fruits, resulting in new sustainable development solutions, new products and services, empowering of communities especially youth and women, informed policy and decision making, etc. In fact, this plan constructs a roadmap assuring the commitment of the DWS in addressing the challenges of unemployment, poverty and inequality as stated in the National Development Plan (NDP) of South Africa. The RDI Chapter of the NWSMP is aligned with and linked to key strategic goals of the DWS as well as other Government priorities. Above all, the NWSMP is meant to advance and comply with the Constitution and all other relevant policies and legislations of South Africa. The chapter thus provides:

- A brief comment on RDI gaps and opportunities
- An overview of the key activities and instruments that underpin the water RDI sector
- The key investment themes/clusters that should be prioritized
- Tracking progress
- An estimation of envisioned investment required
- An overview of the proposed implementation and partnership approach

The Water RDI Roadmap is a 10-year innovation plan (2016/17–2027/27) that provides strategic direction, a set of action plans and an implementation framework to guide, plan, coordinate and manage South Africa's

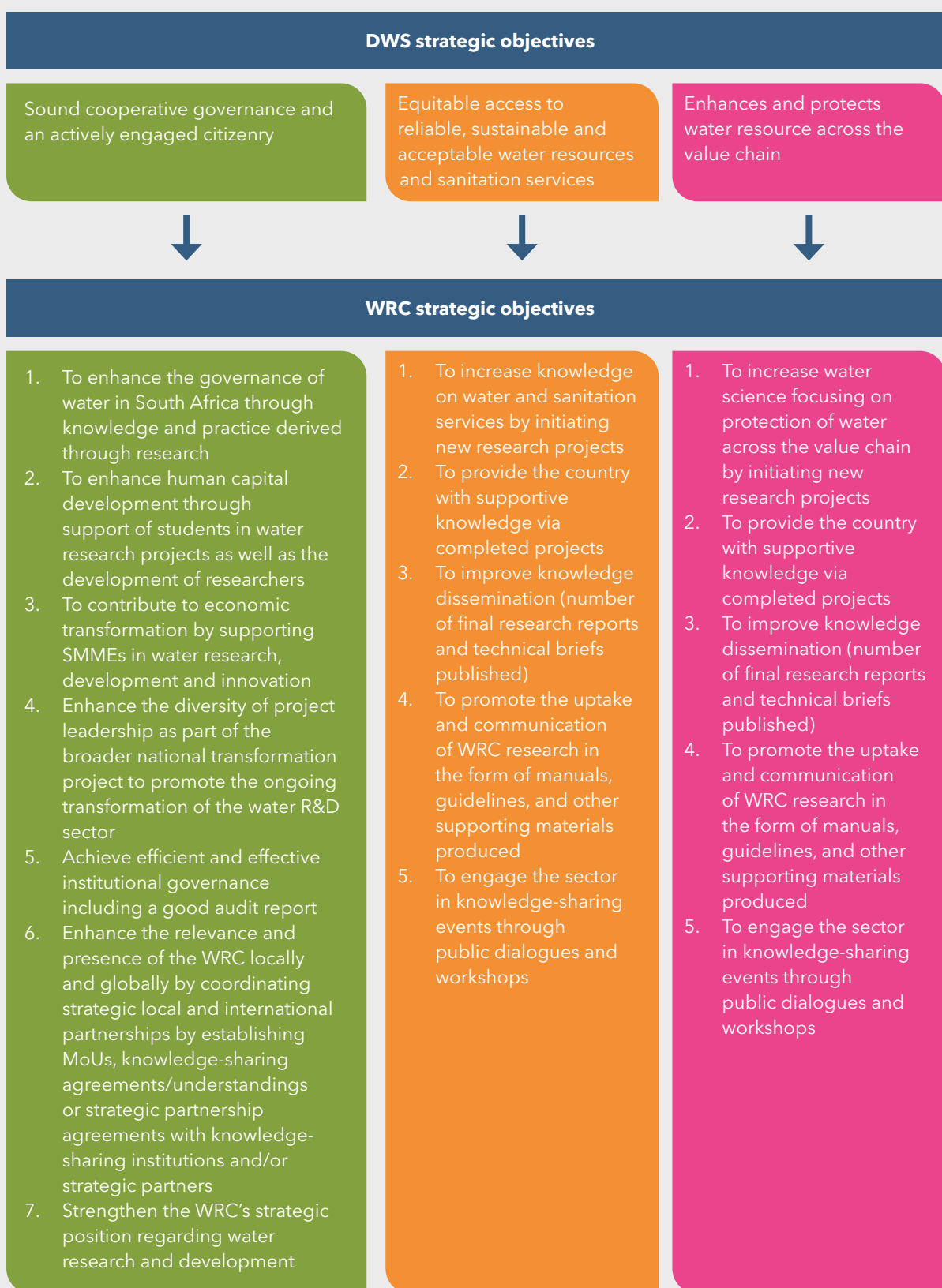
water RDI investment. The Roadmap is a partnership initiative between the DSI, DWS and the WRC. The Roadmap is thus positioned as the implementation plan for Chapter 14 of the NWRS-2 and its current revision processes. It also provides the basis for the research chapter of the National Water and Sanitation Master Plan. The Roadmap has strong alignment to the Water Chapter in the Industrial Policy Action Plan released in 2017/18. The plan focuses on tracking and driving a series of research, high-end skills development and innovation deployment activities focusing on a range of clusters/thematic areas, such as unlocking alternative sources of water, ecological and built infrastructure, or monitoring and metering. Ultimately the plan aims to:

- Address water knowledge gaps
- Grow the water sector high-end skills base
- Facilitate faster and more effective deployment of context-appropriate solutions to market
- Provide evidence that guides policy and implementation
- Develop content that guides education and awareness campaigns
- Unlock new opportunities for business and industry
- Deepen insight on how best to balance protection and use of the environment
- Facilitate a learning culture in water sector institutions about the challenges, risks, opportunities and solutions related to the water sector

Figure 5: Alignment with DWS strategic objectives



Table 2: Alignment with DWS strategic objectives



05 | Situational Analysis

5.1 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, innovation and partnerships will continue to maintain 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.

5.2 ORGANISATIONAL ENVIRONMENT

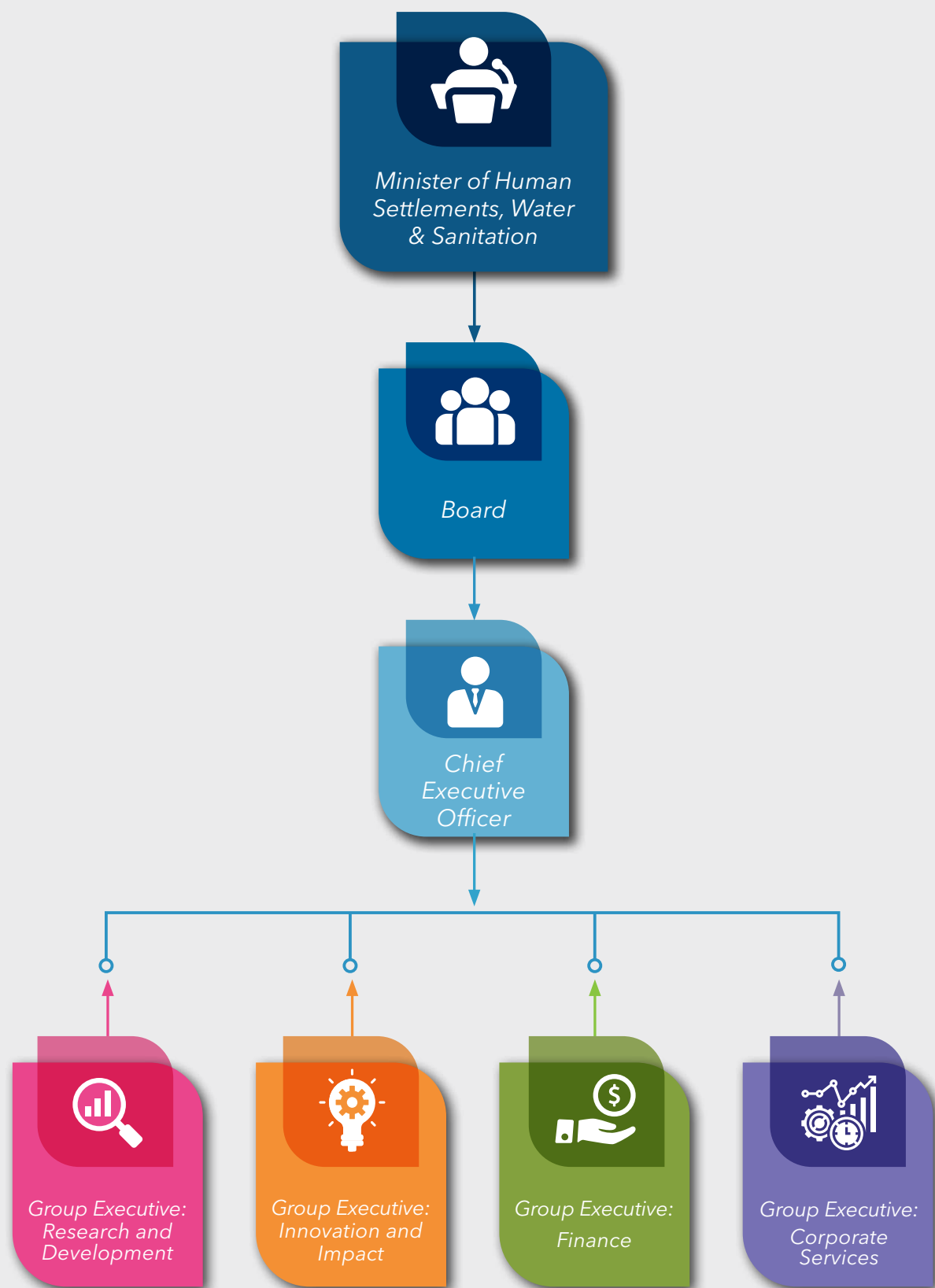
The primary functions of the WRC have always been to fund and steer the water research agenda in South Africa, and to effectively disseminate and communicate research findings. Administrative activities are carried out to ensure compliance with regulatory requirements and to provide an enabling environment 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. This not only necessitated an expanded mandate but also a suitable organisational structure capable of handling these added responsibilities. The WRC has re-engineered its operations and structure to address challenges faced by the water and science sectors and the country.

As such, four core teams have been developed (Figures 6 and 7):

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. Innovation and Impact - 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.
3. Finance - which focuses on improved efficiencies and effectiveness within the WRC's supply chain and the enhancement of financial planning capabilities which will contribute towards creating an appropriately funded and financially stable operating environment.
4. Corporate Services - which focuses on the world of work for the WRC. This includes people and culture, information technology, corporate social responsibility, legal and compliance, and facilities.

Figure 6: WRC organisational structure



The following structure defines the internal governance framework:

The Minister of Human Settlements, 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 a member of the WRC Board.

The Heads of Branches, which include the Group Executives, the Chief Financial Officer and the Executive Manager for Corporate Services, report directly to the CEO.

Figure 7: WRC Branches



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



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.



Finance -

which focuses on improved efficiencies and effectiveness within the WRC's supply chain and the enhancement of financial planning capabilities which will contribute towards creating an appropriately funded and financially stable environment.

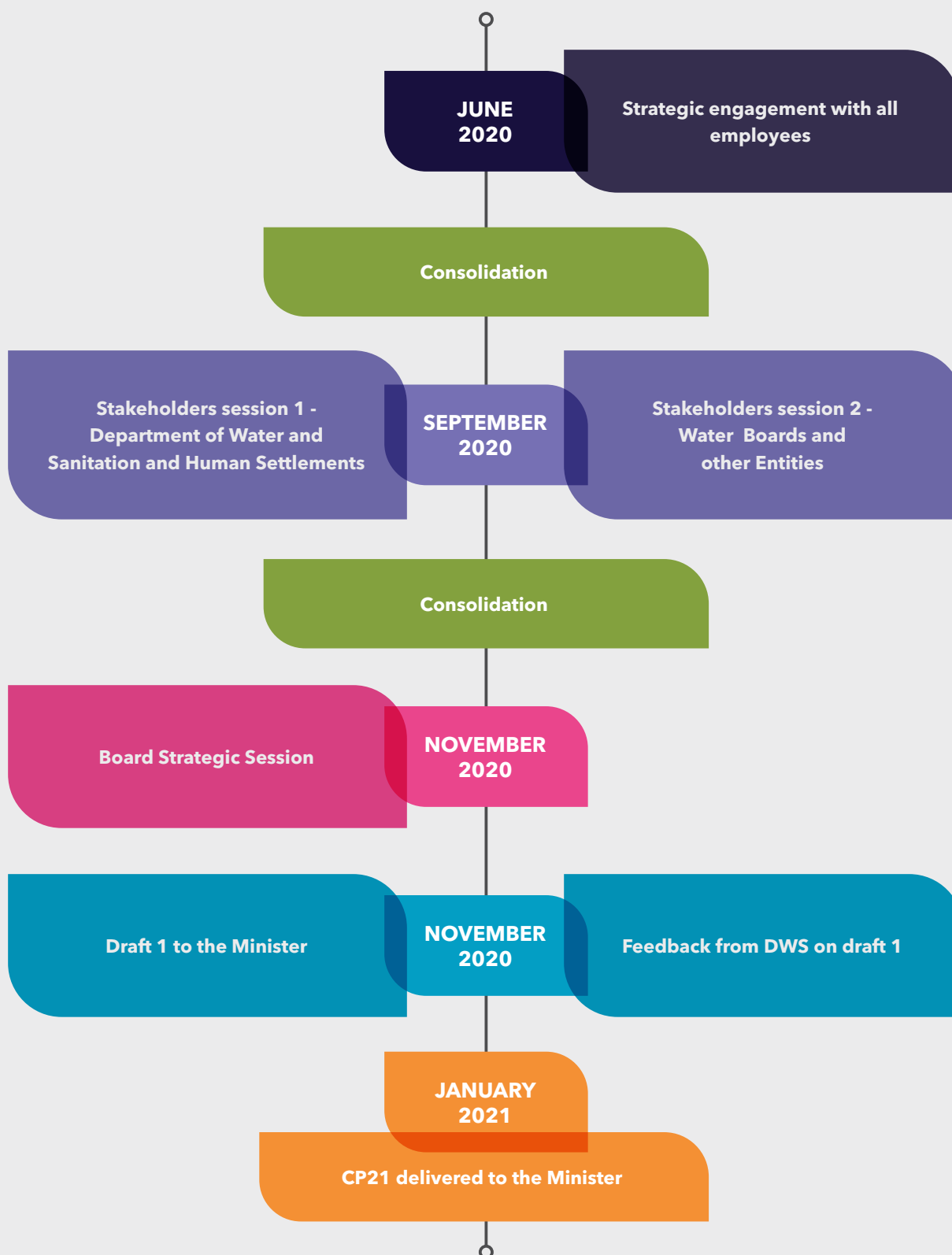


Corporate Services -

which focuses on the world of work within the WRC. This includes people and culture, information technology, corporate social responsibility, legal and compliance as well as facilities.

5.3 DESCRIPTION OF THE WRC'S CORPORATE PLANNING PROCESS

Figure 8: The WRC's corporate planning process



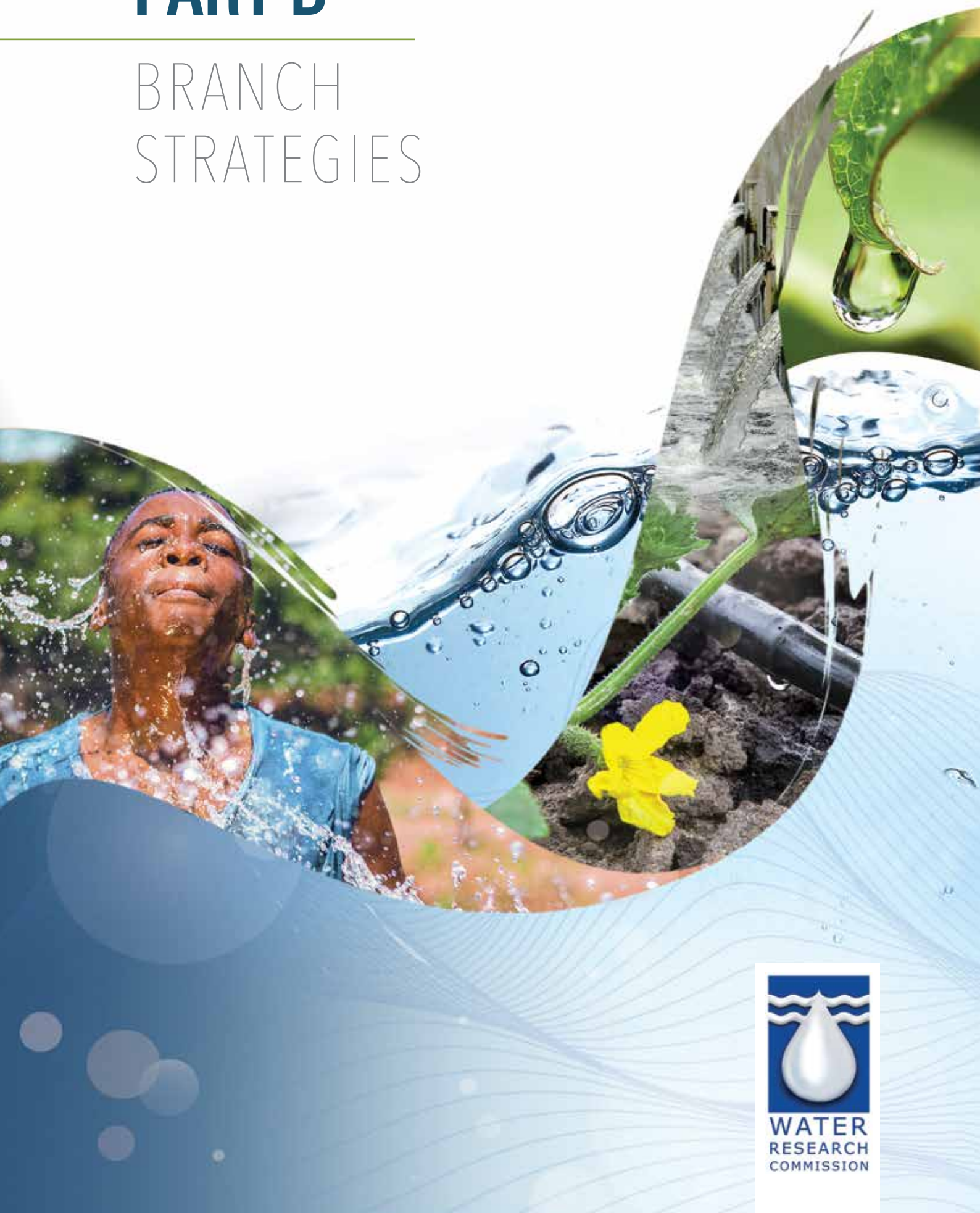
The process (Figure 8) conducted to develop this Corporate Plan is characterised by three important elements. Firstly, it has been an ongoing and iterative process. Secondly, it has been consultative, incorporating discussions and considerations from the Department of Water and Sanitation, Department of Human Settlements 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 5-year planning cycle. All of these processes have been under the guidance of the WRC Board.

The Strategic planning process started in June with all employees engaging the various areas of the business from both the external and internal perspectives. The session covered key areas in the research, innovation, business development and finance spheres. From the internal perspective employees engaged the strategy on 'workflows', 'spaces', 'the way we work', and 'communication'.

Leading on from those sessions, the WRC convened two stakeholder engagements to provide a platform for stakeholders to contribute to the development of the Corporate Plan for 2021/22 – 2025/26. The session on 8 September 2020 was a closed session for the shareholder department (DWS) and the Department of Human Settlements, targeting senior officials, while the second session held on 11 September 2020 was open to all WRC stakeholders. The consultative process is an annual engagement and an important step in the development of the Corporate Plan. 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 National Development Plan (NDP) objectives as well as the Corporate Plan (Annual Performance Plan) of the Department and the performance agreement of the Minister of Human Settlements, Water and Sanitation.

PART B

BRANCH STRATEGIES



06 | Research and Development

6.1 INTRODUCTION

The COVID-19 pandemic has posed a significant challenge to the science, technological and innovation sector, especially in the developing world where most services are manually produced or delivered. The pandemic has invigorated institutions to quickly embrace the 4IR (the 4th industrial revolution), artificial intelligence, and other appropriate innovations to remain a 'going concern'. Research institutions like the WRC have explored new ways of conducting its RDI business. The WRC has had its share of opportunities and risks or threats, which will strengthen our RDI programmes. While embracing and adapting to changes, the R&D branch in the WRC will continue with its broad strategic objectives, and also factor in initiatives to contribute to stopping and managing the spread of COVID-19.

The wastewater severance programme and post-COVID-19 recovery projects are some of the commitments that the R&D branch will embark on in 2021/22. However, it is also important to continue to strengthen the base of scientific and technical knowledge, which enable us and the sector to be more prepared for future challenges. For this reason, the WRC R&D branch has revamped its Water and Wastewater Use business unit to introduce new thrusts in CP21, and this has resulted in renaming the unit to Water Use, Wastewater and Sanitation Futures. This is necessary and useful in enabling the WRC to remain competitive and relevant as a global science and technology leader in water and sanitation.

The Research and Development (R&D) branch of the WRC is the custodian of instruments, programmes and processes which create new knowledge and innovation in water and sanitation. It uses R&D projects and other activities to produce new knowledge required for water and sanitation, human settlements, and many other sectors in South Africa and beyond. The knowledge generated results in new or refined technologies and innovations which the WRC provides to the water and other sectors to address specific needs and

challenges. The branch is actively involved in human and institutional capacity development using research and development projects, research products and services. It supports other branches in the WRC with knowledge, innovations and technologies that enable them to fulfil their functions, for instance, I&I and Corporate Services (Corporate Social Responsibility) get R&D support when they embark on knowledge dissemination and transfer, screening and evaluation of new technologies, negotiation of new water business development initiatives, assisting schools and needy communities, etc. The R&D branch has three business divisions, which are Water Resources and Ecosystems, Water Use, Wastewater and Sanitation Futures, and Water Utilisation in Agriculture (Figure 9).



Figure 9: The three business divisions in the Research and Development branch of the WRC



Figure 10: Identified critical water and sanitation challenges through stakeholder consultation



6.2 SCOPE

Wide consultation with all key stakeholders and the shareholder enabled the R&D branch to consider both the macro- and micro-environment within which the WRC must create relevant and appropriate R&D products and services, as opportunities to grow the water and sanitation sector (Figure 11). Some of the opportunities for the WRC relate to addressing knowledge uptake/

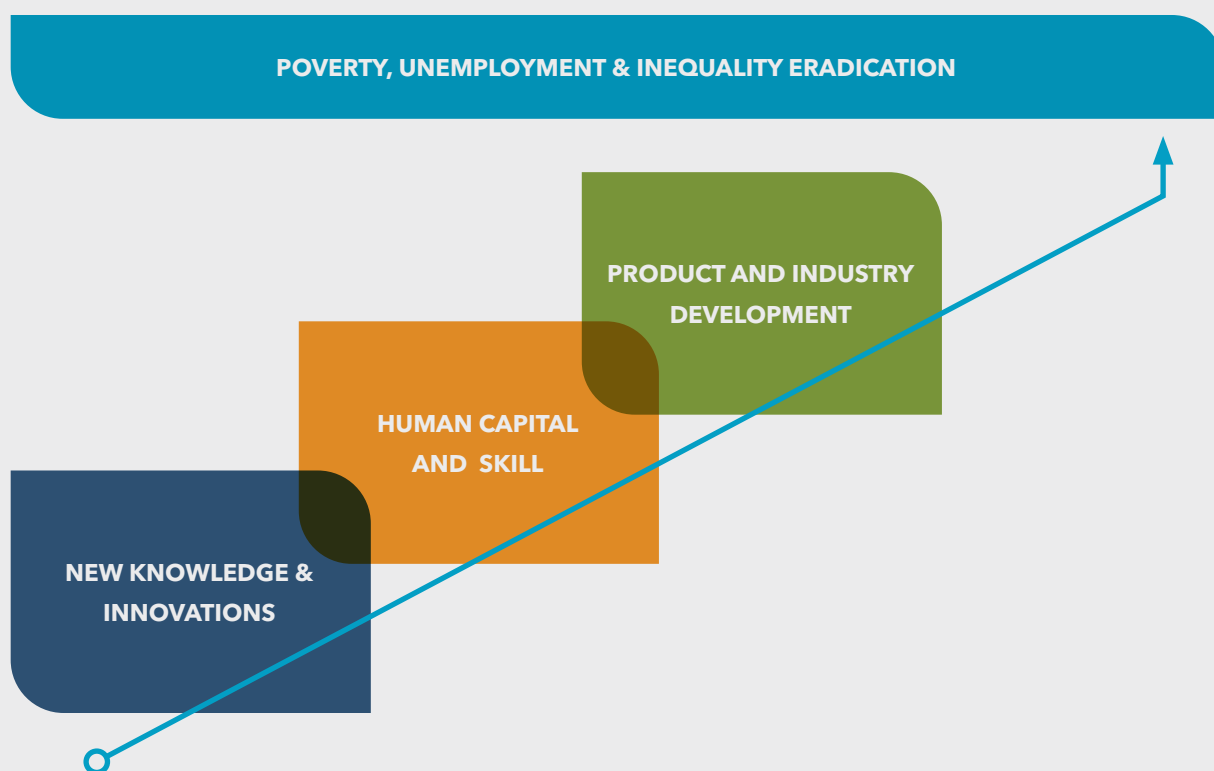
use as well as building both human and institutional capacity, which the WRC is committed to support using its RDI portfolio. The R&D portfolio has to address both the challenges and opportunities relating to water and sanitation (W&S) and human settlements. While some of the challenges are global in nature, the majority can be viewed and dealt with in a local context. Water scarcity or security has been identified as a major risk in attaining sustainable economic growth and development. It is

for this reason that the attainability of most of the UN Sustainable Development Goals (SDGs) depends on the availability of sufficient (and clean) water. In a water-scarce region such as ours (SADC), where countries share water resources and cultures, water scarcity threatens socio-economic development and environmental sustainability. As a result, the R&D branch of the WRC has introduced new research and innovation portfolios on 'water sensitive and resilient settlements', 'water quality futures', 'sustainable integrated wastewater resource futures', and the Sanitation Transformation Initiative (SANITI).

The WRC will continue to support and encourage new research and development initiatives which adequately

address these challenges and associated risks. Socio-economic challenges, such as those associated with COVID-19, will be given a special focus, even in this funding cycle. As we embark on consolidating our strategy, evaluation and refining of our existing structures and instruments will be important to enable the WRC and the water sector to thrive in these challenging times. The R&D portfolios will continue to develop products and services geared to overcome the 'cubed' challenge (poverty, inequality, and unemployment). The branch will put emphasis on ensuring that knowledge solutions support growth (economic and social), the competitiveness of water-related industries and thus enterprises, and the continuous development of current and future water knowledge workers.

Figure 11: Knowledge creation by Water and Sanitation R&D that leads to product and industrial development necessary to eradicate poverty, unemployment, and inequality



In addition, more emphasis will be directed, through R&D projects and other activities, toward influencing water-related behaviour and approaches to water use and management. In addition, the R&D portfolio will address critical aspects about dignified sanitation,

food security (urban and peri-urban agriculture and promote underutilised indigenous crops), water quality, and energy challenges. Addressing these aspects (challenges) will enable the WRC to develop disrupting innovations needed to support and grow

the W&S sector. For instance, the WRC is already championing the sanitation evolution nationally and globally, especially with regard to the development of novel but appropriate sanitation innovations for communities in Africa and for schools. The exploration and implementation by the WRC and its partners of nature-based solutions for water and sanitation are at advanced stages. The WRC continues to support the development of technologies and knowledge that improve and protect water quality. The WRC will continue to generate knowledge that influences society and decision makers to be wise water resource users, while at the same time improving understanding of available innovation and the complexities of water management. The R&D branch will pursue the generation and development of knowledge and tools to enable the water and sanitation sector to overcome inefficiencies in the use of water resources, and promote those practices and technologies that will result in high water security or high availability and access to clean water. To attain the above, the R&D branch has begun to look at its research and development portfolios, with the intention to align them to what the WRC intends to achieve by 2035 and beyond. The competitiveness of the aspired products and services in relation to their value or relevance to the water and related sectors will be given special attention when selecting and allocating resources to projects/portfolios. The Knowledge Tree and the Lighthouses provide guidance on critical areas to focus on in addressing the cubed challenges. There are possibilities to advance the organisation's strategic objectives, using budgetary allocations to promote a paradigm shift in research and development (from a big 'R' and small 'd' in R&D to a small 'r' and big 'D').

The branch will continue to ensure that all innovative ideas are given a chance to be developed, explored scientifically, and tested. This will be made possible by ensuring that the R&D branch work closely with Innovation & Impact (I&I) and other branches in the WRC. All four P's in the WRC corporate strategy will be implemented in the operations and practices of our branch. The branch will continue to seek more relevant partnerships, local and international, in addressing people's needs and ensuring that the WRC is strategically positioned to fulfil its mandate.

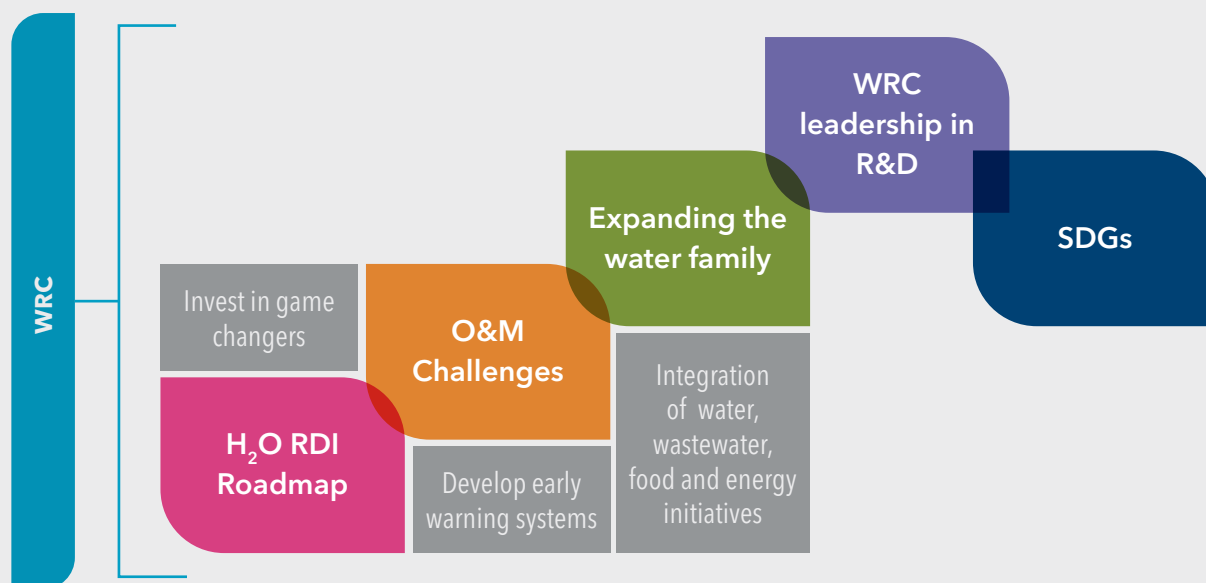
6.3 PRIORITIES FOR R&D

The R&D branch will continue to focus on consolidation of the corporate strategy of the WRC so that sustainable solutions are created to resolve the most impactful areas identified with regard to water and sanitation as well as human settlements. This will include paying special attention to and promoting knowledge and innovation production in five identified main priority areas (see Figure 12): supporting the Implementation of the Water Research, Development and Innovation (RDI) Roadmap; improving operation and maintenance in the sector, supporting efforts to develop and expand the water industries (family); ensuring the WRC is well positioned as a global water-and-science leader; and to support our country and Africa to achieve the water-related SDGs. In addition, the R&D branch will continue to look out for opportunities to disseminate water and sanitation knowledge to all users, as shown during the COVID-19 lockdown period, when the WRC through R&D initiated the wastewater-based epidemiological surveillance programme and also hosted various events to keep South Africa informed about the latest developments in water and sanitation.

Implementation of the Water Research, Development and Innovation (RDI) Roadmap

The Water RDI Roadmap is a programme initiated by DSI. The WRC was appointed by DSI to develop the programme on the Department's behalf. The RDI Roadmap has been endorsed by the Science and Technology Parliamentary Portfolio Committee and has been adopted by DWS and included in the R&D chapter of the NWRS-2. The WRC, like all other institutions in the water and science sectors, regards the Water RDI Roadmap as an important project to be supported through the initiatives of the WRC. The R&D portfolio will address all seven key areas identified in the Roadmap. These include all issues relating to water supply, such as: increase ability to make use of more sources of water, including alternatives; improve governance, planning and management of supply and delivery; improve adequacy and performance of supply infrastructure; and run water as a financially sustainable 'business' by improving operational performance. Regarding water

Figure 12: New priority areas to be focused on by the R&D branch



demand, the RDI Roadmap identifies the following to be pertinent to South Africa: improve governance, planning, and management of demand and use; reduce losses and increase efficiency of productive use; and improve performance of pricing, monitoring, billing, metering and collection. The Water RDI Roadmap will be implemented or supported in the WRC in consideration of other identified critical areas such as prioritizing investment in the ‘game-changers’; and developing and improving our early warning systems. There is a suite of Lighthouses that will effectively address the Water RDI Roadmap. In addition, the WRC has identified additional Lighthouses to ensure research concentration on issues that relate to people or society, i.e., Sustainable Water Behaviours, Water Data and the 4th Industrial Revolution, and Water Scarcity and Extreme Weather Events. These Lighthouses and others are described in detail in the previous sections. The Water RDI Roadmap guides the water sector and others to address the entire water value chain.

Improving operation and maintenance in the sector WRC-funded projects will need to address identified operation and maintenance (O&M) challenges in the water sector. The R&D outputs of the WRC are aimed to

inform policy, empower decision makers with credible world-class knowledge, and support training of water service providers/workers so that O&M challenges can be resolved resulting in all systems running efficiently and optimally. This will be advanced, among others, by producing tools and guidelines for use by practitioners and also materials that can be used for training. The WRC will continue to partner with other national and international agencies to start and implement R&D initiatives which address identified O&M challenges.

Expand the water industries (family)

The WRC will continue to invest in and promote identified or developed ‘game-changers’ in the water and sanitation sector to promote sustainable socio-economic growth and development. The R&D branch has a unique role of ensuring the production of new knowledge and innovation required to advance this cause. New knowledge, tools and innovation will enable the establishment of new enterprises in the water and associated sectors. New knowledge and more water enterprises will assist in addressing the cubed challenge (poverty, unemployment, and inequality).

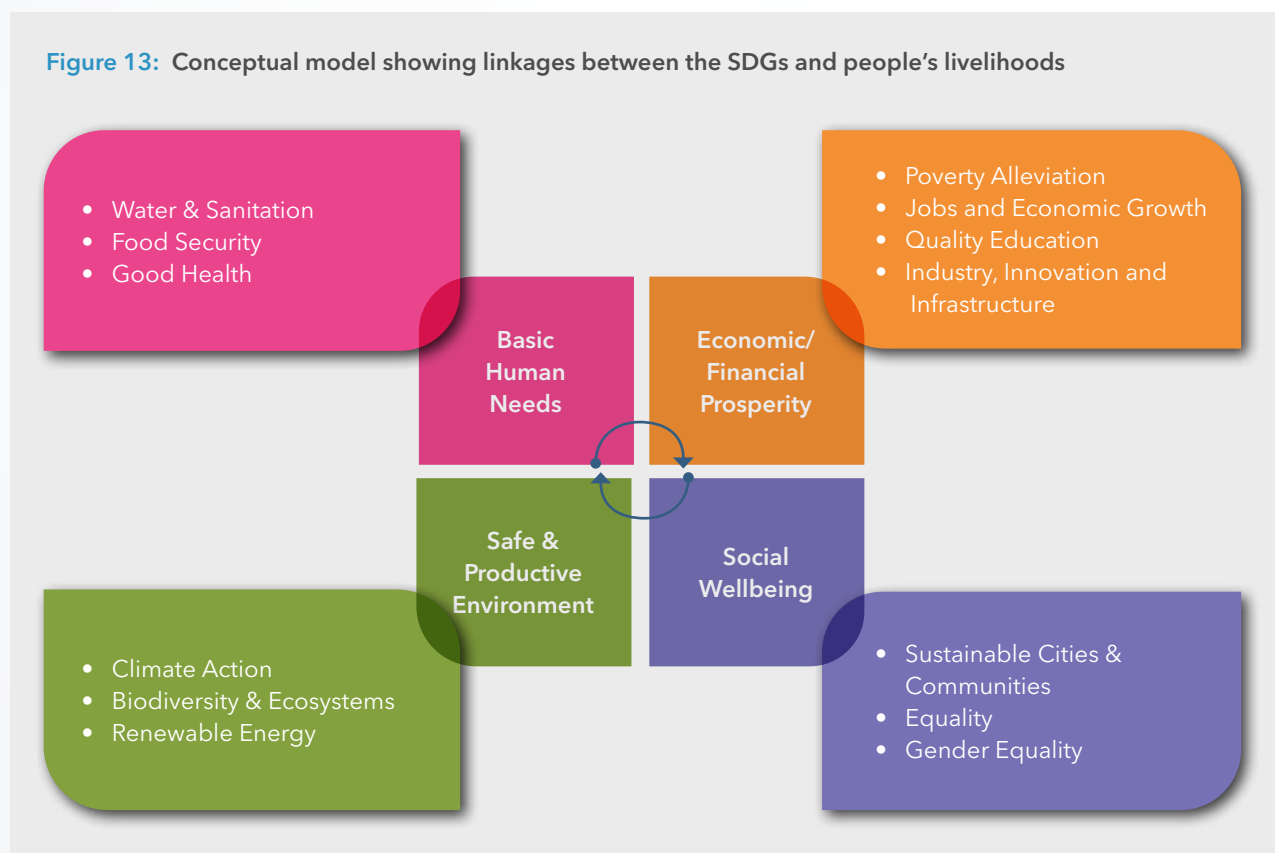
Global water-and-science leadership

It is the desire of the WRC to be a global water node and a national/regional water hub. This requires us to be positioned appropriately in the local water sector and in the global arena in water science and technology development. While the WRC is already a key global and regional player on water, CP18 and CP19 emphasised the commitment of the R&D branch to implementation of the four P's (people, partnership, paradigm shift, positioning) as strategic tactics to advance its leadership in water and sanitation. The R&D branch will continue to identify and support research, development and innovation that can be uniquely identified with the WRC. The WRC is well positioned to lead in areas or matters that are unique to South Africa, Africa, and the developing world. We have shown this kind of leadership in the past by leading the world in research such as cloud seeding and fog harvesting, alternative sanitation, desalination, environmental flows or water requirements, irrigation water saving, and many others.

Achieving the water and sanitation-related Sustainable Development Goals (SDGs)

The WRC will support the Government and Africa's initiatives geared towards achieving SDGs, especially those that relate to water, sanitation, and ecosystems. The WRC will continue to initiate relevant projects to address identified knowledge or innovation gaps in water and sanitation. More effort will be made to integrate initiatives about water, wastewater, sludge, food and energy research, to attain sustainable gains or benefits addressing SDGs as shown in Figure 13. The R&D branch will work with I&I and DWS to ensure that available tools and materials are distributed and used by all relevant stakeholders to resolve water, sanitation, food, energy, and other environmental challenges in South Africa and Africa.

Figure 13: Conceptual model showing linkages between the SDGs and people's livelihoods





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The R&D branch will work with I&I and DWS to ensure that available tools and materials are distributed and used by all relevant stakeholders to resolve water, sanitation, food, energy, and other environmental challenges in South Africa and Africa.

07 | Knowledge Creation and Implementation Approach

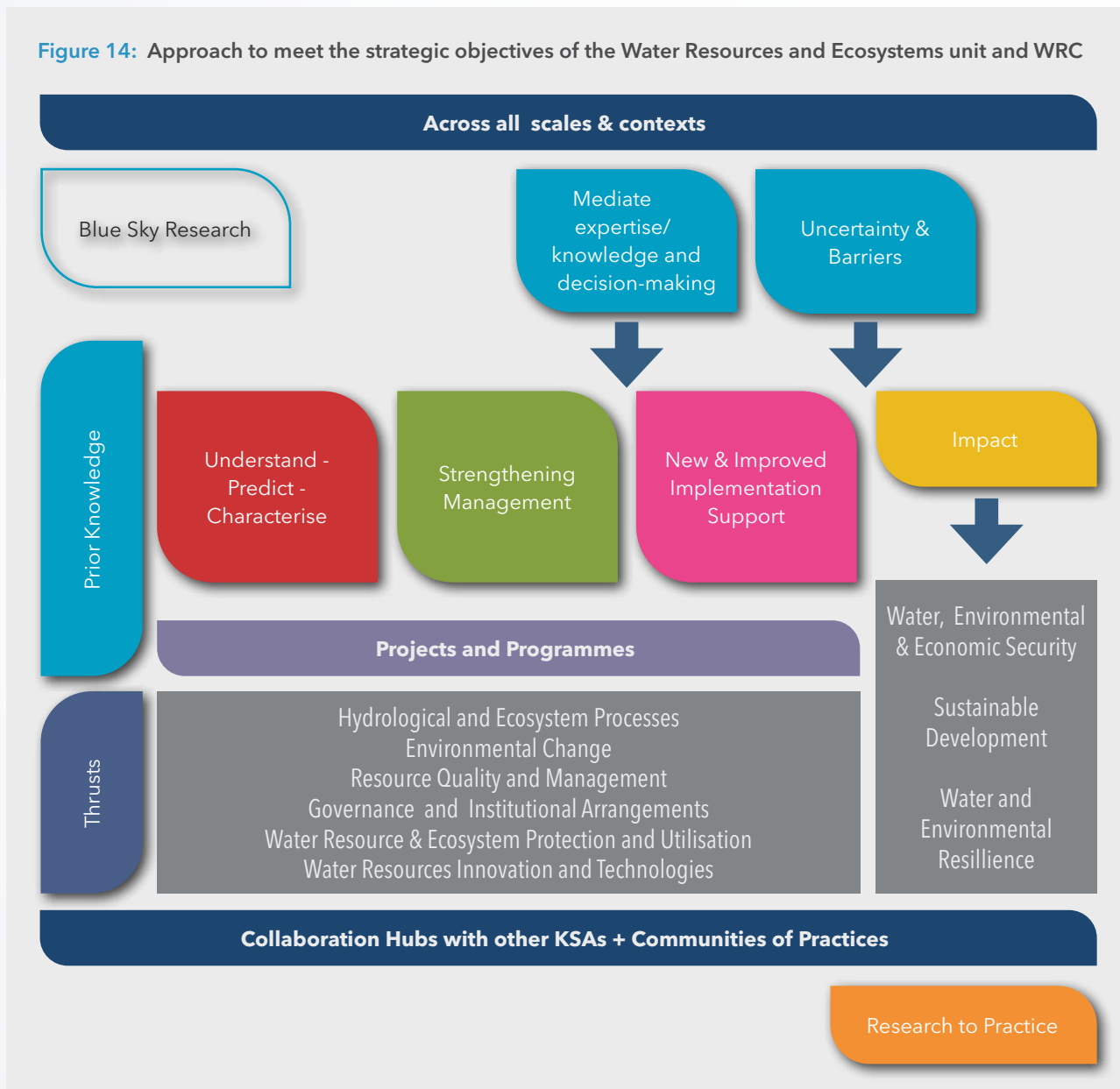
7.1 WATER RESOURCES AND ECOSYSTEMS

Scope

The Water Resources and Ecosystems group continues to provide knowledge, experience and innovations

to meet society's demands for natural resources, environmental and human health and resilience to extreme events. A key strategy is to enhance decision-making for water, environmental and economic security and societal and environmental resilience to natural and man-made impacts at the local level (Figure 14).

Figure 14: Approach to meet the strategic objectives of the Water Resources and Ecosystems unit and WRC



Attention is still given to national, global and water sector related plans, roadmaps and goals. Inter- and intra-branch coordination and collaboration is encouraged to improve return on investment and to increase uptake of research and development outputs. The portfolio consists of projects and activities that will stretch the business division further across the research, development and innovation value chain. Progress in building the Water Resources Innovation and Technologies thrust in developing products and tools has been good. Innovation is a key growth driver in the form of new and improved products, processes and services, underpinned by a strong science and technology foundation. Water resources include watercourses, surface water, estuaries and aquifers and, together with the related ecosystems, are best managed based on a hydro(geo)logical boundary, while considering administrative boundaries. Integrated water resource and ecosystem management calls for an improved understanding and quantitative description of the interactions between the different components of the hydrological cycle (atmosphere, surface and subsurface), linked ecosystems and society. Water Resources and Ecosystems will focus on hydrological and ecosystem processes, management, and protection, through social, institutional, economic and technological interventions at the appropriate scales.

Benefit derivation from our water resources and ecosystems will enable meeting a variety of outcomes, such as the WRC's Knowledge Tree and Government Outcomes, for the benefit of society, the economy and the environment. The discipline-specific approach to solving water challenges is important but on its own cannot address current environmental problems and complexities. A coordinated approach that links various disciplines is important and achievable through the formation of strategic partnerships, positioning and coordination. Product and process innovation are encouraged within the Water Resources and Ecosystems business division. Innovative and empowered institutional arrangements and responses will ensure the implementation of resilient coping, adaptation and mitigation measures. The use and development of water resource technologies will be encouraged to

ensure cost-effective and reliable data and information collection, processing, storing and modelling of these systems. Technologies that will enable water quality monitoring, remediation and treatment will also form part of the research portfolio. Transdisciplinary communities of practices will be strengthened through Lighthouses and specific areas that requires attention to ensure awareness and policy uptake.

Strategic objectives

The strategic objectives (Table 3) have embedded in them all of the elements of the WRC's Knowledge Tree and at the same time aim to enhance the development focus to ensure higher resource security and improve livelihoods in and around water and related systems. Fostering research and implementation partnerships at all levels will ensure that we create not only a robust science system but also a customer base for our research, development and innovation outputs. High-impact, outcomes-based projects will form the basis of the portfolio while funding R&D projects that are complementary to existing products and solutions for maximum impact. Solutions exchange will be encouraged through a complementarity model as well as through process improvements with relevant stakeholders. The portfolio of projects will continue to build capacity at all levels and ensure that this capacity is maintained in the sector and beyond. Participatory approaches have been developed to strengthen knowledge sharing and improvement of research tools and ownership. In order to improve water security, a competent portfolio that will diversify South Africa's water supply mix and develop processes and technologies that will enhance and embed resilience in water resource and ecosystem use and protection will be built.

Table 3: Water Resources and Ecosystems strategic objectives

STRATEGIC OBJECTIVE	DESCRIPTION OF STRATEGIC OBJECTIVE
To establish better governance models aimed at facilitating equitable, productive, and sustainable use of water resources and ecosystem goods and services	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. The sustainability of installed schemes ultimately depends on how we operate and manage these schemes or interventions. Governance is a crosscutting issue within the water sector but also needs strengthening across the energy, agricultural and mining sectors to ensure sustainability as well as integrating the activities of departments responsible for water (DWS, CoGTA, DALRRD).
To improve our understanding of hydrological and ecosystem processes that will enable efficient management and decision-making	This Thrust focuses on developing a scientific understanding of the hydrological cycle and inter-linkages to promote systematic water assessment and planning. Sound water resource assessment and planning can only be achieved with reasonably accurate and consistently recorded and processed data and information.
To improve environmental and climate change resilience and disaster and risk mitigation through improved understanding of the atmospheric, water, land and people interactions	The Thrust will address research to improve our understanding of the connectivity between land, water, atmosphere and people. Any change induced to the environment through natural and anthropogenic means may have an impact on the biophysical and socio-economic environment, ultimately affecting resource use, and should be assessed to be able to quantify the risks, determine response and adaptive strategies while implementing IWRM. The Thrust will also focus on movement of people (migration) changing land use and response of aquatic ecosystems to these population dynamics.
Converting natural assets into societal, economic and environmental benefits whilst maintaining healthy trade-offs	This Thrust is focused on research, innovation and development which specifically address tested sustainable management tools necessary in natural systems decision-making, and guide sustainable utilisation of these systems for the provision of the benefits that people depend on. Central to this is the need to manage the social and economic requirements of society from natural ecosystems and the implementation of policy and legislation. Outputs from research should contribute to improving the lives of people while also contributing to improving the condition of water resources and the environment at large.
To provide innovative solutions for water and ecosystem degradation and depletion and its impact on public health	This Thrust will focus on research on water resources (rivers, dams, groundwater) and their quality in terms of chemical, biological and ecological health as well as flow and how it links to or affects quality. The health/quality of these resources have an effect on water users (domestic, recreation, ecological, traditional, religious, industrial, mining and raw water abstraction) and similarly the users have an impact on the resources. There is a need to focus on research and development as well as innovative tools for monitoring modelling, and the prediction and early warning of impacts.
To provide applicable and marketable technological solutions that will enable improved management of water and land resources	Use of electronics, earth observations, early warnings, numerical models, remediation technologies, sampling and analysis technologies, as well as innovations critical in water resource protection will form a key component of this thrust

Portfolio analysis

The Water Resources and Ecosystems portfolio encompasses elements of 'blue-sky' research to pilot implementation projects. Uptake of guidelines and tools by institutions entrusted with policies and regulations has been excellent. A key focus on strengthening decision-making and management of natural resources requires good data and information. Several tools and approaches have been developed to curate data and to improve monitoring - with the aim to develop this suite of outputs into a comprehensive data and information system to assist stakeholders with improved and efficient decision-making. Working with several partners, the unit coordinates data and information on weather and climate to produce regular climate advisories for South Africa. These tools and systems will also form the basis for the planned Water Research Observatory. The focus for the period of CP21 will be to repackage and code existing tools to be more accessible; develop conventional and non-conventional partnerships to improve monitoring and to deepen the data and information strategy within the context of the 4th industrial revolution. New mobile applications to improve water management are under development, as well as other tools that will assist with collecting, processing and modelling remotely sensed data. The development of novel and cost-effective sensor technology is ongoing and will be further expanded to improve data collection, and to be cost-effective and suitable for the South African environment as well as forming part of early warning systems.

The headwater-to-source strategy involves improving catchment, transboundary and local resources management. The push to localised approaches and tools continues and is supported by a rich citizen-science portfolio and implementation pilots associated with the multiple water uses, dam siltation and ecological infrastructure programmes. The pilot implementation projects encompass a broad suite of the strategic objectives to improve water security and resilience. The localisation and implementation of the research on strategic water source areas will continue to support implementation and regulation. Downscaling the drivers of environmental change, especially climate

change and variability and urbanisation, is still a key challenge in managing water resources, and the research portfolio is building towards developing coping and adaptation strategies through the understanding of weather and climate processes and patterns as well as the concomitant impact on water, land and socio-economics. Regional projects are supported through transboundary research and involvement like the big data and transboundary water projects managed by the WRC.

Strengthening of the enabling environment is another key focus area. A healthy enabling environment ensures that policies and goals are achieved, while balancing out the social, economic and environmental demands for water resources. Projects and initiatives that support this strategy are the development of alternative service delivery models, institutional and law reforms and improving understanding of water and ecosystem economics and water pricing, among others. A review of the key lessons and strategies associated with droughts and emergency interventions will be produced to assist with improved future decision-making and interventions.

Key milestones have been the development of planning and governance tools for the sustainable management of water resources. Water resource management and decision-making relies on up-to-date and spatio-temporally significant datasets. Tools and approaches to arrest the steady decline in hydrological and related observed data, and issues with the acquisition of long-term weather and climatic data are a focus. Embedded in these, the use of cutting-edge tools associated with the 4th industrial revolution, coupled with physical measurements by professionals and citizens, is being developed. The WRC continues to develop an innovation strategy to revive and enhance data and information collection (monitoring), management and usage. The development of robust remote-sensing techniques and numerical models to assist decision-making with sparse datasets over larger areas will continue to be a strategic focus. Issues with quantifying uncertainty will be addressed, as well as how the uncertainties are used in decision-making employing an adaptive approach. Developing a multi-parameter database with online

visualisation tools will assist communities and regulators to understand and manage their water resources better.

The diversification of the country's water supply mix from traditional surface water resources and rural groundwater supply schemes remains a key strategy for implementation through innovative solutions. Coupled with demand-side solutions from this and other business divisions it is possible to significantly improve our water security vulnerabilities at all scales. Environmental change, especially climate change and variability and urbanisation, is a key challenge in managing water resources and the research portfolio is building towards developing coping and adaptation strategies through the understanding of weather and climate processes and patterns as well as the concomitant impact on water, land and socio-economics. A key focus will be to develop innovative real-time early warning systems and reporting tools that will enhance prediction and intervention capabilities at all levels. This work directly supports the following Lighthouses:

- Climate Change
- Water Scarcity and Extreme Weather Events
- Water Data and the 4th Industrial Revolution

Water quality and water resource protection remain key challenges to sustainable water supply due to the impacts of, among others, environmental changes, rapid urbanisation and poor land-use planning. Understanding pollutant fate and behaviour remains a key focus as it allows for strategic, technological and non-technological/social interventions, to protect the environment and public health. A key area that will be strengthened is around emerging contaminants within the environment as well as guidelines to assess and characterise water quality parameters. The portfolio will also significantly contribute to the Water Quality and Health Lighthouse as well as the Water-Energy-Food Nexus Lighthouse, through the unconventional gas research headed by the WRC, for example.

Unlocking water resources and ecosystems for societal and economic benefit through enhancing the developmental focus of the portfolio will continue to

be a strategic deviation from the previous ecosystem portfolio. However, key research questions will still be pursued that will ensure that water-linked ecosystems are protected and that trade-offs are sustainably managed. The development of land and water can be made profitable, productive or useful if supported by proper strategies, tools and a good understanding of the environmental limits. Through the application of green and blue economy principles, a new economic growth paradigm is envisioned that is friendly to the Earth's ecosystems while contributing to poverty alleviation over multigenerational timescales. The Green Economy Lighthouse will be strengthened in order to prioritize and concentrate green innovations aimed at making an impact on society and the economy through partnerships.

7.2 WATER USE, WASTEWATER AND SANITATION FUTURES

Scope

A high assurance and quality of water supply and sanitation services has been the primary area of attention for this Key Strategic Area (KSA) for several years, when the resource was plentiful and available. However, challenges associated with population growth, industrialisation and climate variability have exerted constraints on water resources availability and quality, warranting a new approach to water and sanitation services delivery. We call this 'Embracing One Water and Being Water Positive', defined as striking a very sensitive balance on water availability and its exploitation, such that we maintain a consumption level that always affords us some security of supply and quality into the future. Considering these challenges, research in this KSA continues 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 embraces this new normal of 'Embracing One Water and Being Water Positive' with

the intent that the portfolio will encourage this behaviour and practice within the sector. This concept together with the Water Research, Development and Innovation (RDI) strategy helps formulate a new focus for the KSA moving forward, as well the opportunity to look at multi-disciplinary responses and integration over the length and breadth of the WRC activities in R&D. This has given effect to the new Water Use, Wastewater and Sanitation Futures key strategic area, which embraces and leads solutions towards 'one water' and being 'water positive'.

Strategic objectives

The primary objective of this KSA is to provide knowledge and innovation that ensures reliable, affordable and efficient water use and waste management services to enhance quality of life, and contribute to economic growth and improved public health.

The secondary objectives are to:

- Improve the management of water services in both rural and urban areas
- Develop appropriate technologies for improving the quality and quantity of our water supplies for both domestic use and industrial applications
- Develop new approaches to manage and enhance hygiene and sanitation practices
- Provide appropriate, innovative and integrated solutions to water and waste management in the industrial and mining sectors
- Develop innovative technologies and applications for improved treatment of wastewater and effluent and improve processes for enabling increased reuse thereof
- Improve health, economic and environmental conditions, while supporting the development of appropriate technologies and socially focused management practices related to water and effluent management

The Water Use, Wastewater and Sanitation Futures (WUWSF) KSA will continue to focus on RDI related to water supply, quality and usage, as well as sanitation and wastewater management in the domestic, industrial

and mining sectors. It aims to proactively and effectively lead and support the advancement of technology, science, management, and policies relevant to water supply, waste and effluent management, for these sectors. This KSA also supports studies on institutional and management issues, with special emphasis on the viability and efficient functioning of water services institutions, as well as integrity of the infrastructure for both water supply and sanitation. The strategic emphasis of this KSA 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.

A further focus is on water supply and treatment technology serving the domestic (urban, rural, large and small systems) as well as the industrial/commercial and mining sectors of our economy. The provision and supply of water of adequate quality and quantity for economic and public health purposes remain continuous challenges. Water is a finite resource and, specifically in the context of South Africa, is becoming incrementally scarce. Managing water use and the waste released to the water environment is thus of paramount importance to ensure the sustainability of the resource and the activities relying on it. Water use and waste management in South Africa is consequently a key factor for social and economic growth, as well as for our environment. The entire way we think about and use water is thus an important factor in determining our future.

This KSA encompasses waste and effluent as well as reuse, recycle and recovery technologies that can support the municipal, mining and industrial sectors and improve management in these sectors with the aim of improving productivity and supporting economic growth while minimising the negative effects of economic development on human and environmental health. Thus, the strategy on sustainable wastewater management seeks to drive a paradigm shift (as part of disruption) from an end-of-pipe treatment approach to that of resource recovery underpinned

by innovation. In this regard, the strategy is driving a research and development agenda that targets four basic interconnected phases within the wastewater management cycle with simultaneous promotion of converting current wastewater treatment plants into future water resource recovery facilities in support of the circular economy.

With respect to 'new sanitation', there were projects that had been proven in other fields of the WRC RDI portfolio to have applicability and potential for product extension for non-sewered sanitation. The strategy enabled the WRC to capitalise on existing laboratory and pilot-scale systems used in other fields and extend these to non-sewered sanitation. The benefits of this strategy are numerous: (i) reduce the length of the innovation cycle for new products; (ii) make use of existing capability and systems for testing these novel technologies; (iii) create funding efficiencies in the WRC system while still developing an innovative product. Further, the shortening of the innovation lifecycle means that products can move faster towards implementation.

This KSA encompasses waste as a resource, promoting effluent reuse, recycle and resource recovery from municipal, mining and industrial sectors for improved productivity and economic growth, as well as human and environmental health.

The new re-focused KSA will be giving greater attention to growing the portfolios listed as a means of directly responding to generating greater capacity, competencies and solutions which will directly contribute to solving emerging and priority national issues. These areas include the following:

- Water quality challenges
- Resource recovery
- Water use efficiency
- Catalysing a new sanitation paradigm shift
- Linkages to a circular economy
- Building towards a water mix

In these areas further bias and attention has been afforded to the projects portfolio that will:

- Develop new and easy techniques/tools to enhance water quality monitoring
- Promote a new paradigm on wastewater as a resource
- Promote wastewater and stormwater reuse
- Promote new innovations and proof-of-concepts
- Sanitation beneficiation and valorisation
- New sanitation innovations
- Building water security at a local level
- Influencing behaviour change in water consumption and sanitation usage

With regards to water quality and human health, greater attention will be paid to the aim of protecting public health and preventing population-wide disease. Research will support regulatory and legislative initiatives, through the development of guidelines, manuals and tools with a purpose of improving the way in which water supplies are managed. Innovations in treatment technology assist water service institutions to provide a safe product, while also contributing to water security through the use of diversified sources. Research will respond to water security, quality and governance issues in support of the implementation of the National Development Plan, National Water Resource Strategy, National Chemicals Strategy and National Water RDI roadmap, and valorisation of reject brine concentrates from desalination processes.

To achieve the above the KSA has introduced four new thrusts:

- Water Sensitive and Resilient Settlements
- Water Quality Futures
- Sustainable Integrated Wastewater Resource Futures
- The Sanitation Transformation Initiative (Saniti)

A key emphasis for the KSA over the next 5 years, 2021/22-2025/26, will be in accordance with the core WRC strategy to shift the attention of WRC activities and research into the domains of application/demonstration

and uptake. We believe that the KSA is ideally placed to be a key feeder of innovative technologies, processes and best practices. In this regard the following key focus activities are planned:

- Initiating and ramping up the concept of 'innovation challenges'; two of these are the WaterSmart Fund and SMARTSAN fund
- Further integrate and enhance objectives of the WRC Lighthouses
- Promoting innovation and technology demonstration at scale; key activities which are in place under this domain include sanitation technologies, acid mine drainage, and drinking water solutions
- Supporting technology advice and guidance
- Linking innovation solutions to industrial and commercial pathways
- Increasing our attention to provide greater support towards O&M activities, including extending our processes to support training and capacity building
- Increase uptake of reuse and recycling
- Explore and harness opportunities for new water - recycled water, rainwater harvesting, stormwater, atmospheric water, etc.

Through these processes and interventions, we envisage developing a more vibrant and responsive area which will be able to address both short-term solution requirements and long-term research needs. We hope to achieve this strategy through our programmes and thrusts.

The 2021/22 financial year will afford greater attention to content and topics which advance the area of water security within the broad ambits of the KSA strategy. Several devastating droughts around the country and the impact of COVID-19 have revealed several fault-lines on the issue of water security for drinking water and sanitation. In making these a priority, the portfolio will give attention to the following:

- Wastewater
 - o Better understanding of the water footprint of industries

- o Promote water use efficiency with reduced effluent production
- o Establish capabilities for preventing and reducing pollutants entering the environment
- o Tapping into reclaimed water opportunities as an alternative water source
- o Development of innovative technologies, processes and solutions for resource recovery from wastewater effluents
- o Technologies and processes to be developed, tested and applied in support of the circular economy
- o Strengthening natureinspired research, development and innovation traction targeting products and innovations
- Sanitation
 - o Re-engineered toilets
 - o Sanitation-sensitive design
 - o Municipal sludge valorisation
 - o SaniBus - sanitation-linked business
 - o Water security
 - o Higher levels of services - water and sanitation
 - o Densities and impact on services
 - o Greater efficiency on use
 - o Reduce pressure on resources - RRR and water loss management
 - o Review of institutions
 - o Hygiene focus
 - o COVID-19 related responses and recovery
 - o Risk governance - improving performance, resilience and capacity of water supply systems
 - o System design, process control & operational efficiencies (energy, chemicals, water, etc.)
 - o Wastewater Surveillance for COVID-19 RNA and improvements

7.3 WATER UTILISATION IN AGRICULTURE

Introduction

The Water Utilisation in Agriculture Key Strategic Area (KSA) has four thrusts and eight interlinked programmes. The primary goal of this KSA is to provide knowledge and innovation in the agricultural sector that ensures practical solutions to assist the sector to produce more

food with less water, while ensuring the affordability and nutritional value of food, as well as efficient and effective water use, to enhance quality of life and contribute to economic growth and improved public health. From a broader perspective, it aims to inform the longer-term sustainability, transformation, and inclusivity of South Africa's agriculture.

The strategic objectives directing the research and development activities in the KSA are aligned to the first four Sustainable Development Goals (SDGs), with linkages to several other SDGs related to jobs and economic growth (SDG 8), reduced inequality (SDG 10), climate action (SDG 13) and partnerships (SDG 17). The first four interconnected SDGs guide the prioritisation of research to address sustainable production and reduce poverty, unemployment, and inequality, with linkages (directly and indirectly) to the other SDGs. This is particularly relevant for South Africa as the agriculture and water sectors remain as major catalysts for socio-economic transformation. Priority attention is therefore given to investment in research and development for knowledge creation and dissemination, as well as training for knowledge application and skills development of smallholder farmers. The focus for research, technology exchange and implementation in this KSA is purposefully directed towards overcoming poverty, hunger and malnutrition and building resilience in the advent of climate variability and change.

Within the next 5-year planning period of CP21, the strategic direction in this KSA will focus on knowledge dissemination and translation, targeting a range of end users and stakeholders in agriculture and the broader food system. The actual impact will be increased through public and private partnerships, and establishing Africa-wide as well as international linkages. The strategic focus for research and development is on increasing the system of knowledge for efficient use of water for production of food, forage, fibre, and fuel crops, improving food and nutrition security, reducing poverty and increasing the wealth of people dependent on water-based agriculture, and ensuring sustainable water resource use. These are addressed through creation and application of water-efficient production technologies,

practices, models, and information systems within the following six interrelated sub-sectors of agriculture:

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

In the process of undertaking these research and development projects, the composition of research teams' endeavours to increase the representation of black and female researchers. Postgraduate 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.

Scope

The Water Utilisation in Agriculture Key Strategic Area (KSA) endeavours to fill knowledge gaps that exist in the broad context of the WRC mandate related to agricultural water management, under the following key activities for the next 5 years:

- 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
- Promoting the cultivation and consumption of underutilised indigenous crops and trees
- Improving food security, nutrition, and health
- Creating water research demonstration sites to showcase research products
- Developing an integrated climate-driven multi-hazard early warning system (MHEWS)
- Enhancing modelling and remote-sensing capabilities for decision-support tools

- Uplifting urban agriculture and agro-processing to address food and nutrition insecurity and unemployment in urban areas through innovative systems that save on land, water, and energy (WEF smart systems)
- Promoting renewable energy in irrigation
- Preventing environmental degradation and protecting terrestrial and aquatic ecosystems that support agriculture
- Promoting transformative agriculture under climate change
- Promoting and supporting small-scale aquaculture and fisheries

The above-mentioned key activities are aligned with the Thrusts and Programmes in the Water Utilisation in Agriculture KSA. The Thrusts and Programmes shown in Table 4 are currently being championed. These were developed based on research needs, government priorities and global challenges facing the agriculture sector, for example, climate change and SDGs.

Table 4: Water Utilisation in Agriculture Thrusts and Programmes

THRUST	PROGRAMME
Thrust 1: Water utilisation for food, forage, and fibre production	Water-efficient production methods in relation to soil, crops, and technology in rain-fed and irrigated agriculture Fitness-for-use of water for crop production, livestock watering and aquaculture
Thrust 2: Water utilisation for fuelwood and timber production	Water-efficient production methods and systems in agroforestry, woodlands, and forestry plantation
Thrust 3: Water utilisation for poverty reduction and wealth creation in agriculture	Sustainable water-based agriculture activities in rural areas Integrated water management for profitable farming systems Promote the cultivation and consumption of underutilised indigenous trees and crops
Thrust 4: Water resource protection, restoration, and reclamation in agriculture	Sustainable water resource use in irrigation schemes and within river catchments

Strategic objectives

In the execution of the WRC's mandate and functions, the strategic objectives for research and development in Water Utilisation in Agriculture are indicated in Table 5.

Table 5: Water Utilisation in Agriculture strategic objectives

STRATEGIC OBJECTIVE	DESCRIPTION
To increase the biological, technical, and economic efficiency and productivity of water use	The primary objective is to increase national and household food and nutrition security, improve livelihoods, and increase efficient growth as well as equitable distribution of wealth at a farm, community, and national level. A particular focus is given to rural resource-poor households as well as peri-urban settlements where evidence shows a high incidence of household food and nutrition insecurity. The major challenge is to produce more food with the same or less water and with minimum or positive impact on the environment. 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. 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. Over the long term, a systematic approach in support of the transition to a sustainable, healthy, and equitable food system is required. This calls for integration of agricultural-based interventions with other sectors such as health and the environment, among others.
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	

Alignment to national goals

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. 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 (NDP); the outputs for Outcomes 7 and 10 in the Programme of Action; core water strategies of the NWRS-2; measures in the framework for the New Growth Path; the National Agricultural Research and Development Strategy; and the Irrigation Strategy for South Africa.

Short- to medium-term goals

Demonstration sites for agriculture innovations

Agricultural demonstration sites connect research and new products with farmers. The connection between farmers and innovation empowers the farmers with



skills that can revolutionise the agricultural sector and transform the sector towards sustainability. Demonstration sites allow the uptake of new knowledge and technologies towards modern farming in the smallholder sub-sector and enhance productivity and resilience through increased adoption rates for new technologies. Through practical and interactive on-farm demonstrations, the WRC, together with its partners will facilitate the uptake and adoption of new knowledge and technologies by farmers into practice. This involves the WRC having demonstration sites to showcase new knowledge and innovations and translate these into climate-smart agricultural activities. The demonstrations plot, when well-designed and organised, will contribute

to the dissemination of information and stimulate farmers to observe, experience, experiment with, and adapt new and innovative ideas, practices, and technologies that can improve and increase their farm outputs and income, and ultimately improve their livelihoods. The innovations and products that will be demonstrated at the sites include, but are not limited to:

- Rainwater harvesting technologies
- Demonstration of hydrological and water management tools, and models
- Development of smart plants that are more drought tolerant through genetic modification and genome editing
- Engineering of more efficient photosynthetic pathways that use solar energy
- Use of mobile apps and other social media platforms to provide information, especially agrometeorological information for on-field farming decisions
- Use of drones and remote sensing to allow better farm management and productivity, as well as information on markets

Mainstreaming of underutilised indigenous crops



This entails cultivation and enhancing the mainstreaming of underutilized indigenous and traditional crops into food systems for sustainable and healthy diets. The cultivation of adapted crops like maize and rice in Southern Africa is under threat from extreme climatic events, high climate variability and change, decreasing rainfall and degraded lands. Unlike underutilised indigenous crops that are uniquely suited to local environments and are more resilient to climatic

variations and tolerant to local pests and diseases, adapted crops require costly inputs and agronomic practices, and huge volumes of water, for their production. Even with new seed varieties for adapted crops, food demand continues to outstrip local supply in Africa and the continent currently spends about 35 billion USD annually on food imports to supplement local deficit. The WRC and its partners will identify potential areas for growing indigenous crops to derive maximum economic benefits with lower production costs. This will facilitate better water and land management practices that enhance food and water security. The WRC will promote indigenous underutilised crops to become the 'future food' towards sustainable food systems. The indigenous crops, which have been prioritised based on previous WRC-funded research, which will be promoted are listed in Table 6.

Development of multi-hazard early warning system



Climate change is a reality whose impacts are being felt mostly through water resources. The increasing frequency and intensity of extreme weather events (drought, flooding, cyclones, heatwaves) is taking a huge toll on water, agriculture and livelihoods, and other climate-sensitive sectors of the bio-economy (including ecotourism), hydroelectricity, and fisheries. The severity of extreme weather events is exacerbated by poor levels of preparedness, and low adaptive and response capabilities, which also impact on recovery. Whilst weather extremes and hazards are inevitable, the preparedness to manage such hazards determines their impact, and whether they become disasters, and the direct and indirect economic and social costs. In the short- and long-term, the WRC and its partners will

Table 6: Examples of underutilised indigenous crops suitable for arid and semi-arid areas

	COMMON NAME	SCIENTIFIC NAME
Cereals	Sorghum	<i>Sorghum bicolor</i>
	Tef	<i>Eragrostis tef</i>
Legumes	Bambara groundnut	<i>Vigna subterranea (L.)</i>
	Lablab	<i>Lablab purpureus (L.) Sweet</i>
	Cowpea	<i>Vigna unguiculata (L.) Walp</i>
	Marama bean	<i>Tylosema esculentum</i>
Roots and tubers	Taro	<i>Colocasia esculenta</i>
	Sweet-potato	<i>Ipomoea batatas</i>
Leafy vegetables	Jew's mallow	<i>Corchorus olitorius</i>
	Spider plant	<i>Cleome gynandra</i>
	Amaranth	<i>Amaranthus spp.</i>
	Nightshade	<i>Solanum nigrum</i>
	Wild watermelon	<i>Citrullus lanatus L.</i>

develop weather early warning systems to enhance preparedness, intervention, and recovery. As extreme climate events are slowly becoming the 'new norm', there is a need to accelerate measures aimed at building resilience, especially for vulnerable groups that inherently have low adaptive capacity. While the intensity and frequency of extreme weather events is increasing, there is a need to step-up efforts to develop capacity in the application of modern early warning technologies, build resilience, and develop adaptation strategies, so that extreme weather events do not become extensive and expensive disasters.

Promote urban agriculture for food and employment security



Rapid urbanisation in developing countries is generally accompanied by urban poverty and urban food and nutrition insecurity, unemployment, high food prices and malnutrition. Available data indicates that South Africa is already undergoing this transition. The increasing pressure on land and natural resources emphasizes the need for innovative ways of increasing production with limited resources. Urban agriculture provides huge opportunities for the urban poor to cope with household food and nutrition insecurity through the growing of vegetables, raising of small livestock within and around cities, community gardening, rooftop gardening (hydroponics), foraging, green walls, vertical farms, animal husbandry, urban beekeeping, school-based vegetable gardens, etc. In the short to medium term, the WRC and its partners will provide knowledge and technologies that will enhance and improve urban livelihoods through viable urban agricultural initiatives and inform the spatial development plans for local municipalities. Supporting and strengthening urban agriculture is critical for food and nutrition security as well as for improving urban livelihoods. Research on strengthening urban agriculture includes updating spatial development plans to provide agricultural rights to communities for urban agriculture, providing

guidelines on hydroponic agriculture, and providing sustainable research to support the development and piloting of innovative techniques of farming in small pieces of land.

Medium- to long-term goals

The re-use of wastewater for irrigation



Wastewater reuse in agriculture involves the use of 'treated' wastewater for crop irrigation. The reuse of reclaimed wastewater for crop irrigation could contribute to mitigating/decreasing water shortages, support the agriculture sector and protect groundwater resources. Additionally, wastewater reuse contributes to conserving potable resources and reduces the environmental impact related to effluent discharge into water bodies. Considering the risks of wastewater reuse in agriculture (from changes to the physicochemical and microbiological properties of soils to impacts on human health), the WRC and its partners will explore the beneficial aspects of wastewater reuse in agriculture, as well as its negative impacts and different low-cost strategies that contribute to the decision-making process and favour the adequate use of wastewater in agriculture. This will include the quantitative evaluation of microbiological risk, developing a South African risk assessment framework for wastewater reuse in agriculture as well as developing guidelines for safe reuse of wastewater in agriculture.

Key milestones

The 10 proposed key milestones highlighted below will be achieved through collaborations and partnerships

with key strategic partners, and these include universities, science councils, regional bodies, national, provincial, and local governments. For the next 5 years the Water Utilisation in Agriculture KSA will continue working with key stakeholders to increase its footprint in agricultural water management, capacity building and technology transfer, knowledge dissemination and information sharing. The 10 milestones are proposed as follows:

- The Water-Energy-Food (WEF) nexus summer school intake in June/July 2021: 50 students are targeted across the SADC region. The WEF nexus summer school is a follow-up to a workshop held in March 2020 between the WRC and its stakeholders on 'Building Synergies in WEF Nexus Research'. The aim is to build capacity for operationalising the WEF nexus in Southern Africa. The WEF nexus summer school will be targeted at early career researchers and postgraduates who are conducting research in fields related to the WEF nexus. It will be technical in nature and offer hands-on approaches on research aspects, advanced data analysis and modelling related to the WEF nexus.
- Develop a university WEF nexus programme by 2022: The WRC has already started engaging tertiary institutions to incorporate a WEF nexus programme into the university curriculum both at undergraduate and postgraduate levels. Currently the WRC has several ongoing projects on the WEF nexus across the African continent, and several postgraduate students are directly involved in projects.
- Publish a WEF nexus book by June 2021: The aim of the WEF nexus book is to reflect work or research that provides a synthesis of existing knowledge on the WEF nexus from projects that have been primarily funded by the WRC, and to highlight how such research is in line with emerging global WEF nexus perspectives; however, a few case studies from other regions will be incorporated into this book to give an international flavour.
- Launch the WEF nexus brochure and digital media during the WRC Symposium in 2021: This KSA will compile a WEF nexus brochure and digital media

based on the completed and ongoing projects across all of the KSAs. More than 20 WEF nexus related projects are now being profiled as part of the WEF Nexus Lighthouse initiatives. The WEF nexus brochure and digital media will be launched at the WRC Symposium in September 2021.

- Conduct a seminar/workshop/conference with national stakeholders on the need for an early warning system (EWS), in July 2021: The purpose is to highlight the impact of persistent drought events and future proactive interventions through early warning systems. This will allow sharing of different perspectives and trends on existing and emerging issues around water security and the future of water that are of national importance. The objectives include:
 - o Sharing knowledge generated by the WRC on climate change, the current drought and sustainability of water with a broader audience of key decision-makers
 - o Facilitating an engagement platform for the discussion of future trends and how best these can be harnessed to shape the future thinking around drought and water security.
- WRC-SANCID-SARIA Symposium on water savings innovations in 2021: The Southern African Regional Irrigation Association (SARIA) will hold its Annual Workshop and Steering Committee Meeting (SCM) in 2021 in South Africa. The WRC-SANCID-SARIA Symposium will proceed after its postponement in 2020 due to the COVID-19 pandemic. The workshop will facilitate the exchange of ideas and practices between researchers, advisory agents, and government officials from the Southern African Development Community (SADC) countries.
- Demonstration sites for agriculture innovations developed by the WRC: These will be developed in different climatic zones in the country by 2023. These demonstration sites will showcase new knowledge and innovations and translate into climate-smart agricultural activities. The demonstration sites will drive dissemination and adoption of innovative technologies and practices to ensure the production of more food with the same or reduced amount of water.
- Conduct a needs analysis seminar/workshop with national stakeholders on the development of a multi-hazard early warning system in July 2022: The purpose is to highlight the impact of persistent drought events and future proactive interventions through early warning systems. This will allow sharing of different perspectives and trends on existing and emerging issues around water security and the future of water that are of national importance. The objectives include:
 - o To share knowledge generated by the WRC on climate change, the current drought and sustainability of water with a broader audience of key decision-makers
 - o To facilitate an engagement platform for the discussion of future trends and how best these can be harnessed to shape the future thinking around drought and water security
 - o To enhance preparedness, adaptive and response capabilities: This will allow for timely and effective intervention and recovery
- Establish a wastewater reuse in agriculture programme by December 2022: To address the increasing shortage of potable water as well as reduce environmental effects caused by the discharge of poorly treated wastewater into rivers. Furthermore, this will stimulate the innovation of new technologies.
- Launch an urban agriculture demonstration project, initially focusing on hydroponics systems in the Tshwane and Johannesburg Metropolitan Municipalities by December 2021: The aim will be to roll this out to other metros in the country. The rapid population increase in the cities has led to increased competition for industrial and residential land and a significant shortage in the amount and quality of irrigation water as well as arable land for agricultural purposes. Thus, the increasing pressure on land and natural resources emphasizes the need for innovative ways of increasing production with limited resources.

08 | The WRC Lighthouses



The WRC Lighthouses are a strategic development tool that uses flagship programmes which are trans-disciplinary, multi-KSA and inter-institutional mega-projects that will examine priority water issues across the innovation value chain.

The WRC has 7 Lighthouses (figure 15). These are as follows:



Sustainable Human Settlements: The purpose of this Lighthouse is to develop a critical mass of knowledge around the integration of planning activities for the adoption of more integrated and sustainable solutions using the WSD (settlements) lens for urban, peri-urban and rural environments.



Green Economy: The 'green economy' is a transformation philosophy, which indicates a move from this reliance on destructive development to more environmentally friendly growth. For South Africa, green economy principles map out a sustainable development path based on addressing the interdependence between economic growth, social protection and natural ecosystems.



Water-Energy-Food Nexus: In response to the global trend in adopting the water-energy-food (WEF) nexus approach, in 2012, the WRC initiated its WEF Nexus Lighthouse with a goal to start championing integrated water, energy and food planning and development for South Africa, in particular, and Southern Africa in general. Since then, the WRC, through its Research and Development (R&D) branch, has organised various activities under the banner of this Lighthouse. The WEF nexus has evolved into an important framework attracting global attention. The concept presents an opportunity to promote integrated planning in a sustainable manner.



Climate Change/Variability: The WRC Climate Change/Variability Lighthouse is undertaken through collaborative research on priority water-related climate issues with partnerships forged along the innovation value chain. 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 Lighthouse now incorporates the programme that was associated with water scarcity. 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. The main aim is to enhance the country's water security and resilience to current and future water scarcity.



Sustainable Water Behaviours: Human behaviour, culture, perceptions, paradigms and choices sit at the heart of how the supply of water is managed and demands for water are negotiated. Thus, in the context of the growing challenges of water scarcity, demand outstripping supply, high user expectations and required assurances, and climate variability, interventions are required beyond technical interventions. A focus on behaviour is thus crucial when managing supply and demand issues in the water sector. Behaviour is also important when considering water and its broader links to the green economy and wider sustainable development approaches.



Water & 4IR (Big Data and Artificial Intelligence): The main aim of the Lighthouse is to serve as a platform for growing the knowledge and research base on the application of data and its associated tools in the water sector, and to share current thinking and strategies of future technological development to advance development in the water sector.



Water Quality and Health: The Water Quality and Health (WQH) Lighthouse is a cross-cutter within the WRC research business divisions as it is applicable to the entire water value chain and covers aspects of water resources, sanitation, drinking water, health and hygiene. In this era of growing uncertainty, addressing water quality challenges requires new imperatives that support a shift to more sustainable, integrated, and equitable approaches.

Figure 15: The WRC Lighthouses



The WRC's Lighthouses have since their inception elevated the research portfolio by emphasising the inter-relationships, interdependency and integration of research in the key strategic areas.



8.1 CLIMATE CHANGE/ VARIABILITY

Scope

The Climate Change/Variability Lighthouse serves as a primary vehicle to drive research and knowledge generation on climate change adaptation, response, and characterization of change and risks/vulnerabilities, in order to improve sectoral adaptive capacity and response together with human capital development while planning for sustainability under the future climate.

Climate change is a complex cross-cutting issue associated with consequences that threaten modern-day development and sustenance of society. Actions and interventions responding to the changing climate require the research sector to characterize the likely impacts of climate change and to develop strategies and positions needed by sectors to respond to identified risks and opportunities. The Lighthouse contributes largely to determining how important climatic variables will change, quantifying their natural variability on multi-decadal or longer timescales, and improving confidence in climate projections to allow for better risk management, reducing the cost of managing the impacts of climate change, and enabling exploitation of potential opportunities.

Climate change impacts on water resources occur through a modification of the water balance. A projected decrease in rainfall will negatively affect hydrological responses and groundwater recharge. 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. Figure 16 shows an example of a persistent drought which affected the whole Southern African region at a given time. This type of drought has become a regular occurrence, often referred to as the 'new normal'.

The basis for climate change response in this case lies with adaptive capacity, resilience, improvement of early

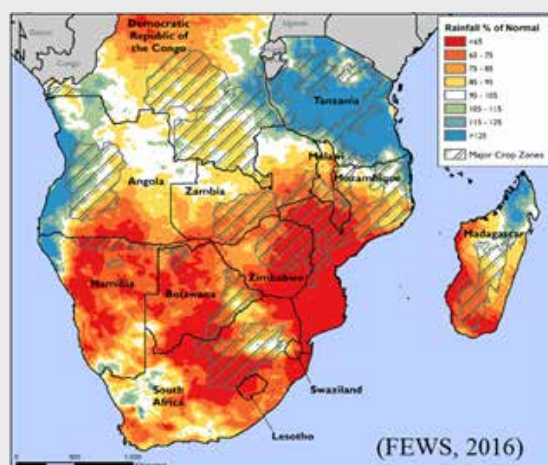


Figure 16: October 2015 - February 2016 rainfall anomaly (% of the 1982-2011 average) for Southern Africa.

warning systems, reducing vulnerability and enhancing the ability to respond, coupled with proactive planning. Aspects of the Climate Change Variability Lighthouse requiring attention include mainstreaming and site-specific responses, adaptive management, and local-scale planning to incorporate climate-resilient approaches. These issues include reorientation and restructuring which incorporates economic reforms and bridging the science-policy interface or gap.

Strategic objectives

In light of the changing climate, the ultimate purpose of the Climate Change/Variability Lighthouse is premised entirely upon improving the adaptive capacity of society and the sector to increase resilience and development of a knowledge base for climate change adaptation and decision support, while providing strategic guidance and a framework for a sectoral response.

This is embedded in the following objectives:

- Conducting research and knowledge generation on climate change adaptation and response
- Characterization of change and risks/vulnerabilities and determining the type of response
- Contribute to human capital development

- Improve sectoral adaptive capacity and guide future response

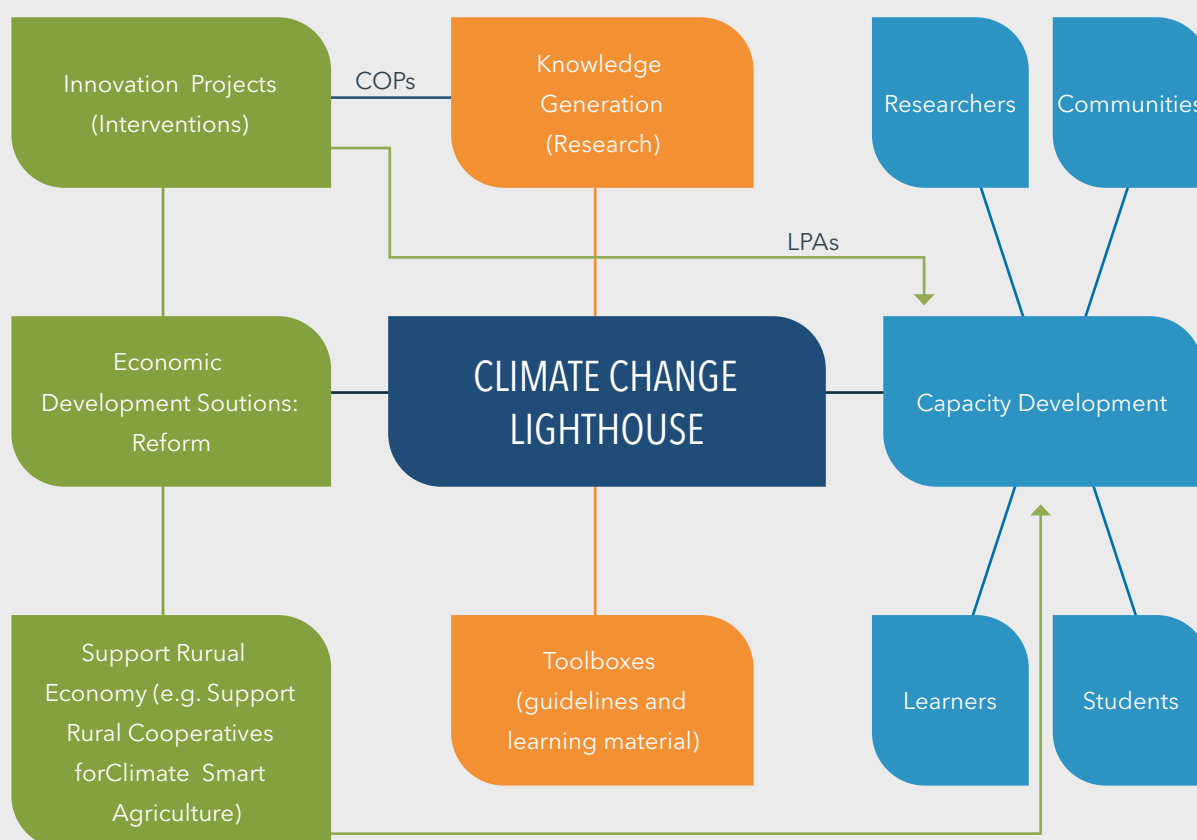
These entail addressing practical adaptation options with a focus at catchment, municipal and national scale while translating the findings of research to aid operational responses/local-scale adaptation through mainstreaming adaptive actions to enhance resilience and response to the overall impacts of climate change.

Approach

Implementation of this Lighthouse is cross-cutting in nature and requires a coordinated effort to address the consequences of a changing climate. The Lighthouse adopts a cross-sectoral approach (Figure 17) for implementation which supports basic and applied research base for knowledge generation, innovation,

capacity building and research for developmental impact. This is undertaken through collaborative research on priority water-related climate issues with partnerships forged along the innovation value-chain to enhance water research, development and positioning with respect to climate change. The aim is to incorporate capacity development covering both research teams (and mentoring of upcoming scientists) and the recipients of the knowledge generated, interventions and innovations. The knowledge generated is intended to scale-up into adaptation and intervention projects/ actions and, to some extent, contribute to mitigation through sector and site-specific responses. Each KSA has a focal point to guide climate change projects. The overall outcome needs to be that of a climate-resilient society with improved adaptive capacity contributing to climate-smart development that does not compromise economic and social development.

Figure 17: Climate Change/Variability Lighthouse implementation model



What is envisaged in redefining climate change research is to integrate it into a larger sphere of national research, thereby embracing a multi-sectoral and multi-level approach towards securing the water sector's contribution to enabling South Africa deal effectively with a multiplicity of existing stresses that climate change impacts will undoubtedly be adding to over coming decades. Considering water as a constraint and opportunity to sustainable growth and development under a changing climate, the purpose was to mainstream research outcomes into water-related policy and practice as well as developmental and adaptation needs, as well as integrating cross-sectoral capacity development.

Progress

The Lighthouse has made a significant impact in addressing a variety of issues on water and climate. These include, amongst others, sectoral impacts of climate change, planning for future scenarios, characterization of future disasters (drought, heat, floods), impacts on mega-dams and estuaries, adaptation, greenhouse gas dynamics and environmental footprints, and also societal impacts (displacements, vulnerability, gender, etc.). The sub-discipline areas covered in terms of research have included predictive modelling/projections for the future, atmosphere-water interactions and the role of the ocean on inland climate, impacts of climate change on aquatic ecology/agriculture, water supply and local government, amongst others. The activities entailed a diversified research portfolio, outreach activities (dialogues, workshops, stakeholder consultations) and establishment of a community of practice.

Research projects

Research conducted focused on the future impacts on floods and droughts together with increased warming, and impacts on freshwater ecology and fish. The focus was also on generation of satellite-derived products for early warning (e.g. nowcasting products) and monitoring global change in wetlands, ocean impacts on water resources, and adaptation strategies, together with societal vulnerabilities and water-linked sectors. Of

more importance, the studies reflected on the impacts on mega-dam areas and implications for water security, while also considering the impacts on future land use and alternative options. More recently, there has been a focus on how climate change contributes to environmental refugees and what alternative measures are in place considering infrastructural responses and possible economic opportunities. Investigation of possible rainfall sources during droughts, such as continental lows and the influence of the Agulhas Current and Benguela Niño on overland moisture have been considered. Options for mitigating future droughts in terms of altering land uses to influence the microclimate are also being investigated. The impacts on ecological reserves are also given priority to inform planning on water allocations. A greater focus is now on dealing with the consequences of climate change at a local scale and providing the necessary responses and interventions while assessing the future impacts on hydrological yield at a national scale (determining future infrastructural responses).

Outreach

All relevant stakeholders are actively involved in terms of participating in the activities of the Lighthouse. This includes, amongst others, contributing to the research agenda and participating in workshops and seminars, while using the research outputs to inform policy. Several workshops were conducted targeting youth and other stakeholders, covering issues of climate change and Earth observation applications. More often research outcomes are presented to stakeholders who are directly impacted by the output to effect decision support and uptake. Operational stakeholder relations were established (DWS, DEFF, DALRRD on advisory and role-playing capacities). Partnerships are being forged for mainstreaming and upscaling climate change response at catchment/local government scale (with CMAs).

Community of practice

Prior to operationalization of the Lighthouse, several experts and practitioners were operating in silos

and to some extent competing against each other. A synergistic workforce has now been established which appropriately informs and advises the water sector. This was further strengthened by the establishment of an Advisory Panel on Weather and Climate. This is a multi-institutional panel which provides regular assessment of climate and weather in relation to water security and water-linked development, and advisories to enable resilience and adaptation to the changing climate. The forum (i) provides a seasonal outlook and reflects on the seasons within the context of water security, (ii) assesses the adaptive options and possible remedies, and (iii) issues recommendations for decision support.

Moving forward

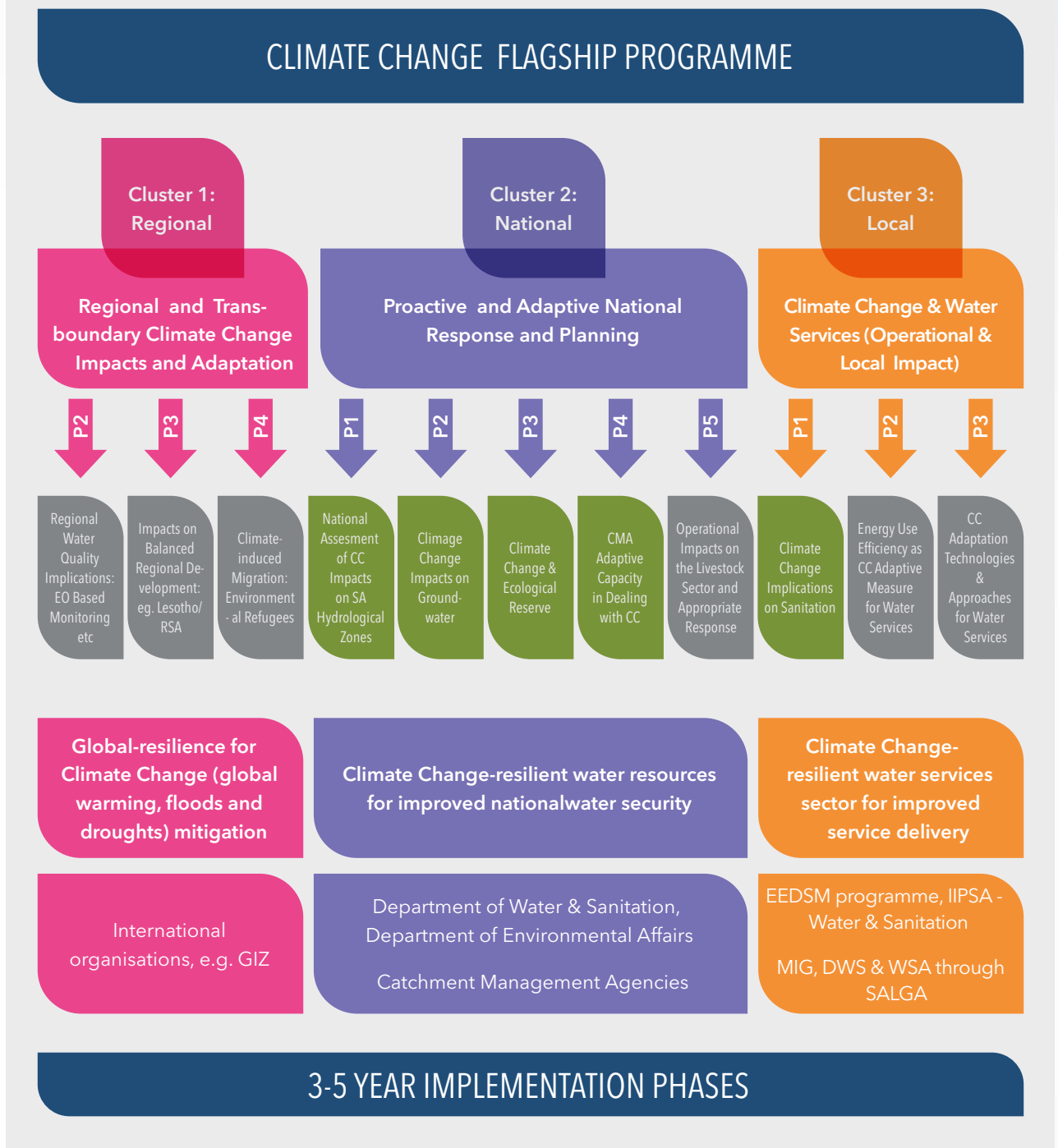
The overall vulnerability of South Africa to climate change impacts has been established, and this emphasizes the necessity to carry out adaptation measures and developmental responses for the country. This cuts across the WRC key strategic areas in addressing the challenges of the water sector. It is therefore now important that climate change needs be considered as a permanent feature in daily strategic routines. This has been clearly advocated in the 2018 Climate Change Bill which further officially endorses the National Adaptation Strategy. This Lighthouse is a strategic instrument for the implementation of the National Adaptation Strategy and it is recognized as such in several DEFF strategy documents. It is upon this premise that a recommendation is hereby presented that the Climate Change Variability Lighthouse be upscaled to a permanent programme with a defined purpose. Apart from working with local institutions such as the IUCMA, BGCMA, NRF and SAEON, amongst others, relationships of common interest have been established with the Kenya Water Institute (KEWI) to implement a similar mandate in Kenya, with a cross benefit in exchange of science and knowledge between the WRC and KEWI. A concrete way forward has already been crafted in this regard. A similar partnership is envisaged with other African countries.

Operational model and approach

The WRC Climate Change Programme will continue to encompass collaborative research and development on priority water-related climate issues across the spectrum, leading to impacts that will be felt at national, regional and global scales.

Considering water as a constraint and opportunity to sustainable growth and development under a changing climate, the research outcomes are robustly mainstreamed into water-related policy and practice as well as developmental and adaptation needs, integrating cross-sectoral capacity development in a clustered fashion (Figure 18). It also intends to establish long-term research relevant for the future sectoral response.

Figure 18: Clustered implementation of the Climate Change Programme





8.2 THE GREEN ECONOMY LIGHTHOUSE (GE)

South Africa has signed an international accord binding the country to production and growth that is founded on a low-carbon footprint. This is particularly critical for this country, as in the past there has been a reliance on developments that are driven by and hugely reliant on the exploitation of natural resources, very often not in a sustainable way. The 'green economy' is a transformation philosophy, which indicates a move from this reliance on destructive development to more environmentally friendly growth. For South Africa, Green economy principles map out a sustainable development path based on addressing the interdependence between economic growth, social protection and natural ecosystems. The South African approach is to ensure that green economy programmes are supported by practical and implementable action plans; hence the importance of building on existing best practice, programmes, initiatives and indigenous knowledge in key sectors 'Towards a resource efficient, low carbon and pro-employment growth path' and that government alone cannot manage and fund a just transition to a green economy – the private sector and civil society must play a fundamental role. The green economy refers to two inter-linked developmental outcomes for the South African economy:

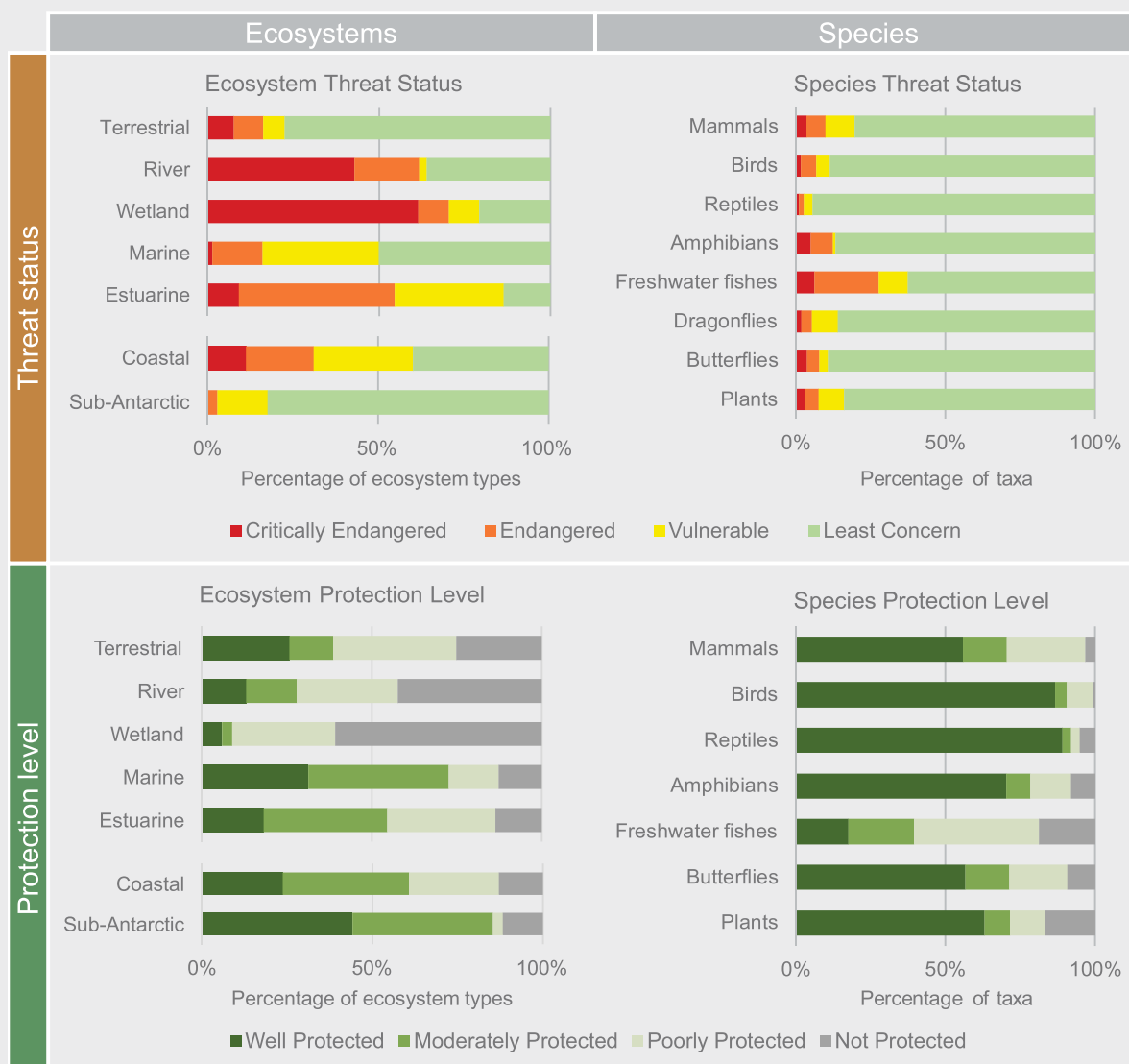
- Growing economic activity (which leads to investment, jobs and competitiveness) in the green industry sector
- A shift in the economy as a whole towards cleaner industries and sectors

This biased focus on business is deliberate, in order to develop green innovations that will enable the industries and various private sectors to buy-in and invest in nature-based solutions. Currently, this is almost non-existent and yet these businesses are not immune to the impacts of ecosystem degradation and non-resilience. The risk to business is escalating due to the destruction

and poor management of natural resources. The World Economic Forum has consistently listed natural ecosystem degradation in the top ten risks that humanity must urgently deal with. Similarly, the SDG:2030 has, in several targets, listed restoration of natural resources as very urgent, with some target deadlines as close as 2020. The UN has declared the next 10 years as the decade of ecosystem restoration, further highlighting the urgency to act and move away from destructive economic development paths. The same calls are made nationally through the NDP, and most recently by the National Biodiversity Assessment (NBA), which provided a clear message on ecosystem degradation in the light of meeting the job crisis (Figure 19).

The WRC utilised the previous Green Village and Economy Lighthouse to initiate the concentration of green innovations. However, the economy aspect of this approach has trailed behind its green aspects for various reasons. In partnership with several organisations, the economic aspect will from now on receive more attention. Aspects of the 'blue economy' will also be accommodated under this newly conceptualised Lighthouse. The blue economy is concerned with the coastline and marine environment (the concern of Operation Phakisa in South Africa). One of the key partners already identified is the GEF6 programme, of which one of the core projects is 'Unlocking biodiversity benefits through development finance in critical catchments'. This is a 5-year project being executed by SANBI in collaboration with the DBSA as implementing agent and the WRC as the leading research and innovation partner. Other initiatives on water security and poverty alleviation include the use of biomass generated through clearing of alien invasive plants. The idea is to produce charcoal (and other products) based on zero emissions. Another example is citizen science monitoring, which is critical in stewardships, through its ability to hold responsible line functions to account. Other areas targeted will be the agro-economy and circular economy. These projects' key focuses will be on planning, finance and development in the water value chain, simultaneously unlocking biodiversity services and water benefits in South Africa, through piloting in selected demonstration catchments. These are

Figure 19: Illustration of threats to natural resources of all types and declining levels of protection mainly driven by non-adoption of green economy principles in development (Source: National Biodiversity Assessment 2018)



catchments where interventions can and should not fail to prove the value of ecological infrastructure, so that these low-hanging fruits can be used to attract further investment. Some of the objectives to be addressed include the following:

1. Working with national and sub-national level stakeholders to strengthen the enabling environment through: developing natural capital accounts; influencing applicable policy frameworks, regulatory instruments and institutions; and

supporting the operationalization of mechanisms for financing ongoing rehabilitation and maintenance of biodiversity and ecosystem services

2. Working with catchment-level stakeholders to test the application of policies and financial mechanisms to improve water security in the Berg-Breede and the Greater uMngeni demonstration catchments
3. Working with a range of national, regional and local stakeholders from the biodiversity and water sectors to improve the integration of biodiversity and ecosystem services into the water value

chain through strengthening social learning, co-generation of credible evidence, and knowledge management

There is potential to work with the project partners to scale up existing projects and research in the green skills, agriculture, governance, pollution and waste areas of work, under the umbrella of the Green Economy (GE). The 'green economy' is the economy that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities. It is low-carbon, resource efficient and socially inclusive. The recently hatched concept of the 'blue economy' is a subsidiary of the green economy, with a global focus on coastal and marine resources. Due to the overlapping principles of sustainability, the WRC decided to pool these concepts under one umbrella, the Green Economy Lighthouse (GE). Its purpose is to concentrate research where possible in selected catchments, catalyse action through appropriate green innovations, position the organization through leading dialogues and presentations (including international conferences), and to market and communicate innovative products in order to see implementation, most likely through partnerships.

South Africa, similarly to other countries, is committed to eradicating poverty, ensuring water supply and sanitation, securing food and energy, and protecting ecological infrastructure, biodiversity and ecosystem resilience through restoration or rehabilitation. Some of these commitments are expressed in the SDGs, the NDP, and various other strategies. The pressure from impacts of climate change and degradation of ecosystems must be considered alongside the need to reduce the numbers of people without jobs (latest estimated unemployment rate is 26% (Stats SA, 2013)). Even though the predictions are that 71.3% of people will be urbanized by 2030 (UN World Urbanization Prospectus, 2014), the challenges of escaping poverty, unemployment and inequality are not likely to disappear as long as the economic growth rate remains less than 5% per annum. About 12 million people (or more) live below poverty line, while more than 80% of aquatic ecosystems (ecological infrastructure) are degraded,

rendering them unable to provide the services they are expected to offer. In an effort to move from poverty to prosperity, through knowledge acquisition and enterprise development, the WRC has prioritized the triple challenges of poverty, unemployment and inequality. Transitioning to a green economy is one of the key imperatives of Government (though this is clouded with numerous challenges, including disintegrated policies, and low uptake by society and business), as highlighted in the NDP. It is further recognised that there can be no transition to a green economy without green technologies and technological innovation. The key focus of the GE will, through a serious paradigm shift, narrow the gap between innovation and application, build partnerships towards co-funding and implementation, influencing innovation through positioning via dialogues, conferences, and community interventions while centralizing citizen scientists (members of the public), especially the 'game-changers' (youth), who are key in 'disruptive' innovation and enterprise development. Gender plays a core role, particularly in rural and disadvantaged communities, hence a prominent effort will be directed towards woman emancipation/empowerment, along with that of the elderly and people living with disabilities. The proven fact is that women are the most committed members of these communities who work the land, even in cases where male dominance means they are still not involved in decision-making.

The objectives of the GE are aligned to the WRC Knowledge Tree, with projects addressing more than one aspect, depending on the case study. The following are the leading objectives:

- Restore degraded landscape ecosystems critical in nature-based solutions for water security and biodiversity services
- Promote adaptation, resilience and mitigation of environmental risks through investment in ecological infrastructure
- Develop adaptable and integrated green innovations that influence policy and change
- Lead and align the RDI with key national and international poverty, unemployment and inequity

eradication aspirations, such as NDP, SDG, Africa Agenda 2063

- Facilitate enterprise development to empower communities, especially women and youth, through green innovation and formalization of restoration as business
- Unlock the economic wealth beyond the environmental processes by engaging the market value chain, for example, as in medicinal plants, charcoal production based on zero emissions
- Encourage partnerships, particularly those that lead to co-funding and implementation, especially by private sector and donor funding
- Position RDI products in leadership, nationally and internationally, through dialogues, conferences, and community interventions
- Develop adaptable and integrated green innovation framework critical in entrepreneurship/business, community empowerment and influencing policy

Maintaining ecological infrastructure (healthy ecosystems) that benefits society and business through their sustained services is the responsibility of every citizen. However, the levels of ecosystem degradation (more than 80% of all water resources are threatened) are alarming, hence this Lighthouse was planned to play a role in reversal of degradation and to proactively protect those in natural condition through development of green innovations to support legislation, and business development founded on low carbon footprints.

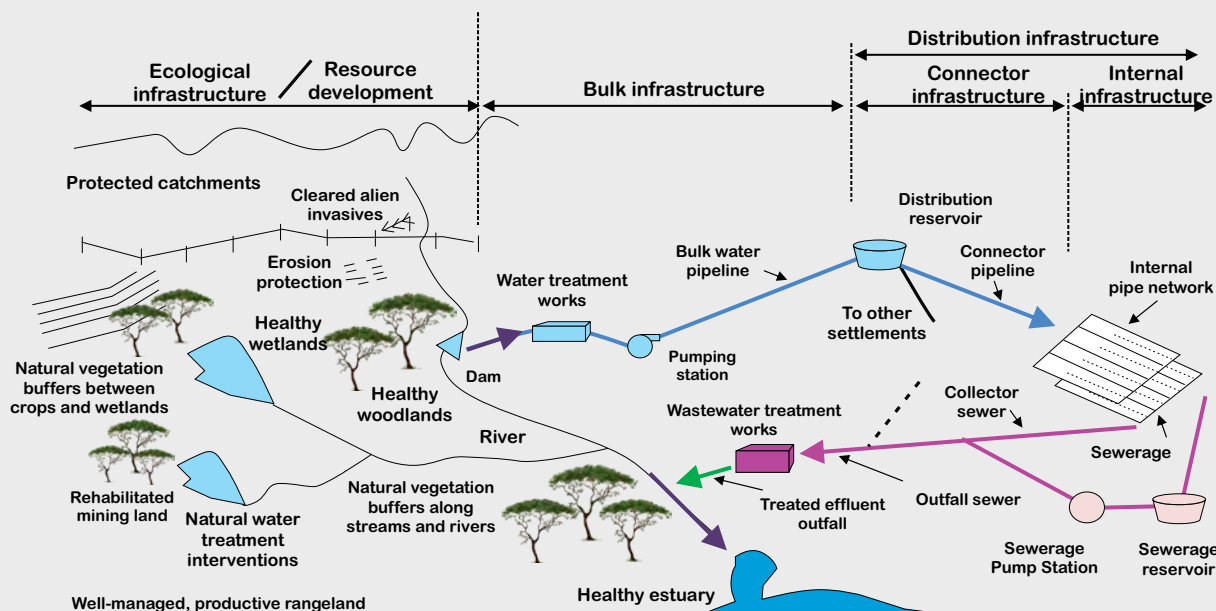
One of the key inputs to the GE is to scientifically support the development of evidence-based research aimed at proving the 'ecological infrastructure' concept and its role in water security, particularly during times of extended low rainfall or drought. Figure 23 illustrates a comparison between ecological infrastructure and water supply and sanitation infrastructure. The GE research projects are focused on catchment restoration, ecosystem resilience, enterprise development and governance.

The GE continues to be focused on the most recent strategic initiatives, such as ecological infrastructure, environmental accounting, and nature-based solutions for water security. This is critical in a country undergoing dramatic change, from urbanization to adaptation to climate change and resilience. All this is threatened by further degradation of the very ecosystem services on which society and business depend. The role of business investment in mitigating environmental risks is becoming more apparent than relying on mandated line function departments to protect our dwindling water resources; all stakeholders have a responsibility to care for nature. A number of projects are therefore initiated within the Economics of Ecosystem Research Portfolio (ecosystem and water accounting, water pricing, review of RDM methods based on CBA, green jobs, etc). Even more critical is the plan to engage the uMngeni and Berg-Breede water security challenges in partnership with GEF:6 (SANBI/DEFF/DBSA). Central to this initiative, is the investment in ecological infrastructure, so important in restoring degraded landscapes and mitigating broader environmental risks. The DWS master plan clearly articulates that ecological infrastructure or restoration of ecosystem services is a priority.

It is very important to appreciate that unlocking wealth (creating green jobs) from natural capital is a slow process and demands increased investments across the value chain (especially funding of the risky 'valley of death' stage in the innovation continuum). Some green innovations are under way, such as the 'Living Catchments', and protection of natural ecosystems through benefits yielded from nature, such as wetland plants with medicinal use.

Figure 20: Comparison between ecological infrastructure (SIP:19) and Water Supply and Sanitation (SIP:18) (adapted from DEA)

Connecting Ecological and Grey Infrastructure



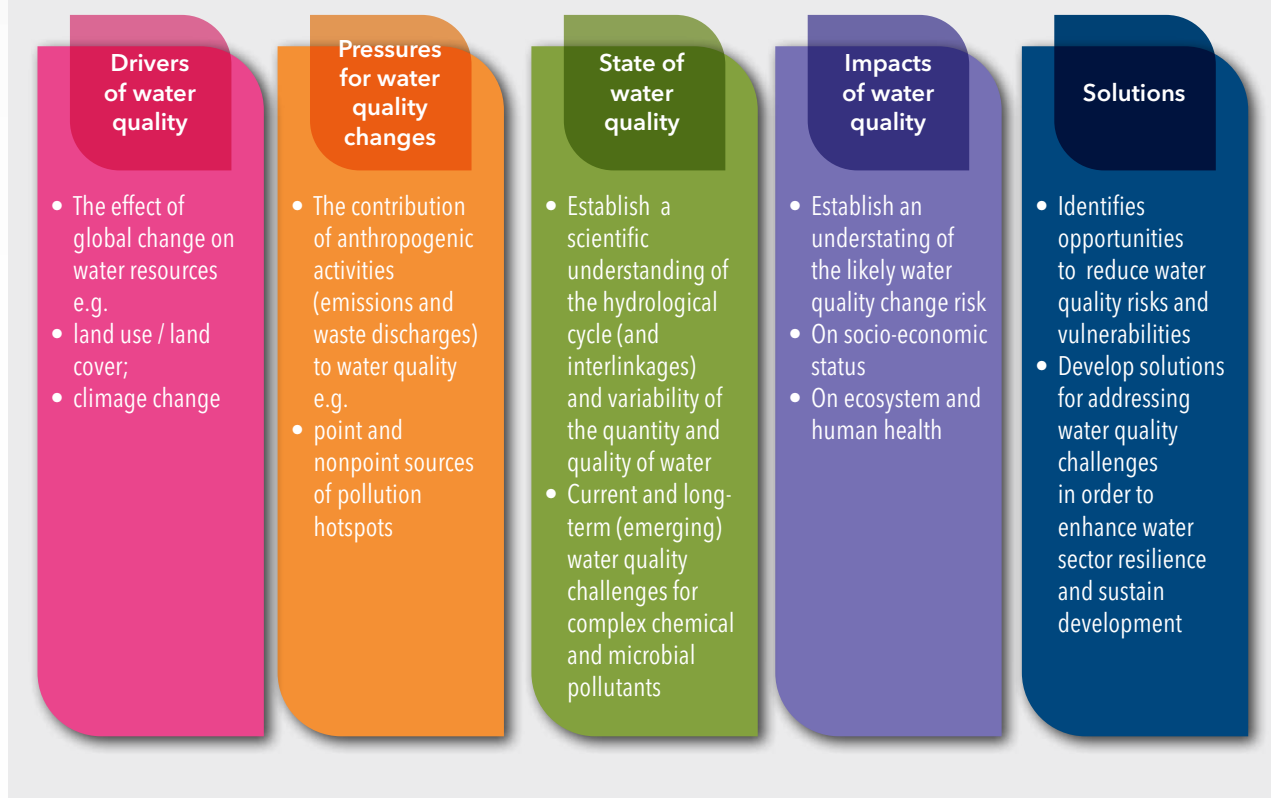
8.3 WATER QUALITY AND HEALTH (WQH)

Problems arising from the deterioration of water quality still remain a major challenge in South Africa and across the world, as they impact on water availability, the economy and social development, and ecosystem and environmental health. The Water Quality and Health (WQH) Lighthouse is a cross-cutter within the WRC research business divisions as it is applicable to the entire water value chain and covers aspects of water resources, sanitation, drinking water, health and hygiene. In this era of growing uncertainty, addressing water quality challenges requires new imperatives that support a shift to more sustainable, integrated, and equitable approaches. The 'one water' concept considers the water cycle as a single integrated system, consisting of different sources – surface water,

groundwater, stormwater, and wastewater. The quality of these interconnected sources needs to be managed in an integrated manner, considering the different multiple end uses, i.e., drinking, environmental use (the ecological reserve), industrial and agricultural uses, in order to benefit livelihoods, the environment and the economy.

The research focus of this Lighthouse (Figure 21) is improving the understanding of the influence of major drivers (i.e. climate change, industrialisation, land use/cover, etc.), as well as anthropogenic activities, on water quality. Research on contaminant sources, transport and partitioning, as well as their combined impacts, is also key in determining appropriate risk management scenarios. Developing the appropriate water quality management responses such as tools/technologies and regulatory/policy instruments in order to protect human and ecosystem health is vital.

Figure 21: Focus areas of the Water Quality Lighthouse



Current priority areas are:

- Water quality and sustainable development – the current Sustainable Development Goals (SDGs) emphasize the role of water quality (and quantity) in sustainable development. Thus, the Lighthouse activities also focus on addressing the main challenges related to access to safe water, sanitation and hygiene, and implementation of water resource and quality management, as they are critical for socio-economic development, healthy ecosystems and human survival.
- Supporting implementation of the Integrated Water Quality Management (IWQM) strategy – research activities for the Lighthouse will continue to address priority issues outlined in the five goals of the IWQM strategy (Figure 22), including a strong focus on pollution prevention and control at source.
- Smart water quality monitoring and decision making – this priority area supports research on data acquisition, use of innovative information communication technologies and models for real-time monitoring, as well as predicting and forecasting for water quality, development of knowledge hubs and cataloguing platforms for knowledge dissemination changes and subsequent use of the information for decision making resulting in improved health outcomes.
- Emerging issues and substances of concern in water – tracking the emergence of new water quality issues and substances of concern considering the three types of emerging waterborne pollutants, i.e. (i) emerging chemicals of concern deposited from the atmosphere, (ii) emerging chemicals of concern from wastewaters, and (iii) microbes that are either newly discovered pathogens or long-established agents recently rendered more resistant and/or virulent.
- Risk assessment for environmental water quality management – specific focus areas include selection of indicators and biomarkers for assessing the cost/benefit of water pollution to human health,

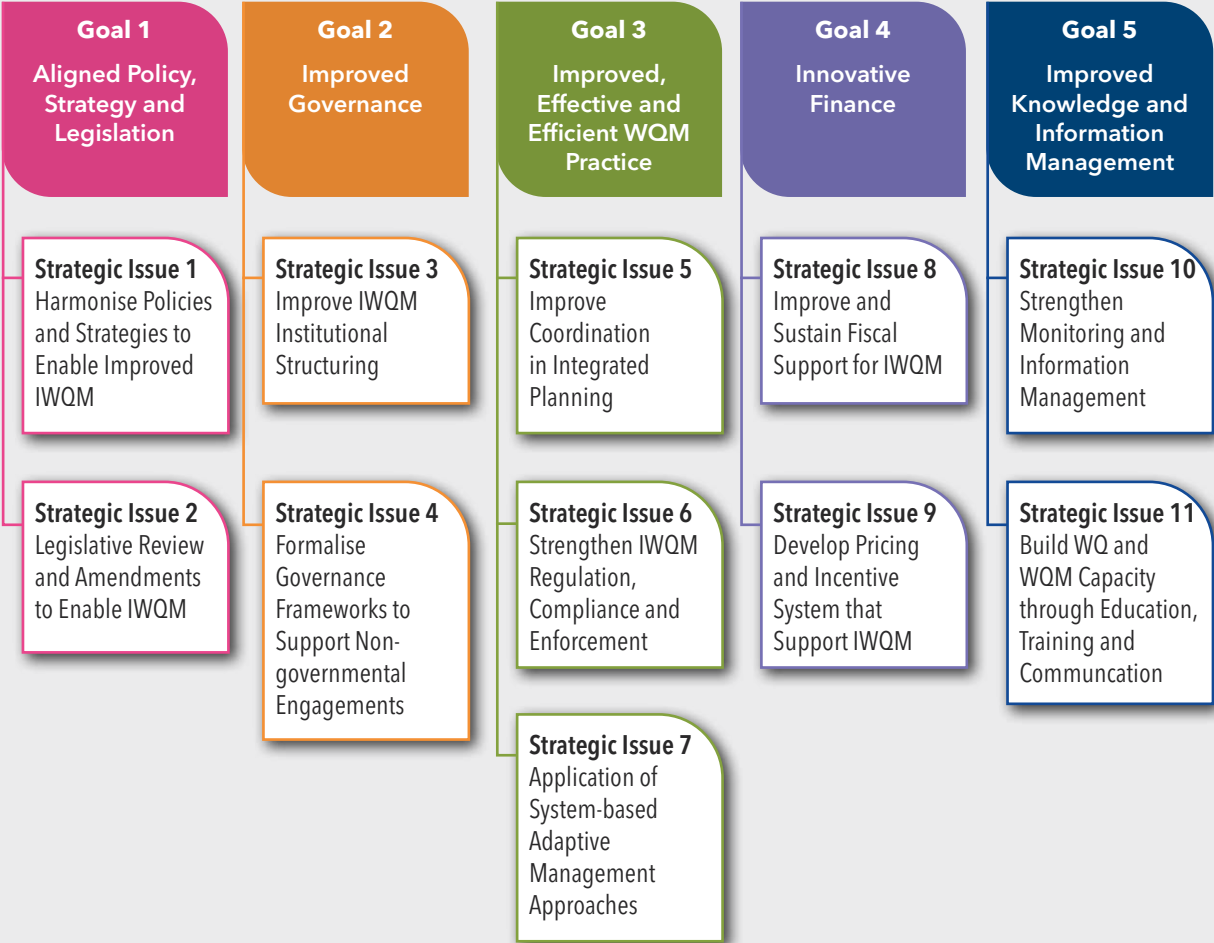
ecosystems and the economy. With regards to human and environmental health, studies aimed at assessing water quality risks as a result of non-point and point-source pollution to both human and ecological systems are encouraged.

- Circular economy approach to water quality management – adopting a circular economy approach will promote an integrated approach to

water quality management and improved efficient use of water, combined with robust incentives for innovative solutions.

- Knowledge dissemination and capacity building – coordinating local and international engagements on water quality issues, capacity building, supporting the next generation of researchers and providing networking opportunities are also priorities.

Figure 22: IWQM strategy goals and strategic issues (DWS, 2016)





8.4 WATER DATA AND THE 4TH INDUSTRIAL REVOLUTION

Water data refers to the broad suite of data and information that inform decision making and research on water-related topics, including data to characterise and monitor systems. It goes beyond streamflow, groundwater and precipitation measurements to include many areas relevant to water management, including data on ecology, land use, agriculture and so forth. Data refers to measurements of basic properties in the environment. Information refers to data that has been processed or synthesized in order to answer questions or assist in understanding a particular issue. Data and information systems often refer to software and hardware systems that collect, organise, archive, distribute, integrate, process, analyse, or synthesise data.

The 4th industrial revolution (4IR) is being characterised by ‘...a range of new technologies that are fusing the physical, digital and biological worlds, impacting all disciplines, economies and industries, and even challenging ideas about what it means to be human.’ Plans are afoot to create new learning and research centres, and to address issues of governance and ethics in other sectors, whilst institutions dealing with water issues are lagging behind. The 4IR era is built on the 3rd industrial revolution although it is a significant leap forward. What does this promise of doing things vastly differently mean for water management as well as the physical environment in which it finds itself? The rise of big data analytics and advanced algorithms offers a good opportunity to start bootstrapping and improve data collection, availability and quality. Big data analytics, machine learning and artificial intelligence is revolutionising decision-making at all levels. Coupled with land-based measurements and sensors as well as remotely sensed information from satellites, unmanned aerial systems (drones) and land-based radar intelligent data layers can be developed. Data collection systems must be optimised in time and space to give the best

available information using these technologies. The incorporation of data collected by ordinary citizens will also be important and several projects within the citizen’s science portfolio will contribute know-how and tools.

Observations are used to develop mathematical and statistical algorithms to do predictions. To ensure that these models (whether it is a simple equation or complex numerical model) perform as close as possible to reality we need more measurements and data to calibrate and validate model performance as well as improve confidence in the model outputs. Based on the information on hand, decisions are made, and the quality of these decisions is directly related to the quality of the data and information. We manage the uncertainties and risks with the information at our disposal. All this requires quantitative and qualitative observations.

The main aim of the Lighthouse is to serve as a platform for growing the knowledge and research base on the application of data and its associated tools in the water sector, and to share current thinking and strategies of future technological development to advance development in the water sector. The Lighthouse, aims to:

- Coordinate related research, development and innovation activities, and increase access to and use of related knowledge and innovations
- Coordinate and facilitate engagements in water data and 4IR developments in the water sector
- Build relationships and establish collaborative partnerships with external organisations/ individuals, including drivers of innovations
- Strengthen the adoption of solutions across all stakeholders (including public, government, private/non-governmental) and track progress towards supporting water sector objectives
- Strengthen capacity building in the sector and empower communities on the use of data and information tools

The lack of coordination in the water sector has hindered access to and use of big data to provide the

needed intelligence for managing water resources and provision of related services. Thus, the short- to medium-term actions for the Lighthouse are as follows:

- Conduct a status quo analysis and track the emergence of innovative applications in the sector
- Develop tools and know-how to enable data collection and sharing
- Adoption of existing and emerging technologies in the water sector
- Facilitate stakeholder engagement, dialogues and knowledge dissemination, and bring together partners in such a way that breakthrough/sector-shifting technologies can emerge
- Link the water sector to 'big data' opportunities in order to facilitate a new wave of trend tracking, opportunity trawling and responsive management options

The exponential increase of data being collected will only drive improvements in water research if that data is put to use. Big data becomes useful if it can be quickly converted into knowledge products. The analysis and meta-analysis by which such products are created requires that the appropriate hardware and software are available; for example, there is a new breed of software tools that can perform data mining and predictive analytics. In addition, distribution channels are needed to communicate the findings and predictions resulting from this analysis to the appropriate stakeholders.

The water sector as a whole, by its very nature, generates significant volumes of data, which can and certainly should be harnessed and analysed to provide insight for improved management, reporting and decision-making ability. Utilising intelligent data analytics, based on past data combined with predictive flow modelling as well as real-time information on water levels, weather reports, water flows, pressure and more, could assist in significant event detection and/or prediction. This type of data analysis can create intelligent reporting and enhance knowledge of usage patterns, demand, quality issues and more. Big data is about taking previously disconnected data like water levels in a reservoir and pressure in the sewage mains – and linking them with

other sources of information, such as meteorology, rainfall, and storm predictions. Data then becomes a predictive tool.

Integrating processes and technologies that collect more robust data will lead to a more strategic solution. The technology to improve our portfolio as an organization will only be as good as the managers and staff that support our efforts on a daily basis. It is envisaged that we would have to budget effectively for supporting the insights gained from implementing any big-data-analytics solution. A significant contributing factor for success when employing our big-data-analytics solution is to ensure that there is vast, core functionality that meets our business needs. The results of correctly sourced and analysed data promise enhanced decision making and a further improvement on enterprise-level water management, when the solution deployed is correctly aligned to our organisation's corporate plan.

One of our key goals would be to identify the impact of big data and advanced analytics when it comes to managing water on both a national and global level. The predictive ability provided by data analytics offers opportunities to optimise water consumption in every sector. Big data and predictive analytics could be a transformative cornerstone in water research. This Lighthouse will endeavour to ascertain to what extent this could occur and what the next steps are.

Research, development and innovation mainly focus on developing monitoring tools to manage and protect hard and soft water systems for supply, maintain and monitor water quality for biological and environmental health, manage infrastructure integrity and efficiency, and predict future changes to enhance planning. Data and information are stored within research reports and institutional databases.

We have only recently started to focus on developing integrated systems to assist efficient and accurate decision-making. One initiative has been the conceptualisation of a Water Research Observatory as a national facility that will collect, curate and develop knowledge products using the most advanced tools available.



8.5 WATER-ENERGY-FOOD NEXUS (WEF)

Scope

In response to the need to address the interconnected and cross-cutting challenges facing humankind (climate change, resource insecurity, depletion and degradation, population increase, rapid urbanisation and the emergence of novel infectious diseases) and provide integrated smart adaptation solutions, the WRC initiated, in 2012, the water-energy-food (WEF) Nexus as one of its Lighthouses (flagship programmes). The aim is to provide integrated water, energy and food security smart solutions in South Africa and Southern Africa, but with a global impact (Figure 23). Since 2012, the WRC, through its Research and Development (R&D) branch, has gained recognition as a global leader in providing transformative WEF nexus solutions under the banner of WEF Nexus Lighthouse. The WRC-funded research and activities have been aligned with regional objectives on the WEF nexus related goals which include: (i) promoting regional integration, (ii) achieving simultaneous water, energy and food securities, (iii) job and wealth creation targeting historically disadvantaged populations, (iv) supporting sustainable natural resource management, and (v) facilitating progress towards achieving the Sustainable Development Goals (SDGs), in particular SDGs 2 (zero hunger), 6 (clean water and sanitation) and 7 (affordable and clean energy). In this regard, the WRC has supported the development of a WEF nexus research strategy, a WEF nexus framework for South Africa and WEF nexus analytical tools. The research funded by the WRC has been employed as evidence that has been translated to inform policy and decision-making on formulating coherent strategies on building resilience and enhancing adaptation towards the SDGs.

Going into the future, the WRC, for its part, will continue to drive research, development and innovation linked to knowledge generation on the WEF nexus. The

translation of this knowledge into an actionable plan that can be adopted by policy and practice remains the next frontier. In addition, adopting the original WEF nexus focus to include an explicit focus on health will be needed. The lessons from the COVID-19 pandemic have demonstrated the fragility of WEF systems and their interconnectedness with health outcomes. Further to this, the Anthropocene calls for a more people and environment-centred approach to driving the WEF nexus into the future with clear human health and wellbeing outcomes.

Strategic objectives

The objectives of the WEF Nexus Lighthouse include:

- To develop user-friendly and user-inspired integrated decision support tools for facilitating WEF nexus assessments at various spatial and temporal scales
- To translate such research-based evidence to influence policy and practice and achieve impact on society, targeting historically disadvantaged groups
- Provide integrated nexus smart solutions as pathways towards integrated and sustainable resource management, with a clear focus on the environment and biodiversity
- To develop and support integrated WEF nexus smart solutions in support of the 'smart cities' initiative and urban spatial development
- To establish an integrated programme of capacity development for the WEF nexus

Short- and long-term goals

Since 2012, the WRC, together with its partners, has been spearheading WEF nexus research and development initiatives, which are yielding important results that also have a global impact. The WRC will continue leading and providing transformative and integrated nexus planning smart solutions through national, regional, and international engagements and collaboration, as well as through impactful research publications in international peer-reviewed journals. In

Figure 23: Integrated water-energy-food nexus smart adaptation solutions

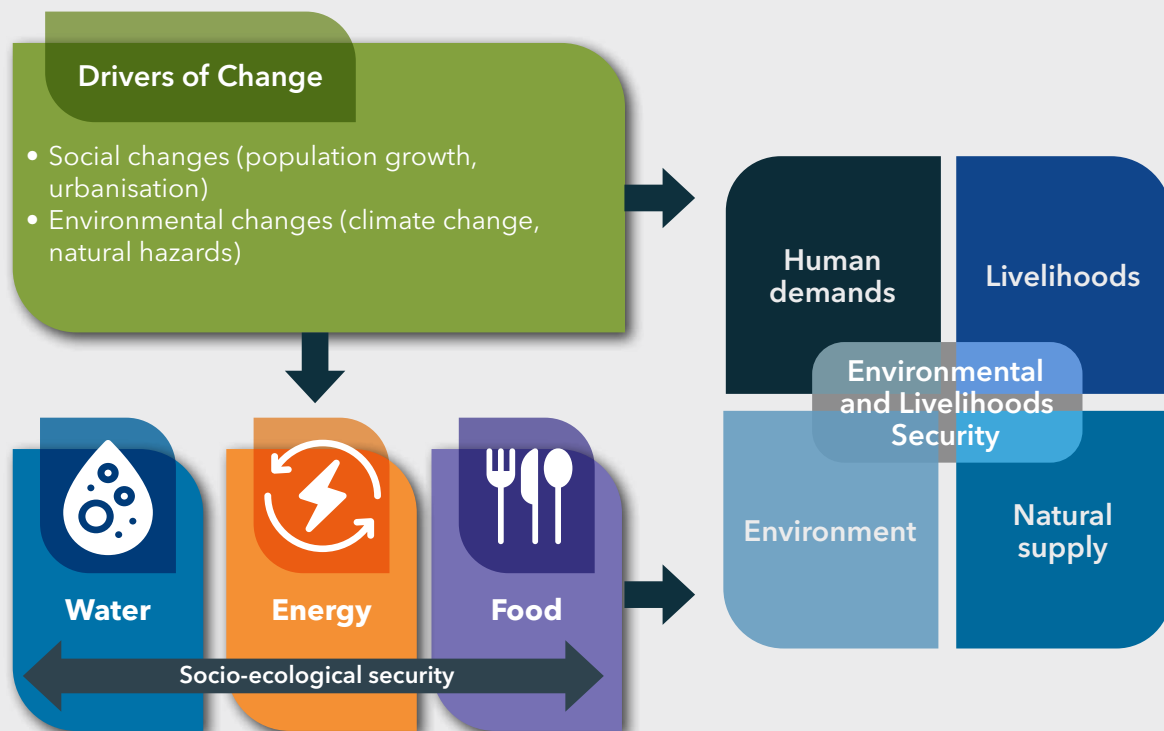
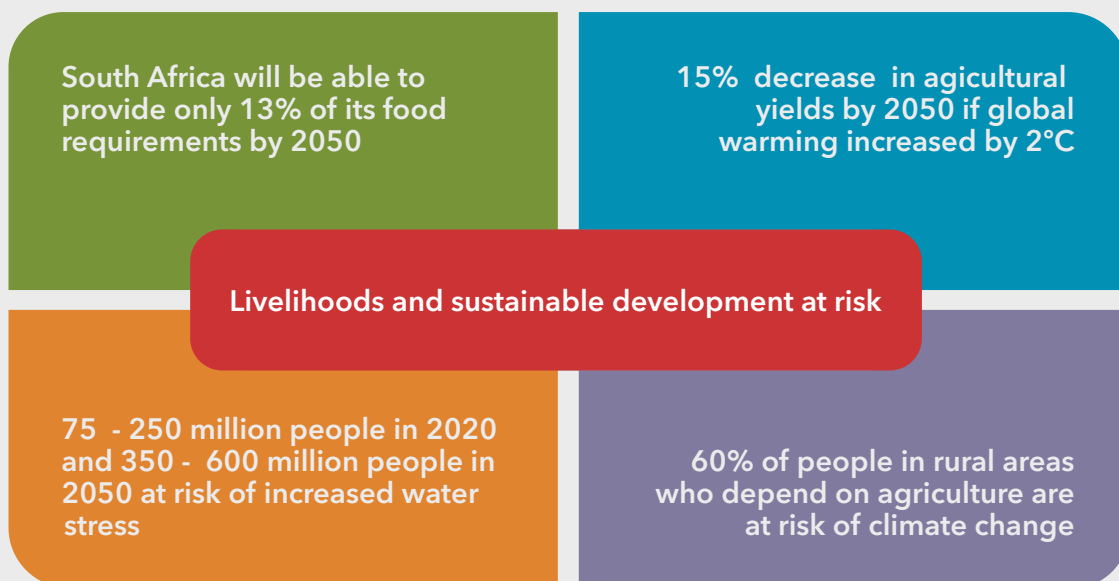


Figure 24: Highlights of climate change risks in southern Africa



particular, research publications have been successful in placing the WRC on the global map as a centre of water research excellence. To this effect, the following activities will be achieved in the short and long term within the life of CP21:

WEF Nexus Winter School: Apart from developing a university curriculum over the long term through its funded projects, the WRC, together with its partners, will be conducting a WEF Nexus Winter School every June/July, starting in 2021. This will provide hands-on knowledge and practice on applying nexus planning tools in real-life situations, as well as informing stakeholders about the relevance of nexus planning in informing sustainable nexus solutions to complex global 'grand challenges'. The WEF Nexus Centre of Excellence (CoE) will also form part of the WEF Nexus Winter School. While the WEFNeS school is envisaged to begin in 2021, the university curriculum will be implemented over the 5 years of CP21.

WEF nexus dashboard and decision support tool: After the successful development of a WEF nexus integrated analytical model, the next phase in the short term is to develop a WEF nexus dashboard, a graphic user interface which will be a one-stop-shop WEF nexus decision support tool. The dashboard will provide tools to users and stakeholders to inform nexus smart solutions. The tool will be developed in collaboration with stakeholders.

Building resilience beyond COVID-19 through nexus planning: A nexus between climate change and increasing population is modifying environments (both built and ecological), creating novel socio-ecological interactions. The novel socio-ecological interactions are resulting in the emergence of novel infectious diseases like COVID-19, which pose a great risk to human health. In the short and long-term, nexus planning tools will be developed to enhance preparedness and resilience against novel pathogens through the water-health-environment-nutrition (WHEN) nexus. This will be achieved by engaging stakeholders and funding related research.

WEF nexus narratives resource book: A number of innovations and research results have arisen from WEF nexus research since the formation of the WEF Nexus Lighthouse in 2012. An internationally peer-reviewed book will be published in the short term, highlighting the research findings since 2012, as well as emerging research. The book provides a source of information to research and policy on the processes, procedures and relevance of the WEF nexus as a transformative approach that enhances our knowledge base on the intricate linkages between resources, and provides a more complete understanding of complex systems. In the long-term, publication of research findings in international peer-reviewed journals will continue. An internationally recognised publisher will be engaged to guide the book publication.

Scenario planning: Scenario planning to inform policy and decision-making with alternatives and response options in climate change adaptation offers an alternative to models that are full of uncertainties. In the long term, the WRC, together with its partners, will spearhead research on integrating nexus planning with scenarios created to inform policy formulations and provide pathways towards informed decisions and interventions.

Rural livelihoods transformation: Existing challenges are exacerbating rural-urban inequalities. The WRC, together with its partners, will develop tools that promote integrated resource utilisation and management, as well as inclusive development, making sure that rural areas are not neglected and are central to economic, social and environmental developmental plans. The tools will be used to reduce the impact of societal mega-trends such as increasing population growth, conflict and migration, economic growth, international trade, rapid urbanisation, diversifying diets, cultural and technological changes, as well as climate variability and change, on rural livelihoods. The aim is to ensure a vibrant rural economy that includes robust agricultural productivity, rural non-farm jobs, and access to markets and trade.

SDG progress assessment: An important aspect of this Corporate Plan is that its lifespan coincides with the crucial phase of the SDGs. Since WEF nexus indicators build on and complement SDG indicators, the WRC will lead research on developing tools to assess progress towards sustainability by 2030. In the short term, the WRC will develop cross-sectoral tools to integrate indicators across sectors and elucidate how best resources can be allocated between competing needs, thus, making the implementation of SDGs more efficient and cost-effective.

Circular economy planning: An important and topical process to achieve sustainability is the adoption of the circular economy. In the long term, the WRC will develop tools to integrate the circular economy and nexus planning to enhance low consumption of energy, low emission of pollutants, and high efficiency in resource use. The WEF nexus and the circular economy are both concerned with resource-use efficiency and security through integrated planning and management. There is still a huge gap in integrating the circular economy and the WEF nexus as a means of enhancing resource security and economic growth by creating employment opportunities, sustainable resource management, and reducing environmental pressures.

Sustainable food systems: An important transformative approach that will be enhanced in the long term is achieving sustainable food systems. The WRC, together with its partners, will develop processes and procedures that will promote sustainable food systems by applying WEF nexus tools to ensure food and nutritional security, and maintain a sustainable economic, social, and environmental base that continues meeting the needs of present and future generations. The aim is to meet the growing demand for food (and bioenergy) and meet SDG 2 (zero hunger), and at the same time ensure a healthy socio-ecological system.

WEF Nexus Centre of Excellence: To achieve and maintain excellence in WEF nexus research, development and innovation as well as spearhead the strategy, a WEF nexus Centre of Excellence (CoE) will be formed. Amongst its objectives, the CoE will (i) achieve

and maintain excellence in its research and postgraduate teaching activities related to the WEF nexus, including the coordination of the WEF nexus summer school and curricula development; (ii) undertake, initiate and lead WEF nexus research in support of the strategy; (iii) contribute to science for impact through active community engagement, translation of WEF nexus research for practitioners and informing policy makers; (iv) produce high-quality postgraduate students (Hons, MSc, and PhD) who will contribute to the WEF nexus agenda locally as well as in Africa and internationally; (v) establish and develop links and collaborations with leading institutions (private and public), both nationally and internationally, in support of the WEF nexus strategy; and (vi) ensure the long-term sustainability of the CoE by securing grants from national and international funding agencies. The WRC will partner with an established and recognised institution to setup the WEF Nexus CoE. The CoE will have a lifespan similar to that of the strategy, beyond which it will have to become self-sustaining. The WEF Nexus CoE will also be linked to the WRC Water Academy.

Way forward

WEF nexus research needs and gaps that will be addressed in the short and long term include:

- Publish a WEF nexus narratives book
- Refinement of WEF nexus analytical tools
- Development of a university curriculum
- Initiate an annual WEF nexus summer school
- Creation of a WEF nexus dashboard and graphic user interface decision-support tool
- Development of WEF nexus scenarios
- Operationalisation of WEF nexus concept
- Formulate WEF nexus policy and strategy with national and regional stakeholders
- Development of a WEF nexus livelihoods framework
- Engagement of WEF nexus innovation labs with regional and international stakeholders



8.6 SUSTAINABLE HUMAN SETTLEMENTS (SHS)

The current realities create a higher impetus to scale up the application of water-sensitive design (WSD) in both rural and urban environments. We will continue to put greater emphasis on training and capacity building, as well as demonstration projects with municipalities and business. The Sustainable Human Settlements Lighthouse has been progressing. 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 WSD (settlements) lens for urban, peri-urban and rural environments.

Thus, in 2014 the Community of Practice programme (CoP) was initiated aimed at building awareness 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, at which the Framework and Guideline documents were shared. Under the CoP platform a total of 18 activities (dialogues, symposiums, seminars, conferences, etc.) are currently planned over the next 5 years as part of the CoP awareness building and information sharing. However, this needs to be further strengthened and consolidated beyond 2021 through stronger partnerships and transformation of the shared knowledge into demonstrations and implementation as a way of stimulating innovation for economic growth, thereby catalysing development to address challenges associated with poverty, unemployment and inequality. On the research front, there has been continued support of 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 eThekweni 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. To date, outside the guidelines for sustainable drainage systems and water-sensitive urban drainage, two projects in support of water-sensitive design have been completed, with six projects currently progressing. The WRC will continue to support projects about water-sensitive design.

Strategic objectives

The objective of this Lighthouse is to develop a critical mass of knowledge around the integration of planning activities for the adoption of WSD in South Africa using the water lens. The WRC envisions WSD as the integration of water cycle management into planning and design for the growth and development of communities, and is inclusive of urban, peri-urban and rural environments. Thus, the definition of WSD is adopted from the principles of water-sensitive urban design which is the integration of planning and design with the management, protection and conservation of the water cycle, which ensures water management is sensitive to natural hydrological and ecological processes. WSD incorporates water supply, wastewater (greywater), water resource management (groundwater and surface), design and environmental and human protection as part of its integrated design concept for environments. The research sets itself apart from international experiences since it will attempt to adapt the WSD principles in a developing country.

Outcomes

The broad plan and outcome of the SHS Lighthouse is to transition the relevant South African cities, towns and villages closer towards water-sensitive environments which meet its socio-political drivers and its service delivery responsibilities (Figure 25). To this end, the WRC has already embarked on a project which aims to provide a framework for water-sensitive cities (urban

environments) as a first step in achieving this outcome and will initiate a new project to provide a research framework for water-sensitive rural design. Water and water-sensitive design are seen as the enabler which could move South African institutions closer to meeting the developmental goals as set out in the National Development Plan (NDP) and the objectives of Water for Growth and Development, National Water Resource Strategy and the Climate Change Strategy. This pioneering integrated design paradigm shift for South Africa will require a societal openness to: embracing a WSD vision as part of its broader developmental vision, adapting planning processes, re-organizing planning departments, absorbing research and guiding new research, adopting new technologies and adapting old technologies, reviewing and applying new policy and legislation, building capacity (skills, competencies and judgment) and initiating demonstrators for technology transfer with partners and stakeholders.

The SHS research roadmap and plans (2019 to 2024)

An investigation into the WRC portfolio shows that there is already a wealth of information around water supply, sanitation (sewerage), stormwater (drainage), management of diffuse and point source pollution in waterways, and fit-for-purpose water. These products are housed within all three research business divisions and will be repackaged and updated using WSD criteria. The SHS Lighthouse has a 10-year timeline with a 5-year research review cycle. The research objectives will seek to: mine existing research products which contribute to the water transition states, critically review and repackage the products using the WSD lens, build a community of practice using research products as the enabler, build capacity through individual research projects, develop frameworks for urban and rural environments, develop guidelines and tools, inform policy and decision-making, and partner with stakeholders to demonstrate various sustainable options.

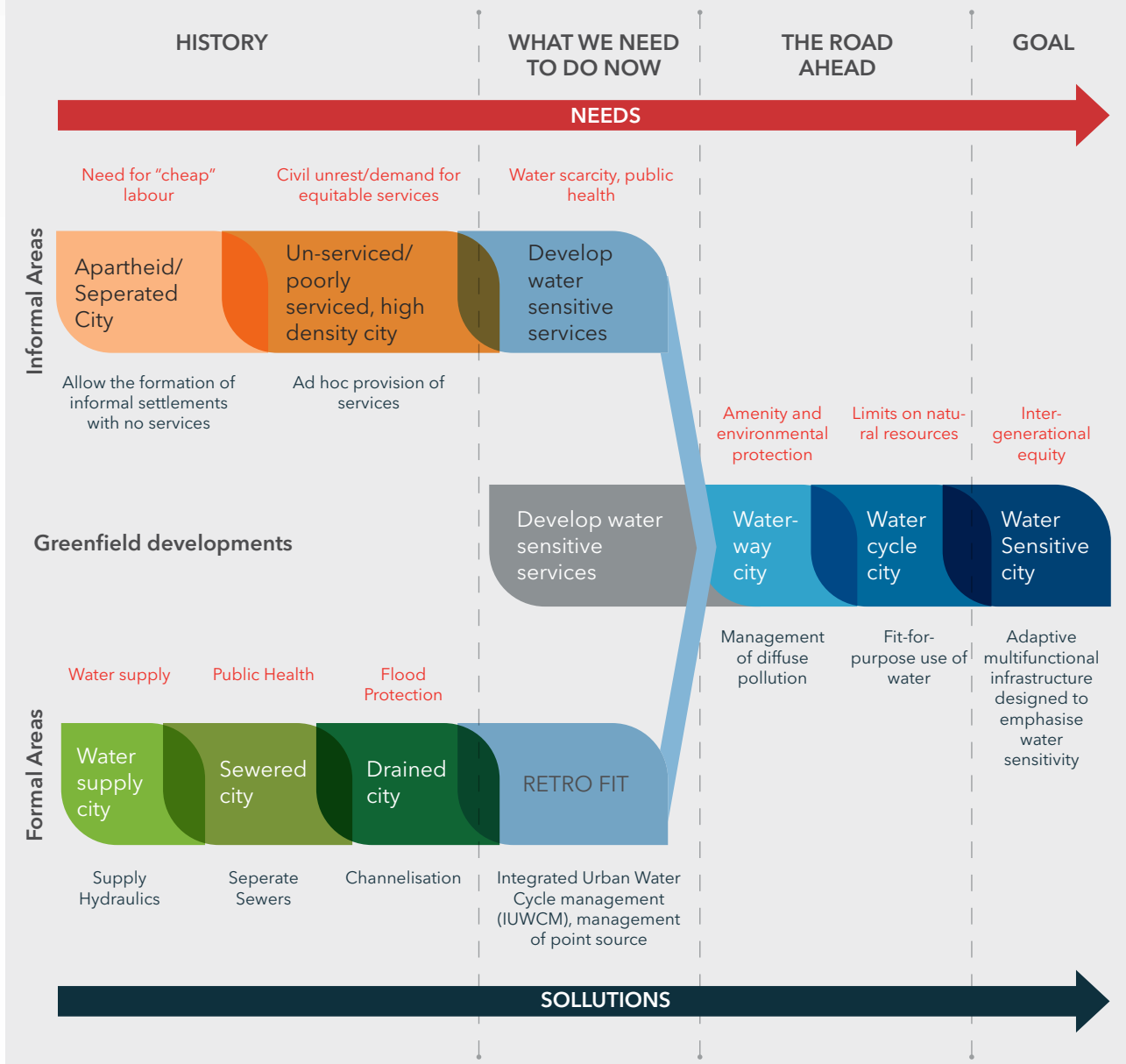
The first 5 years will consolidate past and current knowledge, build capacity and engage with stakeholders by sharing the vision of SHS through several platforms. The framework produced in K5/2071 for water-sensitive

cities will be used to formulate the South African vision for relevant partners. The Lighthouse was presented to the broader sector at the WRC Symposium held in September 2013. Since the planning fraternity are considered critical to the adoption of the WSD concept, it is envisaged that the WRC will engage with partners like DSI to conceptualize and drive the development of a SHS simulator, i.e., a virtual reality macro-planning design platform to bring the concept to life for decision-makers and planners. In addition, new projects will be initiated. The start of projects (a feasibility study and a SHS Community of Practice Programme) emanating from two directed calls commenced in the 2013/14 cycle, and was completed in 2015. The aim of the SHS CoP programme is to strengthen the researcher/stakeholder and implementer interface in order to leverage partnerships and facilitate, manage and document technology transfer opportunities from the design phase through to the piloting and adapting phases. The next 5 years will be guided by the research needs as defined through pilots, engagements and adaptation of design approaches and technology adoption for South African environments.

Achievements to date

- The first South African Guidelines on SUDs (sustainable drainage systems) and WSUDs (water-sensitive urban design) have been published by the WRC
- Several new and related studies have been initiated; a key one is developing spatial planning guidelines to incorporate WSD
- The community of practice continues to grow. A key development from this practice is the establishment of a full training and research centre by the Water Futures Group at the University of Cape Town (UCT) in Franschhoek, Western Cape
- We have set up a strategic partnership with CSE India on running WSD training courses in South Africa and the region. In its second year of activity five training sessions have been held around the country, including one in Namibia. We are looking at rolling out this training further for another 3 years.
- Several new initiatives in the building sector are starting to incorporate these principles in their

Figure 25: SA's transition to Water Sensitive Cities: 'Two histories, one future' (adapted from Brown et al., 2009; WRC Project K5/2071)



design. We are also seeing a greater shift and recognition in the larger Metros towards a WSD mix in their activities.

New plans and way forward

Next year is set out in the timeline as the date for reviewing our strategy and achievements, as well as charting a way forward for the next 5 years. In the meantime, the following will be prioritised:

- It is evident that training is a good stimulus in building new capacity and stimulating a cohort of practice; it also helps to widen the discipline and participation
- An aspect to be considered in the new plans was to incorporate the elements of sanitation-sensitive design; this is required to accommodate new transformative off-the-grid non-sewered sanitation
- Scaling-up on pilots and demonstration project, as well as application
- Start capturing case studies and experiences and develop a log of all initiatives and new ones



8.7 SUSTAINABLE WATER BEHAVIOURS

Scope

Human behaviour, culture, perceptions, paradigms and choices sit at the heart of how the supply of water is managed and demands for water are negotiated. Thus, in the context of the growing challenges of water scarcity, demand outstripping supply, high user expectations and required assurances, and climate variability, interventions are required beyond technical interventions. A focus on behaviour is thus crucial when managing supply and demand issues in the water sector. Behaviour is also important when considering water and its broader links to the green economy and wider sustainable development approaches.

Ensuring our long-term water supply requires the use of both supply-side approaches such as water augmentation through water recycling, reuse and recycling, and demand-side approaches such as water conservation. In an environment of high expectations and many promises, the conservation of water resources is a critical component of the effective and environmentally sustainable management of water supplies. It is anticipated that climate change will decrease the reliability of water supplies, due to reductions in rainfall and the increasing variability of rainfall events. The conservation of water resources will therefore become increasingly imperative. Given the imperative of water conservation for environmental sustainability, the efficient use and management of water, and climate change mitigation, it is critical to understand what factors contribute to water conservation behaviour. Being aware of these factors will inform water managers, government and public policy officers of how best to encourage water-conserving behaviours, and thus reduce the need to augment existing water supplies. Despite the importance of increasing water-conserving behaviours, relatively limited research has been conducted to date.

A focus on behaviour necessitates a dual approach, looking at the professionals who are the drivers of planning, management, governance and implementation in the water sector, as well as having an outward-looking approach that looks towards users of water at the level of individuals, communities, industry, and the public sector. This outward-looking focus on behaviour also needs to interact with the political agendas and priorities and how water is prioritized in the context of competing demands in the broader national economy. A behaviour focus looking inward at the professionals working and engaged with the water sector necessitates a focus on exploring issues around making use of alternative sources of water, rethinking our conceptualization around built and ecological supply infrastructure, and the behavioural shifts required to run water as a smart business from a management perspective. Here the focus is on the levers that can unlock behavioural and paradigm shifts in the traditional ways of managing water. A close focus on training, re-learning, procurement and similar mechanisms is crucial here. When looking outward towards the behaviour of the users of water the predominant focus has been on water conservation as a demand-side measure. This remains important. Equally important, however, are the behavioural shifts towards seeing water as a core driver of economy and business which stretches far beyond notions of conservation.

A significant body of work on factors contributing to positive attitudes toward water conservation exists. However, it is known that attitudes do not necessarily translate into actual behaviour. Over the past decade, utilities, governments, businesses, and non-profit organisations have come to realize that more than just financial considerations and information drive behaviour. Social, cultural and psychological factors also play a significant role in shaping consumers' decisions and behaviours around resource use. Stakeholders have consequently turned their interest to behavioural science, a multidisciplinary field that draws from psychology, sociology, public health and behavioural economics to explain the complex mechanisms that shape human behaviour. In addition, a range of other social science disciplines, including political science, anthropology, linguistics, history and philosophy, help to interpret

some of the broader contextual, cultural and historical factors that drive preferences, paradigms and attitudes. When used strategically, these disciplines support the potential to drive down resource use, drive up profits, and generate measurable gains in conservation and efficiency.

Sustainable behaviour typically focuses on understanding long-term behaviours and, where transformative tipping points can be leveraged, applies behavioural theory and requires rigorous measurement of outcomes and impact. Focusing on behaviour, actions and preferences thus provides one of the key opportunities and sustainable interventions which can contribute to the acknowledgement and management of the water resources, their exploitation and efficient use by households, agriculture, mining, industry and the environment.

The scope of this Lighthouse will drive the building of research capacity, knowledge and innovative products which will support the sector and Government to traverse the pathway towards building a strong and responsive society and consumers, who will contribute to the sustainable management of our water resources. New approaches will be supported by the use of evidence-based principles and apply proven behavioural strategies that align with the behaviours and cultures at multiple levels within the sector and that are best suited for achieving the objectives demonstrated. These new use behaviours can result in significant, persistent, and measurable reductions in resource consumption.

8.8 WATER SCARCITY AND EXTREME WEATHER EVENTS

Scope

South Africa is a semi-arid to arid country, with highly constrained freshwater resources which are unevenly distributed spatially and temporally. The country has been projected to experience water scarcity by 2025 due to exponentially increasing water requirements from a finite and limited resource. The improved socio-economic conditions (and the rapidly growing

population) and the changing climatic conditions are cited as the main factors that put pressure on this limited resource. Specifically, the extreme weather events such as recurring droughts and floods as a result of climate change are projected to worsen societal impacts and to aggravate water scarcity in South Africa. Currently, water scarcity and climate change are acknowledged as the most important global risks for society. The risks largely stem from the unsustainable use of the water and land environment and the extreme human influence on natural systems. Water-related shocks, such as droughts, floods and pollution incidents, combined with ill-preparedness and low coping capacities, present high levels of risk for most of the world's poorest. Therefore, the main aims of this Lighthouse are to:

- Enhance the country's water security and resilience to current and future water scarcity
- Investigate, through prediction and early warning systems, the potential impacts of extreme weather events on water scarcity as well as to develop mitigation measures

With a semi-arid climate with limited water resources, South Africa has unique scientific requirements and challenges which are compounded by data limitations. The dynamics of South Africa's complex water systems and their response to extreme weather events and climate change are uncertain. The objective of this Lighthouse will be to harness the existing knowledge in order to develop novel approaches and tools that will advance our understanding and management of the water scarcity problem, both at the catchment and regional (national) level, and to mitigate the increasing vulnerability caused by extreme weather events. The main research questions will centre on 'managing the complex and dynamic water systems that require new understandings of hydrological process interactions and feedbacks across multiple scales, and the effects of human activities on the water environment'. The projects in this Lighthouse will be built on the principle that water scarcity (and hence water security) is an explicitly universal objective. Therefore, while research is conducted at a catchment scale to find solutions suited to local contexts (and vice versa), it should be

recognised that water scarcity is a global problem that often requires addressing at multiple scales, i.e., local to regional and global. Therefore, local and national as well as international partnerships will be essential in this Lighthouse's endeavour.

Current understanding

Over the past 40 years South Africa has conducted a number of large-scale water resources assessment studies (e.g. WR90, WR2005, WR2012, etc.) that aim to address large-scale water resources management and development. However, these studies focus on fundamental aspects of hydrology with little to no in-depth research on the impacts of human and environmental change on water resources and their associated feedbacks. Additionally, there are a number of recently completed and ongoing climate change and land-use projects to assess the potential impact of the projected change on water resources. Most of these projects are conducted under the Climate Change Variability Lighthouse and a few business divisions. However, it is postulated that these projects do not comprehensively address the understanding of water resources availability, water scarcity and water threats that are caused by extreme weather events.

There are also ongoing research projects on water resource accounting which could prove useful in determining the water use by different land types, and this study complements the water accounting research currently being conducted for Statistics South Africa.

Future perspectives

There are a number of exciting national and international developments that can aid in the advancement of water scarcity and extreme weather events research. These include the growing global links and partnerships among the community of practice in global-scale models, which has led to a growing number of global datasets that reduce uncertainty in global modelling.

Strategic objectives

The Lighthouse on Water Scarcity and Extreme Weather Events was conceived during the 2017/18 financial year to harness the existing knowledge on water scarcity in order to develop new approaches and tools that will advance our understanding and management of the water scarcity problem, both at the catchment and regional (national) level, and to mitigate the increasing vulnerability caused by extreme weather events. The main research questions will centre on 'managing the complex and dynamic water systems that require new understandings of hydrological process interactions and feedbacks across multiple scales, and the effects of human activities on the water environment'.

The Lighthouse was developed to achieve three key objectives such as:

- To enhance the country's water security and resilience to current and future water scarcity
- To investigate through prediction and early warning systems the potential impacts of extreme weather events on water scarcity
- To develop mitigation and adaptation measures against water scarcity

What was planned to be done

A number of activities were planned to advance and implement this Lighthouse as follows:

- **Review of current research on water scarcity and extreme weather events (short to medium term):** A comprehensive review of the state-of-the-art in water scarcity (and extreme weather events) research to synthesise the existing knowledge and to identify gaps both nationally and internationally. The main objective of this review would be to provide a guide (or research strategy) on the long-term research on water scarcity and extreme weather events. The review should provide a quantitative analysis of the impacts of weather extremes (such as droughts and floods) on the hydrological variability, and how the hydrological variability transmits to economic

variability, etc., as well as its implications for water resource management. The work should explore 'managing the complex and dynamic water systems that require new understandings of hydrological process interactions and feedbacks across multiple scales, and the effects of human activities on the water environment'.

- **Building partnerships national and internationally (medium to long term):** The projects of this Lighthouse will be built on the principle that water scarcity (and hence water security) is an explicitly universal objective. Thus, while research is conducted at a catchment scale to find solutions suited to local contexts (and vice versa), it should be recognised that water scarcity is a global problem that often requires addressing at multiple scales, i.e., local to regional and global. Therefore, to accelerate the growth of the knowledge base, this Lighthouse will seek to strengthen partnerships with relevant national and international organisations which will support data, model and trend analysis comparisons. Such partners will also strengthen through advisory support the collaborative framework and institutional support required to improve South Africa's capability in this area. One such set of partners that the WRC is looking to strengthen includes NOAA, USGS, etc. We will seek national partnerships to strengthen exchanges as well as support seminars and events. Therefore, local and national as well as international partnerships will be essential in this Lighthouse's endeavour.
- **Institutionalised expertise (medium to long term):** The synthesis report will provide a strategy on the medium- to long-term research vision for this Lighthouse. Chief among the key issues to be prioritised is the establishment of the hydrology data facility (or centre) to collate and coordinate hydrologically important datasets in all their facets. Of particular interest will be rainfall (climate data), stream flows, groundwater recharge, land cover, etc which are key hydrological parameters in determining water scarcity.
- **Development of tools and novel approaches to mitigate the impacts of water scarcity and extreme weather events (long term):** The impacts

of weather extremes on hydrological processes or variability will have a direct and indirect impact on the economic, agricultural, and other sectors. For instance, it is projected that the increase in population and economic growth will lead to an increase in the degree of water scarcity. The increase in the degree of water scarcity also leads to increasing vulnerabilities in agricultural, industrial and domestic activities. Therefore, work from this Lighthouse should stimulate development of novel approaches and appropriate tools that can improve resilience and strengthen adaptation and mitigation initiatives. The policy changes may also be required to mitigate the sensitivity and vulnerability of the economic sectors to water scarcity.

What was achieved

A number of supporting initiatives (within the framework of the above plan) were brought into effect. These include, amongst others:

- Initiating a directed project (K5/2746) entitled 'The development of an integrated (early warning) system for adaptation and mitigation to hydrological drought in South Africa'. One of the key deliverables for this project is 'hydrological predictability' which forms a major scientific component of this Lighthouse. Dr Brian Thomas, formerly of NOAA and now with the University of Pittsburgh USA), was approached to assist the research team because of his expertise in streamflow forecasting and in the US Drought Monitor. He kindly agreed to assist the project team.
- Finalising a project (K5/2436) that developed a streamflow forecasting framework largely based on a desktop study and using an integrated hydrological model. This framework will form the basis for (K5/2746) hydrological predictability and prediction. Under this project (K5/2436) a Dam Balances & Forum on Seasonal Hydrological Forecasting in South Africa was formed, bringing together water resources planners (dealing with reservoir forecasting), climatologists (from the South African Weather Service (SAWS), University of Cape

Town, Agricultural Research Council (ARC), CSIR, hydrologists (for streamflow forecasting), etc., in an attempt to integrate forecasting processes and standardize the methodology. However, this forum disbanded at the end of the project.

- Finalising a project on Strategic Water Source Areas of South Africa or SWSAs (K5/2431) in which the findings confirm that only 10% of South Africa's land area generates more than 50% of the country's water supply. This study provides a quantitative estimate of the physical scarcity of the country's water resources.
- Finalising a project (K5/2458) on the use of satellites to monitor in near-real-time the eutrophication of 102 large dams throughout South Africa. The study highlights the extent to which point-source pollution (specifically nutrient-enrichment) is diminishing water quality and potentially poses health risks to the citizens.

Way forward

Recent global water resource assessment and climate change studies have underscored a growing scarcity of freshwater relative to water demand. The depletion of water resources which is brought about by increasing population growth and changes in weather extremes. South Africa is already experiencing physical water scarcity. There are two key climatic characteristics that shape water resources in South Africa. These include:

- Generally low and highly variable levels of rainfall across most of the country control the amount of water available. The country's mean annual precipitation (MAP) is approximately 500 millimetres, which is way below the world average of 860 mm.
- High air temperatures and low humidity levels mean that most rainfall is lost via evaporation and less than 10% of the rainfall is converted into usable groundwater or river flows.
- Additionally, approximately 60% of the annual rainfall falls on only 20% of the country's land surface.

All of the above translates into natural physical water scarcity even before human-induced impacts are taken into account.

A recent WRC project (K5/2317) used standard approaches such as the Standardized Precipitation Evapotranspiration Index (SPEI) with Thornthwaite method for calculating the potential evapotranspiration, and SPEI with Penman-Monteith method for calculating the PET, to characterize drought in southern Africa. The findings were that drought frequency, intensity and severity have been increasing from the 1950s to the present, and the projections to year 2100 suggest that this situation will gradually worsen due to climate change.

The above examples serve to demonstrate that water scarcity in South Africa will be the main environmental risk (to economy, agriculture, food production, etc.) that should be understood and tackled with appropriate scientific precision. Therefore:

- Quantifying and mapping water scarcity is crucial to understanding vulnerability to water shortages and to scaling solutions across sectors.
- Accurate mapping of spatial and temporal spread of physical water scarcity is increasingly critical to decision-making in different contexts, to examine exposure to water-related risks.
- Floods and droughts alter the relationship between water availability and economic performance (as exemplified by the extreme drought in the Western Cape). Considered as a whole, South Africa is highly vulnerable to hydrological variability.

The plan over the next 5 years will largely be informed by the research strategy which will be developed from the short-term review and synthesis study. Partnerships and collaboration with national and international stakeholders will be strengthened. A community of practice on water scarcity is proposed for how extreme weather events such as droughts can be addressed across local and global scales.

Proposed modalities of action:

- **Short to medium term:** A comprehensive review of the state-of-the-art in water scarcity (and extreme weather events) research to synthesise the existing knowledge and to identify gaps both nationally and internationally, is planned. This work should provide a guide to the long-term research strategy for water scarcity and extreme weather events.
- **Medium to long term:** The synthesis report will provide a strategy on the medium- to long-term research vision for this Lighthouse. Chief among the key issues to be prioritised is the establishment of the hydrology data facility to collate and coordinate hydrology datasets in all its facets.

8.9 STRATEGIC PROJECT FOR 2021: WATER RESEARCH OBSERVATORY

Data and information are a prerequisite for good decision-making. The paucity of data and information on water and related systems hampers efficient management of our biotic and abiotic systems. The

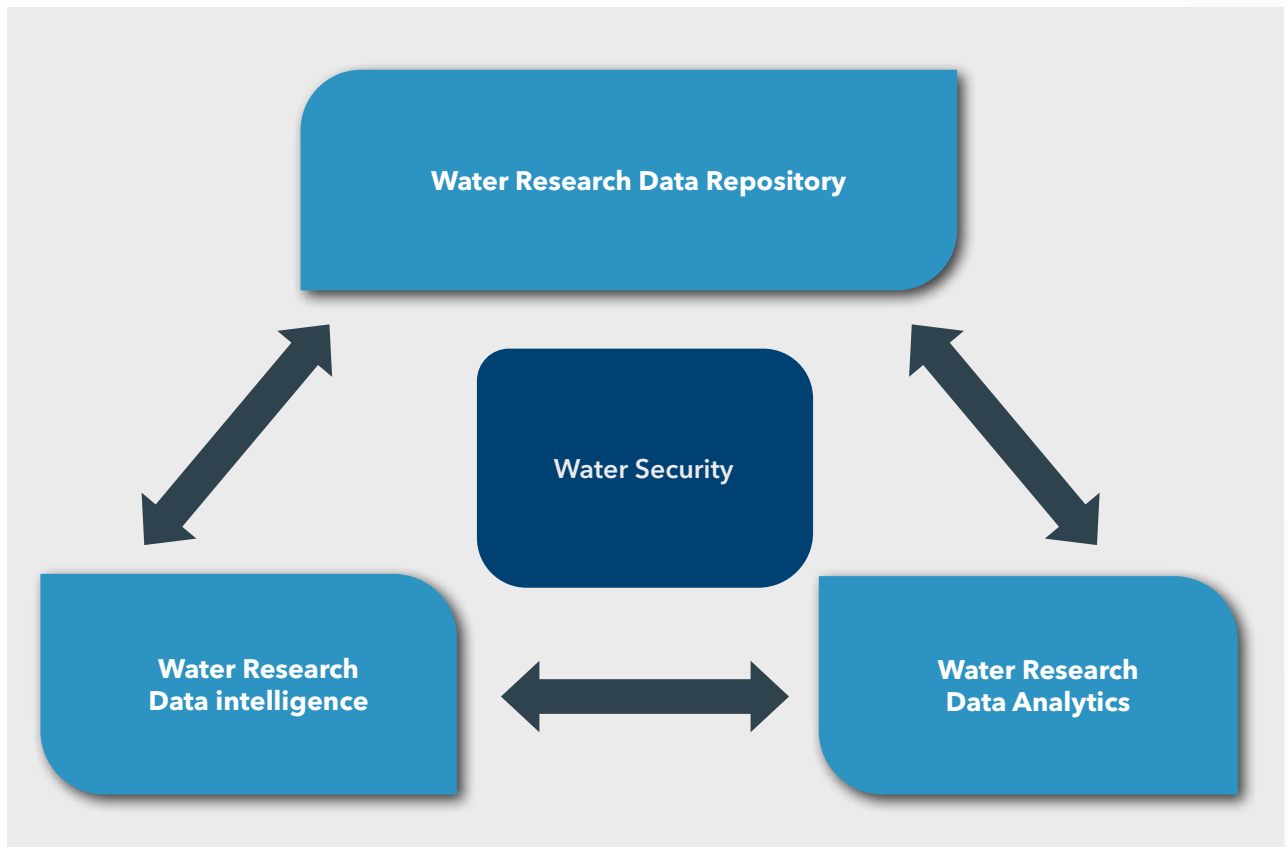
WRC produces, during its research activities, data and information that are stored within its research reports, tools, institutions and databases. New systems and analytical capabilities allow for the curation and analytics of disparate structured and unstructured data and information. The WRC intends to develop a Water Research Observatory (WRO) to digitise, share and add value to the datasets and tools. The WRO will be an integrative system that will improve data governance and usefulness. It will also allow ease of access that will enable research on research and enhance reproducibility of the scientific endeavour.

The WRO will have 3 main elements:

1. Data and tools repository
2. Interoperability with other data systems
3. Visualisation, analytics and reporting

Data and Tools Repository (DTR)

The repository hub will collect and curate all research-related data, information and compatible tools. Data



will be sourced from completed projects through a digitization exercise, available databases, lab networks, etc. The repository will be available to all researchers and students to upload and download data and information. This will be enabled by a data sharing agreement.

The DTR will complement existing activities in the water and related sectors (i.e. DWS, SAWS, SAEON). The WRC will also develop citizen science approaches and tools that will become a rich source of data and information that will require curation and analyses. WRC-developed innovative remote sensing tools and sensors for near-real time monitoring will also form part of the WRO.

It is envisaged that each project will have a workspace on the system that will enable projects to directly capture data and information and have access to background information within their study sites.

Interoperability with other data systems

Globally, there are vast networks of data systems that curate data and information that are collected by direct and indirect means. As an example, the Global Earth Observation System of Systems (GEOSS) collaborate to provide a holistic monitoring system for earth. This is achieved through "GEONETCast a global network of sustained and cost-effective satellite-based dissemination systems. It delivers Earth observation (EO) data and products to and from GEO community activities, initiatives and flagships on a routine basis. GEONETCast is a GEO foundational task and an integral part of the GEOSS Common Infrastructure (GCI). It facilitates access to data to support the GEO Societal Benefit Areas". The WRC can become a contributor and benefactor of these systems through the WRO.

Locally, there are many databases that can benefit the WRO and that will benefit from the WRO. Data agreements will be able to allow free flow of data to national databases such as the National Integrated Water Information System (NIWIS) operated by DWS. The WRO will also complement the DWS Data Management Strategy that is under development.

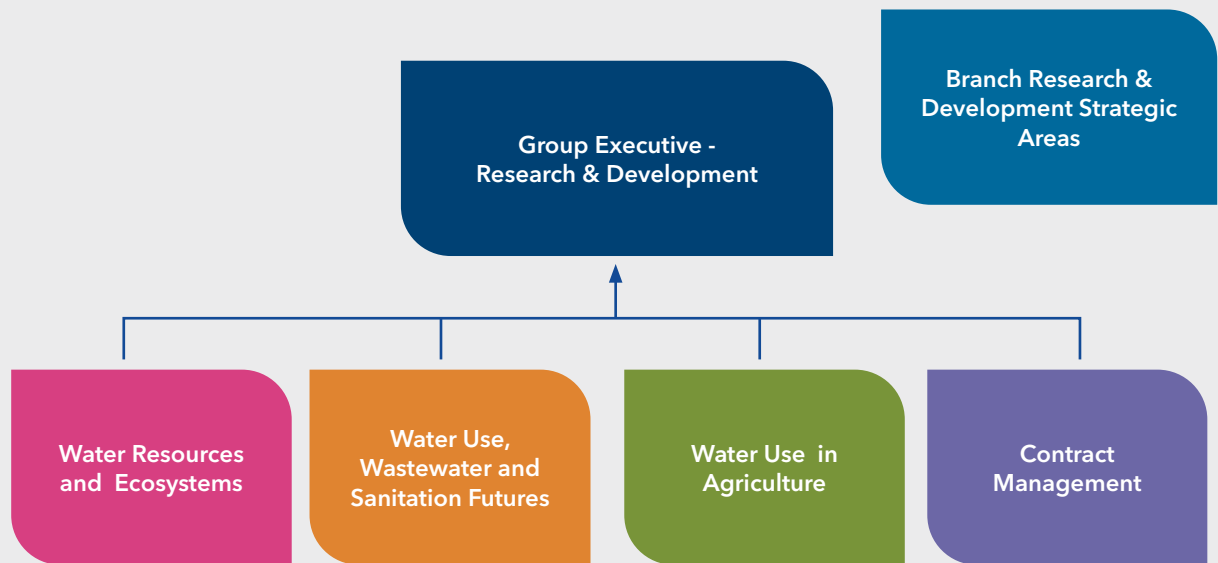
Data analytics, visualisation and reporting

Data and information have limited value unless it is used to create products that can assist with planning and decision-making. Data analysis is the transformation and modelling of data with the goal of discovering useful information, informing conclusions, and supporting decision-making. It becomes even more useful if it is placed in context with its surroundings and interrelated earth systems. Data visualisation is the presentation of data in a graphical format and users to see analytics presented visually. This aids in making difficult concepts easier to understand or to identify new patterns. All data must be analysed, using a variety of numerical tools, to interpret and make it useful. Over time there is an opportunity to shift from data analytics to AI (artificial intelligence) and develop innovative tools that could disrupt (enhance) the way of work and decision-making while creating new businesses.

Implementation Plan

- Short-term (1 year): Develop the framework and plan for the programmatic approach
- Medium-term (2 years): Build the infrastructure, pilot and develop operations and resourcing plan
- Long-term: Establish, Operate and maintain system

Figure 26: Research and Development branch structure



09 | Innovation and Impact

9.1 INTRODUCTION

Regardless of the complexity of the water challenges facing the nation we need to have enough clean water now and in the future. Whilst water demand is increasing due to growth in population and the economy, along with urbanisation and land-use changes, we have to usher in the future water situation we require now. In the next 5 years, there is a need to ensure that these five pillars are addressed urgently:

- Innovative water technologies
- Smart policy
- Adequate financing
- Good governance
- Appropriate skills

Solutions to the country's growing water challenges lie, in part, with the development and adoption of new innovative technologies, paradigm shifts in our technological choices, our ways of working and our ability to smartly and responsibly open up our water services markets leading to creation of new products and services and new industries. But current investment in water innovation is extremely low, especially investment by the astute promoters of innovation – such as venture capital and corporate research and development – and the primary purchasers of innovation such as water sector institutions. This low investment may explain the low levels of innovative output, as measured by patent filings, adoption and diffusion (inclusive of upscaling, replication and institutionalization) of new innovations.

The recent and current extreme weather conditions have further demonstrated to us that unless we take innovations to application, we shall continue to be challenged. The WRC plays a critical role in filling the gap in the water research, development and innovation (RDI) value chain for South Africa. Investing in mechanisms and platforms towards transforming and capacitating the water sector is a central focus of the WRC's Business Development and Partnership efforts. This requires strong partnerships underpinned by smart policy and adequate financing.

The WRC has to continue with initiatives to ensure that all relevant sectors are engaged in these matters.

Scaling up and optimization of technologies and solutions requires significant investment and South Africa lacks venture capital funds from both the public and private sectors to support technology development and de-risking in the public environment. The public sector procurement policies disable any attempts to support technology developers as they require zero-risk spending based on the PFMA and MFMA. Creating sustainable value also requires a focus on social and institutional innovation to create enabling environments through policy shifts and new practices in the public sector. This leads to the critical need for good governance and appropriate skills.

The Innovation and Impact (I&I) branch of the WRC is geared to address the above issues, focusing on the following (Figure 27):

- The positioning of the WRC as a premier knowledge hub, leading the sector in terms of disseminating appropriately packaged knowledge products including multimedia and interactive solutions; taking things further we will embark on integrating knowledge generated by other bodies, making available and accessible credible water data and information, hence improving the general uptake and use of water management knowledge by the relevant sectors of the population.
- Inspiring water conversations, ensuring that water and water-related knowledge permeate through all sectors of our population leading to better understanding of water management issues and hence behavioural changes, positioning the WRC and its personnel as the credible water conversation leader in all media channels
- Creating a robust and vibrant innovation ecosystem that allows the WRC to play a lead and co-ordinating role with strategic sector partners in accelerating innovations and best practice to the market
- Creating an environment whereby professionals and



“

The recent and current extreme weather conditions have further demonstrated to us that unless we take innovations to application, we shall continue to be challenged.

non-professionals can contribute and channel their knowledge and innovative skills to solving water problems from a multidisciplinary point of view

- Drawing various stakeholders to engage in water conversations and tell their water stories, and supporting the development of appropriate skills
- Supporting and influencing the development of smart policies, improved partnerships and good governance

Organising for maximum impact

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 service delivery 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 practice. Above all, research must be of the highest quality: we cannot have impact without excellence.

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 national government objectives. Additionally, we are increasing our emphasis on the need for evidence of economic and social returns from our investment in research and development. Demonstrable impact helps to verify that research is important – that it is worth investing in and applying. Evaluating our impact also enables us to see what works and why. These lessons can then be implemented both by the WRC and our stakeholders.

High-quality research has the potential to enhance social and economic wellbeing across all sections of society. To maximise the impact of our research, we need to continue with engagement of our key user groups. This provides substantial benefits to the quality of our own research and development, 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 to ensure that we have a set of high-quality researchers and students to develop new solutions, and critique current solutions
- **Recognition**, developing new skills and raising our profile, to ensure that we include critical users of information and solutions during the development of innovations for the water sector and play a role in nurturing an innovation culture amongst policymakers and practitioners, and develop new workforce skills as we prepare for the future

Our continued efforts aimed at achieving maximum research impact include socio-economic impact, academic impact, or both. Socio-economic 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 and meaningful contribution to the water and water-related knowledge pool. The impact of research can be instrumental, (i.e. influencing the development of policy, practice or service provision, shaping legislation, altering behaviour, etc.) or conceptual (contributing to the understanding of policy issues, reframing debates, etc.).

To achieve our goals for maximum impact in the next 5 years, we will continue to:

- Identify and work with key partners and stakeholders, for example, other researchers, public sector and 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
- Position ourselves to ensure that we all can benefit, for example, through organising public events, conferences, interaction with the media, sharing of intellectual property
- Create platforms designed to receive stakeholder ideas, concerns and needs, that can reshape our research questions and continue to improve our offering

Figure 27: Rethinking Impact



Knowledge dissemination

The dissemination of research findings is defined here simply as the process of sharing information and knowledge. Knowledge dissemination should address the challenge of improving accessibility of research findings to those we are trying to reach and ensure the physical availability of research output materials to a larger proportion of our target audience. Research dissemination should also seek to make research findings comprehensible to those who receive them. At the WRC, dissemination of research findings continues to be focused as follows:

- Highly prioritized and treated as essential means of maximising the impact of research on development
- As an intrinsic element of all good research practice, especially in the water discipline
- As an enabler for content flow from where it has been generated to where it can be effectively applied
- As providing value to research projects, increasing their visibility and hence the potential for wider application
- As promoting the public profile of the WRC whilst strengthening its research profile

Towards a premier knowledge hub

The conventional model that the WRC has been applying for quite some time is the linear knowledge transfer model. This model adopts the approach where information is seen to flow from the information provider, via a chosen media (publications and reports), to the information user. This model assumes that the dissemination is a one-way, top-down flow of information from research experts to a passive audience. Recent developments at the WRC have demonstrated that information flow is a far more complex process – it is an interactive, multidirectional exchange of knowledge and ideas and that should be reflected in the research dissemination approaches promoted in this strategy. The WRC continues to strive to develop and enhance its knowledge dissemination expertise and activities to deliver value effectively in these complex spaces.

Maximising impact through inspiring water conversations

Advancing and inspiring water conversations within the water sector in South Africa defines the strategic approach of the WRC, building upon the insights, results and examples gleaned from research and development. This approach also builds upon the attributes of interpersonal conversation: intimacy, interactivity, inclusion, and intentionality and indicates a slight departure from traditional water sector engagements.

Critical elements of sector conversations include the following: exchange of comments and questions between a group of people which results in open and fluid exchange of knowledge (such as dialogues), as compared to seemingly closed and directive exchange. Social technology gives sector leaders the means to foster a genuinely interactive culture – values, norms, and behaviours that create a welcoming space for dialogue.

The other attribute is inclusion. At best, sector conversation enables participants to share ownership of the substance of their discussion. Consequently, they can put their own ideas – and, indeed, their hearts and souls – into the conversational arena, and this is critical for the water sector.

Such an approach would also promote brand ambassadors and thought leaders within the sector. For the WRC to develop and promote thought leadership and storytelling is a smart and quick way to bolster the WRC's reputation and relevance.

Fast-tracking water innovations to application

The goal of the South African water sector is to provide the public with reliable and safe water supplies and to dispose of wastewater safely and in compliance with national water quality regulations. However, several challenges have rendered the achievement of this goal rather difficult. On the other hand, this has opened opportunities for a variety of new technologies. The country is taking great strides in shifting focus from supply enhancement to demand management. Current practice has demonstrated that innovative technologies, coupled with incentives and education, can greatly reduce water use. As a result, there is increasing interest in technologies that are more water efficient and in technologies that can help encourage greater conservation among consumers. These innovative technologies will generally fall under the following categories:

- **Supply enhancement:** A need to focus on technologies that are more drought resistant, such as water reclamation, water desalination, and technologies that allow localized resource enhancement such as rainwater harvesting, fog harvesting, etc.
- **Demand management:** Focus on technologies that encourage or enable water use efficiency (achieving the same with less water) and reducing water consumptive activities, decrease the costs and pollution associated with wastewater disposal, water-smart irrigation, technologies that encourage behavioural change, etc.
- **Governance improvement:** Technologies that will help tackle inefficiencies in the water governance system, such as smart metering, leak management, and better understanding of customer behaviour.

The innovative technologies may be classified as follows:

- **Technologies to explore alternative sources:** Technologies with the potential of producing water from non-traditional water sources such as desalination, acid mine drainage, rainwater or stormwater capture, and reuse of wastewater.
- **Smart water technologies:** Technologies that integrate information technology into water accounting and management, such as leak detection, smart water meters, and Internet-based water-use solutions and software. These innovative solutions enable water service providers to enhance supply and curb demand simultaneously.

- **Technologies promoting water use efficiency and conservation:** Technologies that enable short- and long-term demand management in various sectors, such as irrigation sensors, low-flow plumbing, and water-efficient appliances.
- **Water purification technologies:** All the technologies that are used to purify, filter, disinfect, and produce water of different quality for different beneficial uses.
- **Groundwater:** Technologies that enable water infiltration and groundwater banking and recovery.

While the water sector offers many opportunities to innovate and deploy new technologies, in practice the sector has barely tapped the potential those technologies offer. Various hurdles currently inhibit the development, testing, adoption, and diffusion of new water technologies. Other sectors of the economy have experienced various levels of success when it comes to addressing the need for new technology – yet very little of this cross-sectoral learning occurs in the water sector. Various barriers have inhibited fundamental change in recent decades in the basic technologies. Addressing the coming challenges will require new approaches. In this document, we put forth a new strategy to increase innovation and speed-up the deployment of new technologies in the water sector.

Global impact and stature

The WRC recognises that water scarcity is one of the most important and complex challenges facing South Africa, the continent and the world today, and will continue to be the case for the future, especially for South Africa should the national water use and water resource management policies and operations continue as is. As the major funder of water research in the country, it is of crucial importance that the WRC establish international partnerships and facilitate collaborations between South Africa and leading teams in the continent and the world. This will help to position South Africa as a leading knowledge partner, resolve South Africa and Africa's water challenges, and make a substantial contribution to the generation of global knowledge and technological solutions.

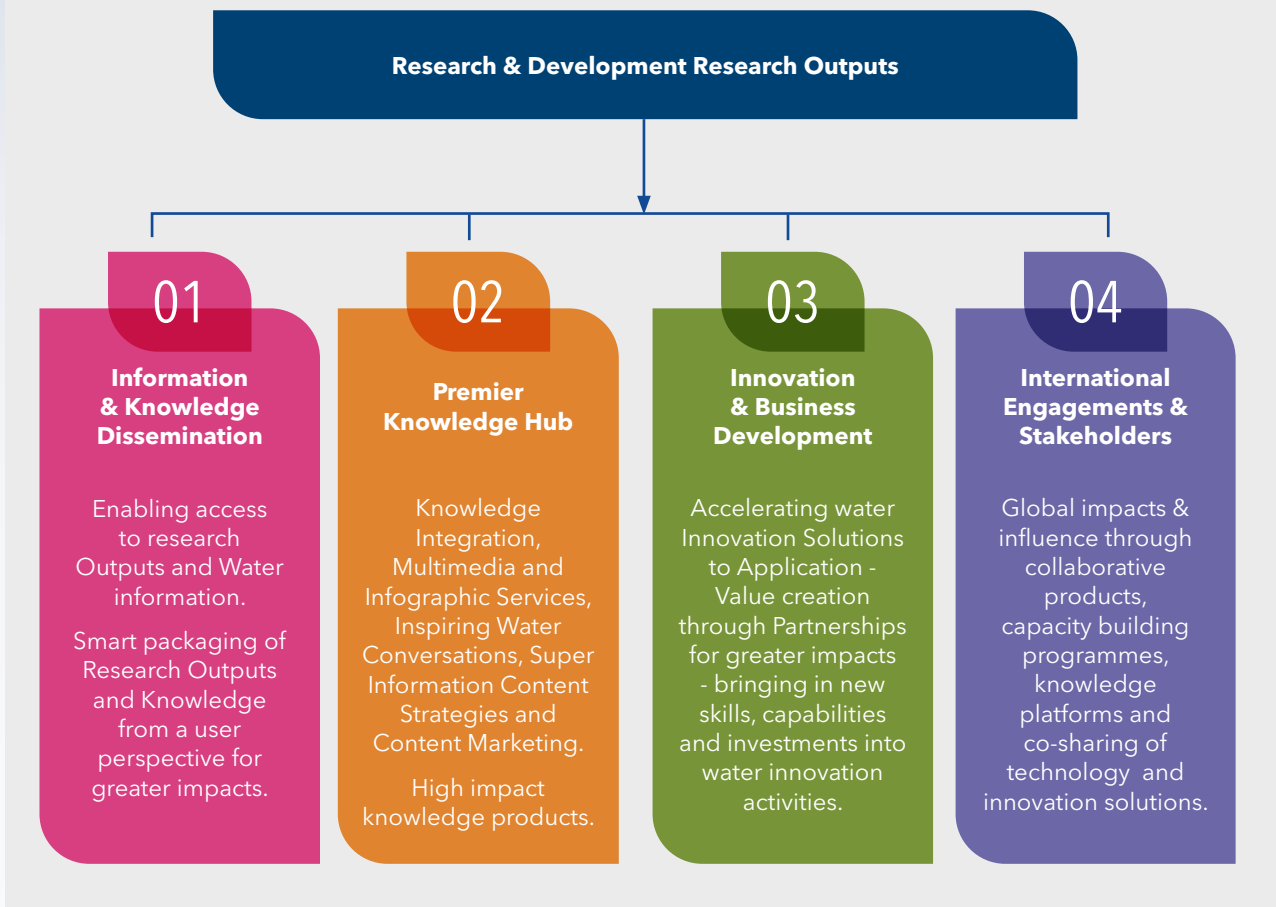
Since its establishment, the WRC has built fruitful international partnerships across different stakeholder groups and undertaken a wide range of international activities that helped to raise awareness and build a good reputation for the WRC, the South African water sector, in the continent and internationally. The activities include: promotion of South African expertise; facilitating South

Africa's access to international programmes, projects and funding; facilitating South Africa's participation in strategic conferences and workshops; and serving on international policy and technical steering committees and working groups that shape the global and regional water agendas.

Organisational structure of Innovation and Impact branch

The Innovation and Impact branch is organised into four units (Figure 28) each focusing on specific activities to implement the WRC strategy whilst working together.

Figure 28: From Research and Development Outputs to Application



9.2 KNOWLEDGE SERVICES AND COMMUNICATION

Positioned as a premier water research science commission in South Africa, the WRC is a trusted go-to Research Development and Innovation (RDI) partner and premier source of knowledge for the South African water sector. The organisation's operating model is anchored on collaborative co-creation, delivering impact through

a stakeholder dependent multiplier strategy. Making stakeholder intimacy through a deep understanding of our stakeholders and their needs a key strategic lever in impact delivery and ultimately the successful implementation of our strategic objectives.

The WRC multiplier strategy is central to its knowledge dissemination strategy, evidenced in the organisations



Above: A central part of the WRC's strategic approach is to advance and inspire water conservations.

support and amplification of knowledge generated by other bodies. This enables the WRC to make available and accessible credible water data and information and ultimately improve the general uptake and use of water management knowledge by the relevant sectors of the population.

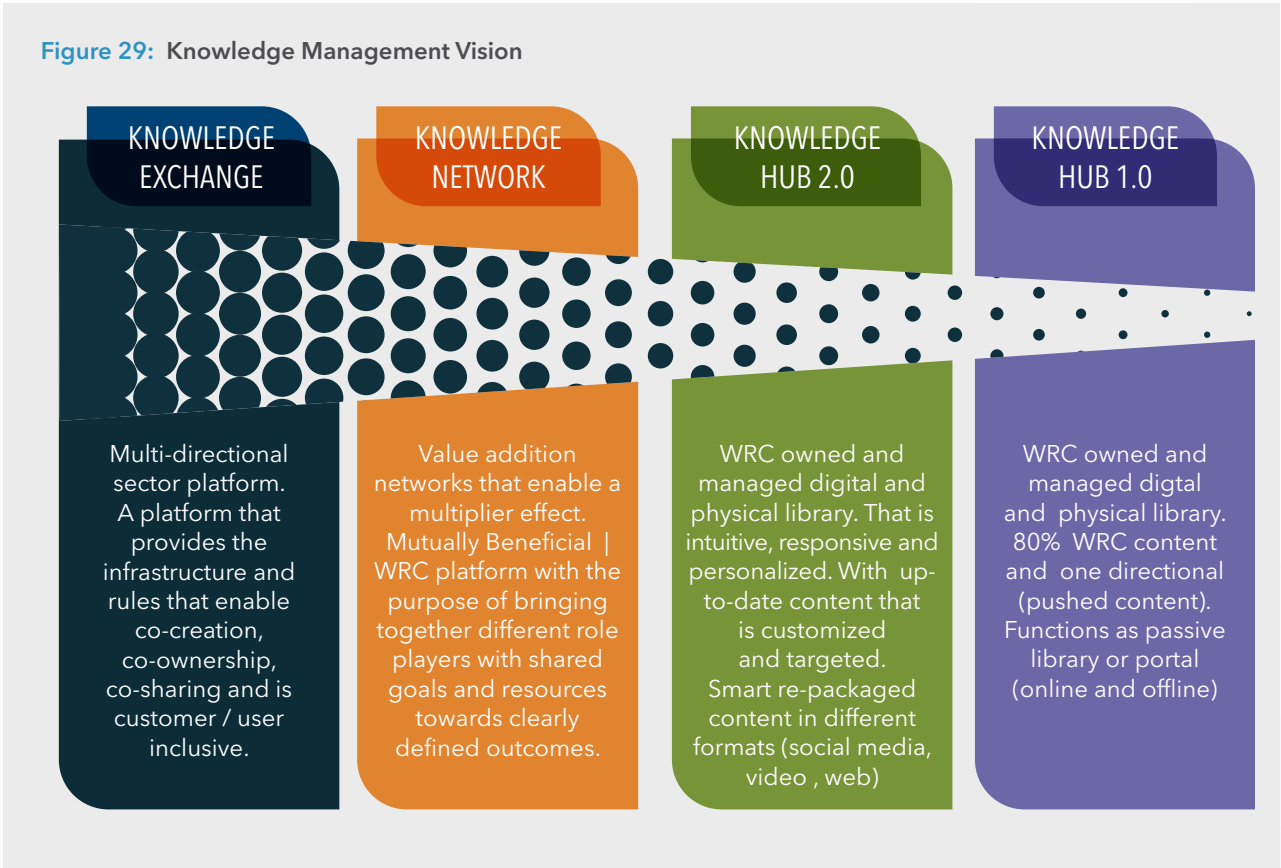
Key to our approach is the strategic focus on operational excellence and stakeholder intimacy. Our strategy is focused on the transformation of our operational process, the upskilling of our people and the alignment to an innovation culture that will enable the WRC to deliver against its position of the premier knowledge hub.

To fully realise its mandate and live-up to its positioning the WRC's knowledge dissemination strategy is poised to respond to the demands of the macro-environment through an appropriately resourced and capable micro- environment. The Innovation and Impact branch has embarked on its knowledge dissemination and communication strategy since 2017, with the aim to improve the WRC's ability to engage target audiences into a participatory process that would derive value from the WRC activities and knowledge pool while promoting the results and achievements of our research outputs.

Key to the success of our strategy is 1) effective marketing and content management as well as 2) superior knowledge dissemination and 3) smart application of technology that will result in the appropriate use and application of WRC knowledge products by our various stakeholders.

Knowledge management vision

The vision for knowledge management is to deliver actionable intelligence through people, technology and systems that will in-turn facilitate the realisation of the WRC brand vision. The objective is to in future deliver, a multi-directional, highly responsive and collaborative knowledge exchange. Accomplishing this will require a dedicated focus on enabling the knowledge management (KM) strategy we have today to create the KM strategy we want in the future. Currently the focus is on delivering the WRC knowledge hub 2.0 strategy in parallel to the WRC knowledge network strategy. Due to the exponential development and change in the macro environment powered by technology, a linear approach focused on a staged application of our strategy may result in the organisation lagging competitors and losing relevance with stakeholders. This would be due to the needs of the macro environment, fast outpacing the ability



of the organisation to effectively respond. Actionable intelligence is about having the necessary information immediately available to deal with the situation at hand. Our knowledge management vision is thus to deliver actionable intelligence from water research science to all levels of stakeholders in South Africa and beyond its borders.

The WRC knowledge management framework

The changing macro-environment and the persisting water crisis in South Africa has changed the landscape and directly impacted the demand for water management knowledge beyond the technical community in the water sector, and as such created a huge demand for water research science related content in new market segments. This combined with the shift in the macro environment from static content to more interactive and actionable intelligence that can be gained speedily. The ability for the WRC to adequately respond to the changing environment requires significant investment in infrastructure, re-skilling and training of employees and as such will take time. However, the transformational impact that the coronavirus pandemic has had on the world of work has significantly increased the pressure to

shorten learning and adaption and embrace new ways of working.

The bedrock of the knowledge management strategy will be built on the core infrastructure developed for knowledge storage and security. The continual review of core organisation platforms to better aid the knowledge creation and acquisition process while ensuring that the transfer of knowledge from legacy systems onto new platforms enhances knowledge dissemination, will be essential to successfully attaining our vision. This can be achieved by investment in technology and systems that will enable the safe storage and retrieval of WRC content across teams and by external stakeholders. These interventions supported by a robust governance strategy to aid application across the organisation and encourage accountability will bring us closer to delivering actionable intelligence.

Figure 30 highlights the key building blocks that will be required to support the vision to deliver actionable intelligence from water research science to all levels of stakeholders in South Africa and beyond its borders. The combination of the WRC's extensive partner network, rich content and growing digital competencies

Figure 30: Knowledge management framework



will bring the organisation closer to using its knowledge products to deliver unmatched user experience and value.

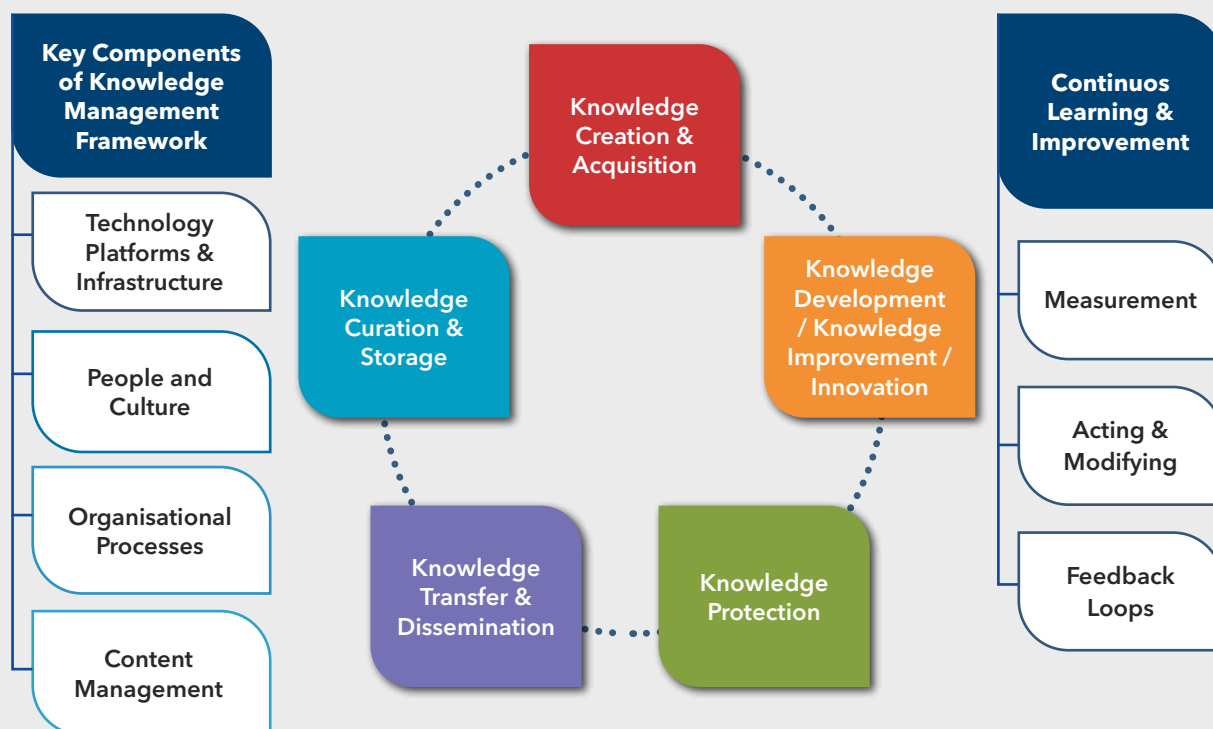
To support the knowledge management framework detailed in Figure 30 consideration needs to be given to: a) technology platforms and Infrastructure; b) organisational processes; c) people and culture; and the d) management of content.

- a. Technology forms a critical bridge that enables people to connect and collaborate with each other and is critical to the storing and safeguarding of information. While fit for purpose infrastructure will facilitate the storage, retrieval and access to information.
- b. To support a culture defined by continuous learning, sharing and good governance, defined steps for knowledge capture and use will be core to the development of business processes. This will enable knowledge management to be a routine part of working and will prompt the on-going review of progress, signal potential improvements and facilitate learning.

- c. People and culture are the most critical elements of the WRC knowledge management strategy, as collaboration, knowledge sharing and learning across different divisions and areas of specialisation is central to the success of the WRC's knowledge dissemination strategy.
- d. A content management strategy will define the scope, frequency and implementation requirements for developing and managing content, while answering the questions regarding: what content? Who creates the content? When and how is it accessed?

Our knowledge management approach needs to be circular as depicted in Figure 31 driven by a strategic focus on operational excellence and stakeholder intimacy and a dedicated focus to continuous learning and improvement. The key elements of which will include periodic measurement of our impact with stakeholders, modifying our outputs based on the feedback that we receive and ensuring that learnings and improvements are documented for further knowledge dissemination with our stakeholders.

Figure 31: A circular approach to knowledge management



Management Area 1: Knowledge dissemination

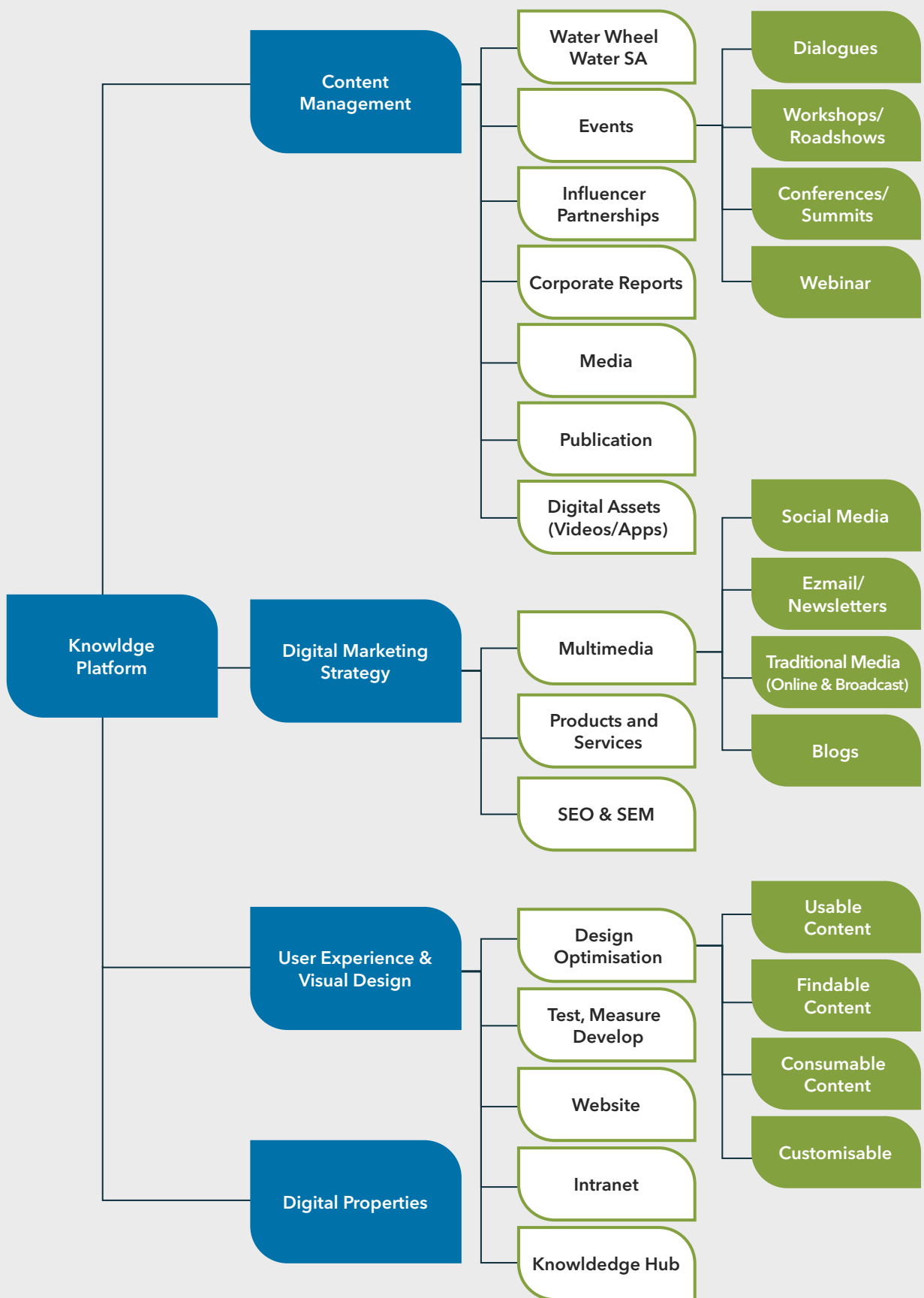
The dissemination of research findings is defined here simply as the process of sharing information and knowledge. Knowledge dissemination should address the challenge of improving accessibility of research findings to those we are trying to reach and ensure the physical availability of research output materials to a larger proportion of our target audience. Knowledge dissemination should also seek to make research findings comprehensible to those who receive them. Content management at the WRC is highly prioritized and treated as essential means of maximising the impact of research on development. As providing value to research projects, increasing their visibility and hence the potential for wider application and finally, promoting the public profile of the WRC and its value add, whilst strengthening its research profile. Therefore, content strategy aims to;

- Improve our content development, packaging, and adaptation/adoption of new dissemination approaches
- Increase our multi-media capabilities, content reach and relevance (internal and external)
- Enhance the ability of our key stakeholders to make informed decisions and feel empowered
- Develop a content marketing strategy in view of a channel strategy
- Attract stakeholders to utilise and value the products and services of the WRC
- Accelerate our efforts in putting in place internal integration processes to support the above

Enabling access to research outputs and water information is central to knowledge dissemination and the impact of the WRC's knowledge dissemination efforts, while greater impact can be achieved through smart packaging of research outputs and a deliberate focus on user centricity.

Figure 32: Dissemination of knowledge products and services for impact

KNOWLEDGE PRODUCTS		RESOURCE SKILLS
Ministerial Briefs	Research Reports	Graphic Design
Policy Briefs	Media Briefs	Copy Writing
Parliamentary Briefs	Speaking Notes Minister	Content Development
Technical Briefs	Special Publications	Web Development
Working Papers	Posters	Digital Marketing
Knowledge Review	Infographics	Communication
State of the Knowledge	Fact Sheets	Videography
State of Science	Conference Reports	Illustration / Animation
Technology Portfolio	Presentations	Photography
Corporate Reports	Opinion Pieces	Editing
E-Newsletters	Videos	Social Media
Brochures	Event Reports	Data Science



Management Area 2: Content development and special publications

The strategic focus for knowledge services in the next few years, is to continue with the coordination of the WRC's knowledge dissemination and information and use these to position the WRC as the premier water knowledge hub, whilst integrating seamlessly with the communication and marketing strategy. Supported by a superior content strategy for improved impact. The WRC will continue pursuing this goal through:

- Advancing, or extracting value from our research and development activities and those of our partners, generating content, developing knowledge products and exploring business development opportunities
- Producing, managing, distributing and storing information and knowledge resources, providing assistance, and sharing solutions
- A deeper knowledge and understanding of our customers, that will aid the development of appropriate and relevant knowledge products
- Initiating and rolling-out new initiatives that will make water knowledge more accessible to the 'man-on-the-street'

Content Development and dissemination will therefore adopt the following approaches to improve our engagements with stakeholders for improved impact.

- **Real-Time Marketing** - This is the process of leveraging events and using social media (Live Video/ Live Tweets).
- **Video Content** - A descriptive video or even slideshows can help you deliver information in a more effective way, and your audience will prefer looking at a video on their phones in addition to reading blogs/news through written content.
- **Thought Leadership** - This involves the senior management publishing blogs, articles, views, etc. on various portals. Publishing such blogs on reputed portals like LinkedIn will help increase credibility of the Leader as well as their company.

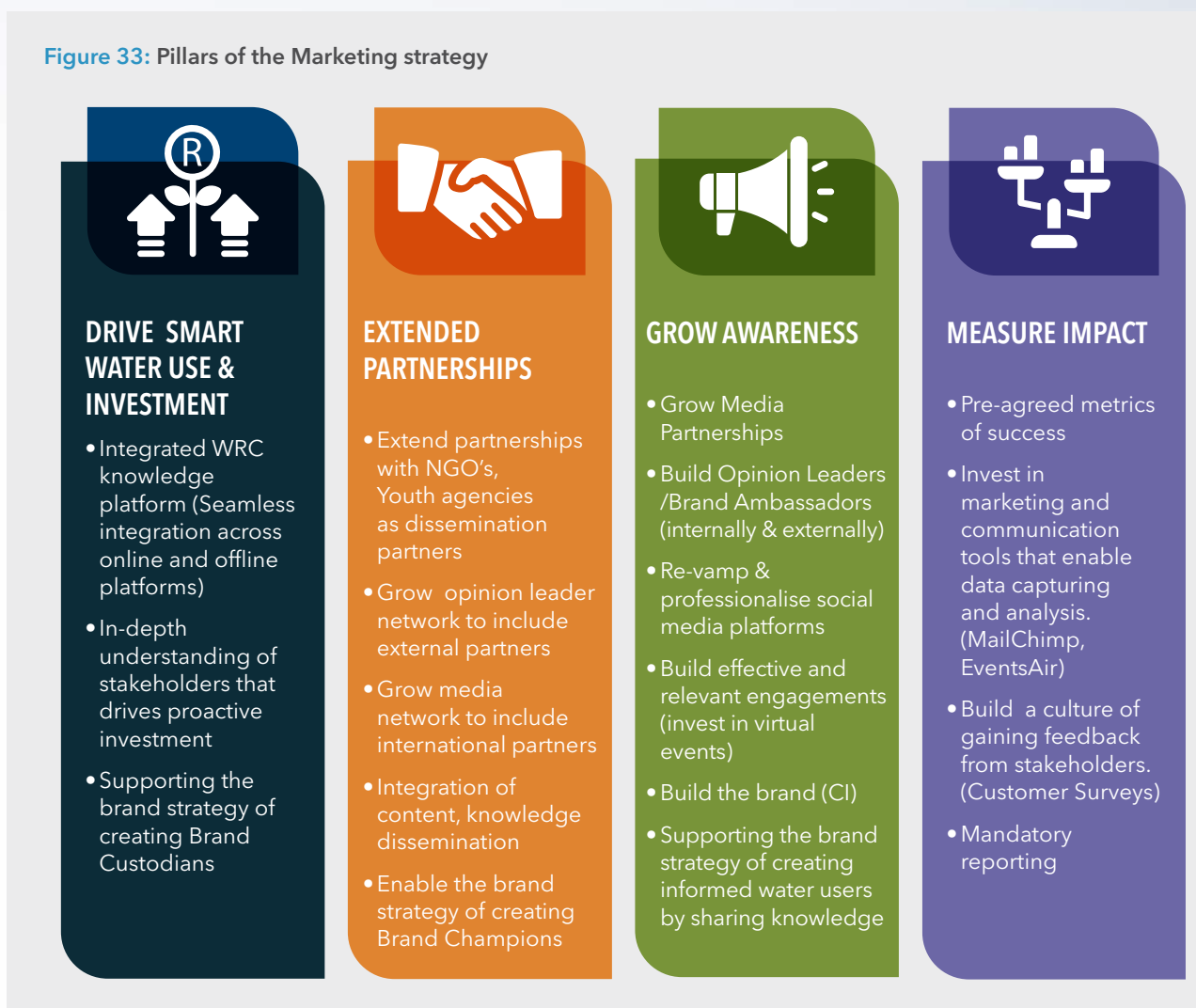
- **Measuring Engagement** - What will help us understand the real impact of the content shared is by measuring the kind of engagement that it gathers. You can easily analyse the type of people that are engaging with your content.
- **Content Marketing** - Content marketing is a strategy to create, curate & amplify a content for building advocacy & thought leadership which can directly result in achieving business & marketing objectives by influencing a set target audience. To increase the readership and reach of that content, you need to amplify it through Social Media. Using tools like Facebook Ads, Twitter Promoted Tweets and LinkedIn Sponsored Updates, you can choose who exactly you want to target and gather the type of engagement your content has generated.

The goal of this approach is to create meaningful, cohesive, engaging, and sustainable content. The strategy helps you to identify what already exists, what should be created and, more importantly, why it should be created.

Management Area 3: Marketing and events

Marketing, in the next 5 years, will focus on the improvement of the public and political profile of the WRC by enhancing the credibility and relevance of the WRC and water knowledge through strategic positioning and strengthening of stakeholder relations, public engagement, media engagement, parliamentary liaison, strategic communication, events management and marketing initiatives and programmes. This includes engagement with relevant stakeholders and national programmes and partners for impact. Key to the implementation of the WRC marketing strategy will be a dedicated focus on; 1) growing brand awareness; 2) Extending strategic partnerships; 3) Driving smart water use and investment; 4) Measuring Impact.

Figure 33: Pillars of the Marketing strategy



To deliver against the key pillars of the marketing strategy and effectively support the organisation's corporate strategy a strong focus on professionalising the marketing and communication outputs over the next three years will include:

- The WRC branding and positioning strategy focused on the development and refinement of the WRC brand identity and image.
- Digitalisation on the overall marketing approach over the next five years, supported by a digital marketing strategy which details the transition to digital platforms that are relevant and enables extended reach to a diverse stakeholder base.

Alignment to the organisational digital transformation vision and embracing new tools required to remain

competitive in our new context will be the foundation upon which the pillars of the WRC marketing strategy referred to in Figure 33 are built.

Brand-led communication

Enabling access to research outputs and water information is central to knowledge dissemination and the impact of the WRC's knowledge dissemination efforts, while greater impact can be achieved through smart packaging of research outputs and a deliberate focus on user centrality.

The WRC's communication strategy supports the brand vision for highly informed water decision making through science and technology by ensuring that the strategy is build on three key phases of impact namely:

Inspiring conversations, Enabling water behaviours and Nurturing our water legacy each stage designed to transform informed water users through research, development and innovation to brand champions and custodians who are co-collaborators in bringing our brand ambitions to life.

The following strategic initiatives need to be adopted:

- User-focused dissemination: getting the right content to the right user at the right time through strategic planning of content creation, delivery, and governance
- Approaching water information as a medium that needs to be strategically selected and placed to engage the audience, convey a message, and inspire action

Marketing and Communication will develop and implement various mini strategies to pursue the following:

- Inspiring water conversations nationally – which may be considered as a ‘push’ strategy, engaging the nation in water discussions and imparting critical water management knowledge
- Partnership with other national and private initiatives to promote water solutions and the WRC brand
- Promoting WRC professionals so that their knowledge and skills can benefit communities
- Effective and efficient use of various media channels, including social
- Redefining the events space to support the above initiatives
- Support the political profile of the WRC by enhancing the credibility and relevance of the WRC through strategic positioning and strengthening stakeholder relations
- Develop, coordinate and implement the WRC’s Media and Communication Strategy (ensuring that all activities related to the media, parliamentary liaison, conference exhibitions, sponsorships, awards, advertisements, press releases, corporate videos, social media, and multi-media presentations

Figure 34: Brand Led Communication Roadmap



are part of the communication portfolio's plans)

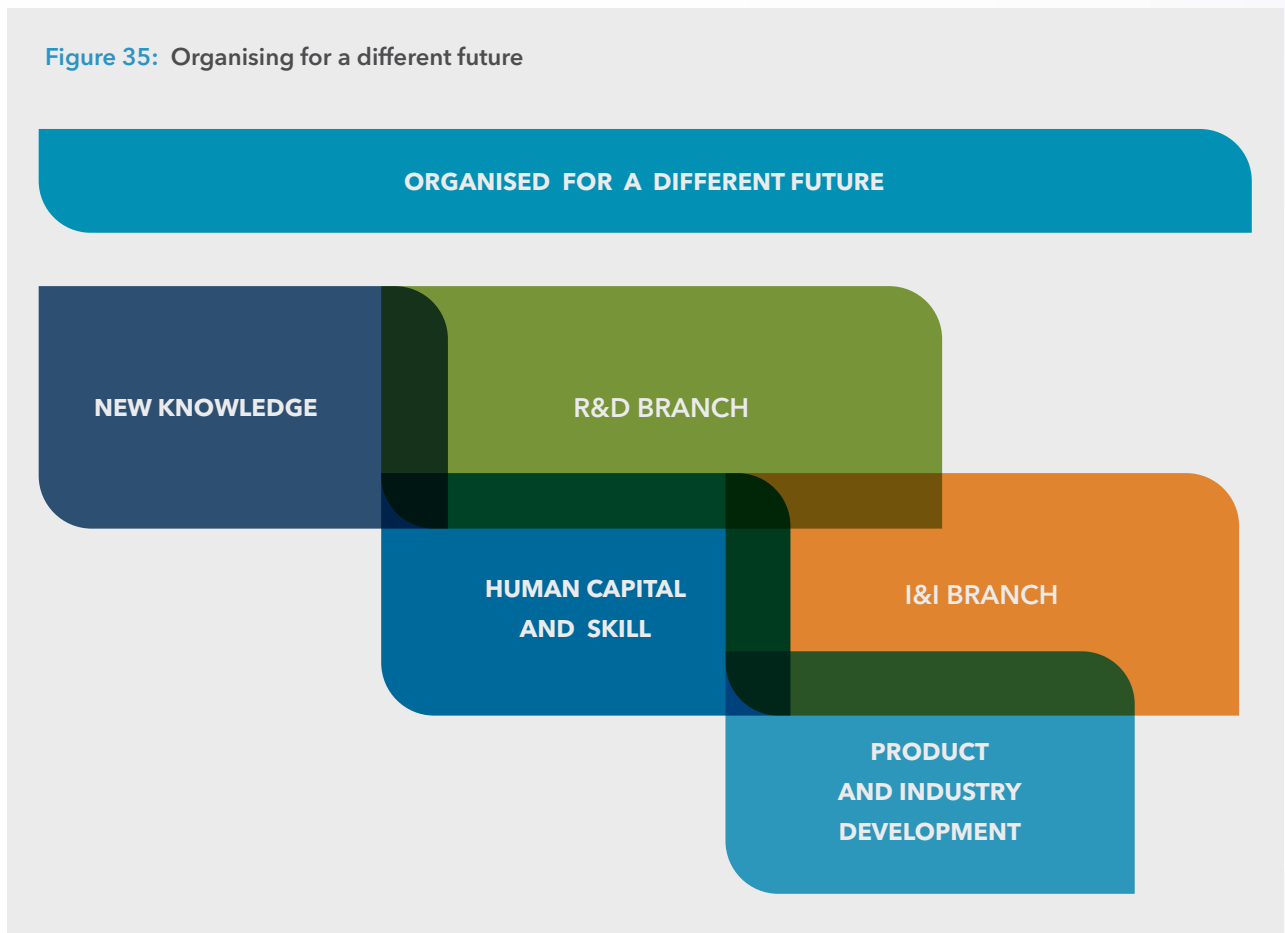
- Meet regularly with business divisions to assess division-specific communication
- Broaden social networking to benefit the organisation
- Continuous engagement with research managers to ensure proper engagement with the media

9.3 BUSINESS DEVELOPMENT AND INNOVATION

At the heart of the Business Development and Innovation (BD&I) strategy is the recognition that South Africa is faced with the triple challenge of poverty, unemployment, and inequality. Therefore, while the WRC seeks to provide the sector with appropriate

solutions for application and use, it also seeks to use knowledge-based capital and the innovations that are developed through public (WRC) and private (SMME) funding to create opportunities for new businesses (through the positioning of new products and services) to enter the water sector, thereby transforming the sector through inclusivity of women, youth and previously disadvantaged individuals in opportunities of entrepreneurship, research, consultancy, and practice. Thus, the Innovation and Impact Branch core function is scale up and value creation of knowledge products and services for all sector partners, including, where possible, to influence and support new skills development (Figure 35).

Figure 35: Organising for a different future



The WRC R&D branch, the Innovations unit, and the Business Development unit works through integrated business processes to create mutual benefits and value for the WRC, the water sector, SMMEs, entrepreneurs, and its partners. (Figure 36). Hence the strategic goals

of this unit are fully aligned to the organisation's goals:

- Influence policy and decision-making across all water sector institutions and via cross-sectoral partnerships, particularly around innovations,

technology transfer, and science, technology and innovation (STI) policy

- Develop, analyse and facilitate the water sector innovations to the stage where products and services are closer to the market and ready for uptake, commercialization, localization, and diffusion
- Scale up sustainable solutions with strategic and business development partners to ensure

impact (application through services, social entrepreneurship or commercialisation)

- Strengthen human capital development opportunities for the sector across the entire water value chain by sharing information and strengthening new workforce skills
- Empower communities with new knowledge, innovations and goods and services for social and market-based entrepreneurship opportunities

Figure 36: Business Development strengthening the role of the WRC as a transformative partner



The business development and innovation division converts innovations and partnerships into value creation and catalytic opportunities for the sector by embracing the core principles of the organisation, i.e., people, positioning, paradigm, and partnership. It recognizes the power of building the right networks of ecosystem partners on either side of the WRC water value chain, as well as across sectors, and empowering them with the relevant knowledge, innovations, skills, and opportunities. The BD and I team uses both human-centric and technocentric tools and mechanisms to amplify diffusion and connectivity. This model offers a unique opportunity to create a multiplier effect which will accelerate diffusion of water knowledge, products, and services to policy-makers, practitioners, professionals, NGOs, entrepreneurs, enterprises, and communities. CP21 will also focus on enabling technology transfer

and market development strategies to strengthen value creation for entrepreneurs and enterprises to accelerate knowledge services and products to the sector and strengthen the financial sustainability of the organisation.

To ensure that the WRC achieves its vision of creating knowledge that positively impacts on the lives of millions of South Africans either directly or indirectly through the water sector and RDI cohort, the Business Development and Innovation division has organised to accelerate research, innovation, and human capital development by focusing on the following pillars:

- **Operational effectiveness and excellence:** Create both internal and external enablers to effectively implement the corporate plan by adopting a model

of operational flexibility that allows the organisation to pilot, test, and incubate ideas and opportunities that support the water and sanitation national system of innovation (NSI), the water sector and the internal operations of the WRC.

- **Connectivity:** Grow the capabilities of the WRC as a collaborative connector organisation with local, national, and global partners and stimulate and influence support for the broader water and sanitation national system of innovation ecosystem development, support and alignment. The division will seek collaborative platforms and networks with traditional and non-traditional partners to stimulate and encourage innovations thinking and 'intrapreneurship' in the WRC and with strategic institutional partners. We will develop supply and demand-driven innovations and relevant innovation services mechanisms to support the acceleration of innovations through the water and sanitation value chain and work with partners to develop a vibrant ecosystem of National System of Innovation (NSI) partners innovators, entrepreneurs, enterprises, investors, and funders.
- **Water Sector Intelligence and Support:** In 2021/22 we will continue to assess methodologies and approaches with strategic private sector and public sector partners to ensure a more robust analysis of the water innovations portfolio in order to improve investment, re-investment in support of critical market-driven innovations, entrepreneurship and enterprise development. In 2023/24 the WRC will work with sector partners to develop the second Water RDI Roadmap (II) to signal priority areas for water sector support.
- **Partnership:** We aim to develop long-term beneficial relationships with strategic traditional and non-traditional partners to complement the WRC mandate on either end of the value chain for strategic WRC and water sector outcomes. We will seek to raise the strategic nature of current partnerships to achieve greater impact in prioritised areas and to enable the achievement of the strategic (Knowledge Tree) goals of the WRC.
- **Implementation:** Play an implementing agent role for large and strategic projects, programmes and

platforms that support research, development, innovation and scale-up. This could transition to the Project Management Unit (PMU) to ensure excellent project execution for partners and focused management to minimize risk, enhance reputation, and amplify opportunity and impact.

Business Development

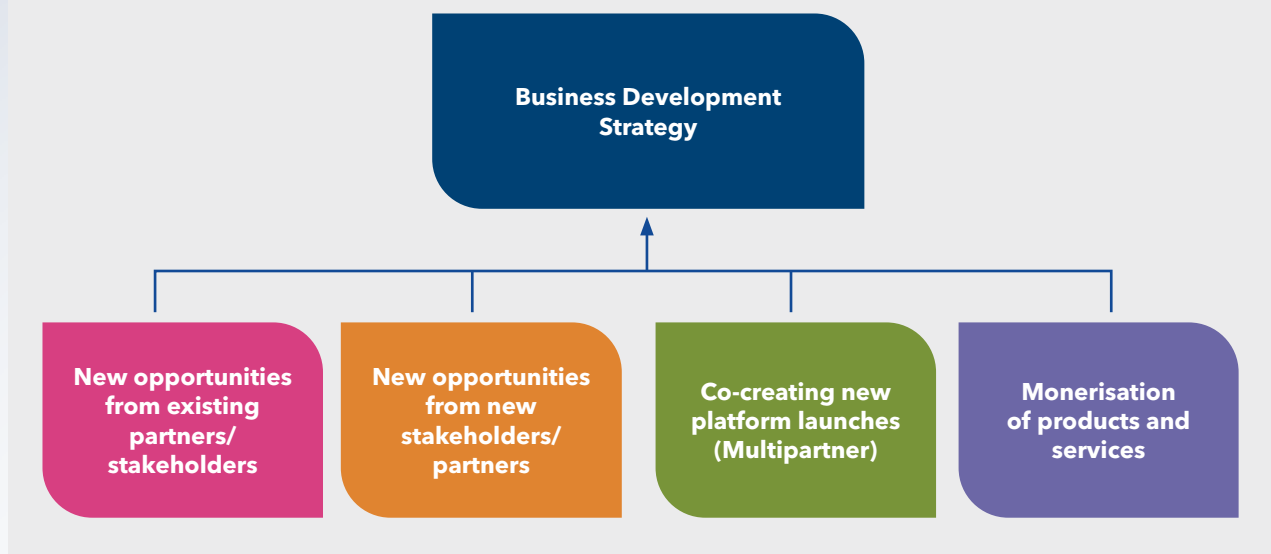
The WRC has embarked on a business development and partnership strategy (through the BDI and ISE Division) to create impact from WRC managed research and to diversify its income streams as part of a risk reduction strategy to enhance financial sustainability. The latter was identified as a key risk in the organisation and is due to a number of factors such as the increased budget demands, difficult economic conditions, uncertain political environment and a predominant view that RDI is a cost rather than an investment. The WRC plays a critical role in filling the gap in the water research, development and innovation (RDI) value chain for South Africa. Investing in and leveraging support for water solutions, mechanisms and platforms, that will contribute towards transforming the water sector and support capacity building and knowledge sharing, is central to the WRC's Business Development and Partnership efforts.

Strategic goals

The WRC's BD strategy (Figure 37) will involve:

- Seeking new leverage and business development opportunities from existing partners
- Seeking new leverage and business development opportunities from new (non-traditional) partners
- Co-creating or developing new platform and business launches
- Evaluating and monetizing products and services relevant to the WRC and sector

Figure 37: Four strategic areas of exploration for business development



Traditional partners include the Department of Water and Sanitation, the water sector institutions, other national departments like the Department of Science and Innovation, Department of Environment, Forestry and Fisheries, Department of Human Settlements, Department of Agriculture, Land Reform and Rural Development, state-owned entities like Sasol and Eskom who have large water allocation footprints and industry partners like the mines who have both a large water use and waste production footprint. Non-traditional partners include the private sector (non-water-sector businesses), provincial governments, investors, SETA's, entrepreneurs, international governments and their innovation NGOs and partners, and foundations.

Co-creating new platform and business launches incorporates initiatives (i) that support closing of the gaps in the national system of innovation for the water sector and are aimed at enabling the strategic goal of development of goods and services for economic development, and (ii) that seek partnerships and leverage on high-impact RDI projects that require scale-up and significant support to enable industry development. The final strategic goal which looks at monetizing goods and services evaluates and supports entrepreneurs and enterprises with each new innovation to strengthen the technical, business and market pathways towards

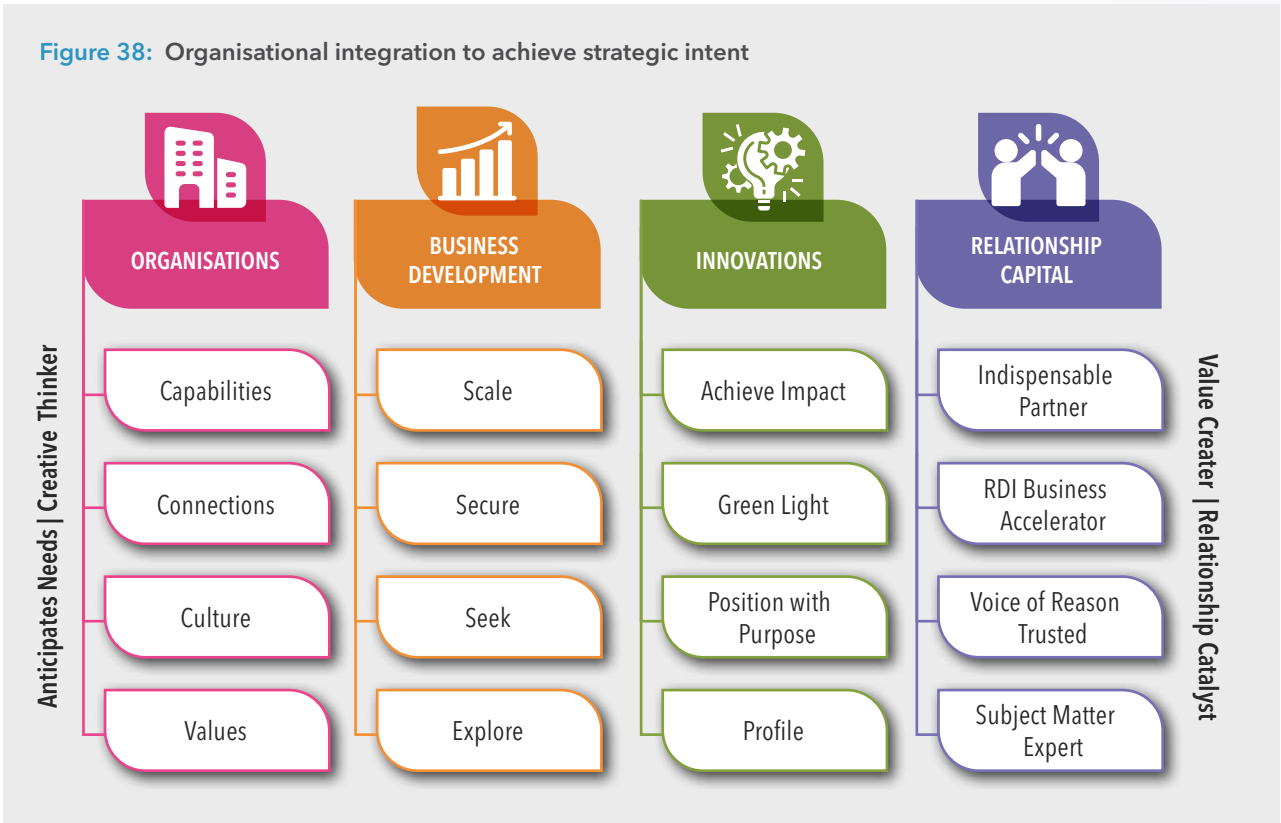
commercialisation, localisation and industrialization of innovative technologies and components.

Strategic Aims 3 and 4 will require an investment in new resources and skills, relevant revenue models and alternative innovative implementation and institutional models. For each new business development opportunity, it is important to assess the revenue and impact potential, the organisational capabilities, the market (water and sanitation sector) needs (futures planning) and demands (current fixes), and the partnership requirements. Pure revenue-based business development opportunities require significant analysis of the customers (market), the value proposition and channels to ensure a high level of success. The key success factors for business development, especially for disruptive initiatives, are strategic focus, innovative partnership and revenue models, technology utilization, consistent business proposition and brand reputation. Finally, the need for cross-sector engagement and establishing co-creation business development opportunities remains high on the WRC's agenda in the 5-year strategic plan 2021-2026.

Business Development is essentially the growth arm of the organisation and hence requires an organisation-wide approach as new opportunities are tested and

rolled out. Figure 38 shows how various parts of the organisation need to evolve as the WRC strategic intent is realized. The values and culture are intrinsic to the growth of the organisation as employees' values and attitudes drive change and growth. Each employee is critical to relationships and connections we build in the wider NSI, sector and across sectors. Each new project will result in building new capabilities in the organisation which then have to be institutionalised and enhanced as part of any organisation's natural growth strategy. The RDI branch and the quality of the innovations it produces, and the WRC strategy of engaging with innovations developed within and external to the WRC and NSI, are critical to guiding business development

as it focuses its approach to explore, seek and secure funds and partnerships that realize scale and impact. The clear profiling of each innovation will lead to the positioning of innovations with purpose and it is this purpose that will ultimately lead to a greater number of 'green light projects' with partners, resulting in higher impact and a healthy set of solutions for the sector and markets. Parallel to organisational capability, innovations and business development is the continuous building of relationship capital at all levels of the organisation. Achieving a transition to being the indispensable partner (one who is seen as a relationship catalyst and value creator) is where the WRC wants to ultimately position itself.



Strategic focus areas

The WRC values the partnerships that have been created and maintained thus far, as they have catalysed opportunities that are bearing fruit for new knowledge, smart implementation and SMME advisory and developmental support. Looking ahead, areas that have been prioritised to seek further leverage and business development opportunities include:

- Engaging on water commercialisation, and localisation:** This includes working with partners such as Department of Trade, Industry and Competition (dtic) on catalysing opportunities for industry partnerships and establishing quadruple-helix (academia, business, public sector and society) mechanisms to fast-track solutions to impact. The WRC will contribute to the development of the

dtic water and sanitation chapter masterplan in 2020 – 2021. Addressing non-revenue water, water use in agriculture and water recycling and reuse to drive water, energy and food security are key considerations for the masterplan. We will seed and stimulate entrepreneurship in the water sector by partnering with the Technology Innovation Agency (TIA) using the WRC/TIA Seed Fund in 2021/22 and test its efficacy in pre-seed and post-seed activity in the next 5 years.

- **Aligning and co-ordinating the water ecosystem partners for impact:** The Water RDI Roadmap is a good example of a smart co-ordinating mechanism for the sector. The Water RDI Roadmap is a partnership initiative between the DSI, DWS and WRC. It is an implementation instrument behind the Research and Development chapters of the NWRS-2 and the National Water and Sanitation Master Plan of 2018. The Roadmap is also closely linked to the priorities of the Industrial Policy Action Plan 2017–2021 and the new water and sanitation industrial masterplan for economic development being developed by Trade and Industrial Policy Strategies (TIPS) for dtic. The National Water Research, Development, and Innovation (RDI) Roadmap is a sector-wide plan to focus interventions in water research, high-end skills and innovation deployment. The Roadmap helps to position South Africa for a water-secure future by ensuring that we are equipped with knowledge, solutions and skills to respond to a future water sector demand gap of 17% by 2030. The Water RDI Roadmap funding comes to an end in 2021. The WRC will look to develop an updated Water RDI Roadmap II in 2023/24. In 2020/2021 we launched the SARChI Chair on Governance and Economics of Ecological Infrastructure and in 2021/2022 the SARChI Chair on Governance and Economics for Water and Sanitation Sector Institutions will be launched. We hope through partner investment and continued WRC project investment the economics and sustainability of the water business will be enhanced over the next 5 to 10 years. The chairs are supported through the co-investment from National Research Foundation, DSI and DEFF.

- **Supporting cross-sector collaboration for water, energy and food security, community resilience, climate, innovation and investment:** Innovative revenue models and approaches can be borrowed and even shared across sectors. For example, considering the importance of water-sensitive design in response to climate and weather variability requires engagement with development finance institutions (DFIs), property developers, construction, and planning stakeholders across rural, peri-urban and urban environments. Equally, financial and investment partners are critical in shifting private sector models towards sustainable practices. Our partnerships with non-traditional partners like the banks, developmental agencies and impact investors will strengthen our learning and implementation models necessary for sustainable uptake of knowledge and innovations. New areas of growth and development, like the 4th Industrial Revolution, require lean innovation models, ‘think wrong’ type ideation processes, a vastly different set of innovators and an organisation with a ‘fail fast’ appetite around idea incubation and prototyping.
- **Learning and Training: Expanding the impact of the WRC’s knowledge products through scale up:** The WRC produces a critical mass of innovations which can be scaled up and diffused for uptake through smart partnerships and revenue models with NGOs, SMEs and strategic partners. The WRC also produces many guidelines which can be translated into training material for extension officers and practitioners, and when linked to certifications, accreditation and continuing professional development (CPD), points can translate into tangible benefits for all water sector professionals. This will need to be done with professional organisations like the Water Institute of Southern Africa (WISA) and South African Institute of Civil Engineers (SAICE) and training entities like the SETAs. In this domain the quadruple helix which also encompasses civil society is critical for success. The COVID-19 pandemic has also highlighted the need to have agile and flexible training mechanisms available and the WRC is currently

working with WISA and EWSETA to pilot an online training platform using the tripartite partnership for the sector. Thus, the pandemic has triggered on-demand training quicker than originally planned for the sector with the partnership plans focussing on a new strategy with the SETAs in the new 5 year cycle.

- Industrialization: Developing a new industry around next-generation sanitation:** Sanitation remains a key challenge in South Africa especially in rural, peri-urban and informal areas. With renewed focus from the Presidency on school sanitation through the launch of the SAFE Programme in 2018, developing and supporting next-generation sanitation products to the market remains a key imperative. The South African Sanitation Technology Enterprise Programme, in partnership with Department of Science and Innovation and the Bill & Melinda Gates Foundation, was also aimed at creating further incubation and industry support for innovators and technology developers in the water and sanitation sector, thereby understanding market demands and creating a market pull. The Business Development and Innovation division will support the business and industry development component with partners while Water Use and Waste Management KSA will continue to support the research and early stage technology development components. In 2019, the WRC secured additional funds for the SASTEP (South African Sanitation Technologies Programme) to roll out a focused and co-ordinated approach to incubate and stimulate the quadruple helix economy opportunities for sanitation, viz: the toilet economy, the circular sanitation economy and the smart sanitation economy. The 2020 to 2023 plan will allow the WRC to test the industrialisation and localisation models put forward. The lessons obtained will contribute to the DSI Transformative Innovation Policy Consortium Initiative which is testing innovative policy mechanisms to drive change.

Financial Sustainability: Strengthening income streams

The WRC has planned a leverage increase of 10% per annum over the next 5 years. Several contracts have been secured but more funding supporting is required to achieve the targets set (Figure 39). It is important to enhance leverage processes to increase the chance of success by matching funds availability with high quality knowledge and innovation we wish to scale up for impact. In 2020 COVID-19 led to increased risk analysis of financial sustainability and leverage mechanisms due to the potential for significant reduction in leverage funding. This led to creating more robust internal processes. In 2021 to 2026 the WRC will continue to strengthen the processes for leverage by enhancing mapping, seeking and re-positioning relevant areas/innovations for scale up and support (Figure 40).

A SWOT analysis has shown that the WRC is indeed a learning organisation and has had good success in developing new leverage streams for high-impact projects. The strong WRC pipeline, technical expertise which resides within the organisation and within our broader networks, and the excellent co-ordination platforms have elevated the WRC as a key strategic partner in the sector. This has strengthened our ability to deliver on our mandate of technology transfer using and testing innovative leverage and scaling approaches. The contracts-based approach is both a strength and weakness for the WRC as it allows us to remain agile as an organisation while testing, but requires strong organisational relationship management while balancing partner and administrative needs with sector opportunities and impact. Large projects with several partners require improved execution. Deal structuring for innovators with prospective investors is a key weakness and requires new skill sets and new organisational models to bring into effect. Improved internal models between the knowledge owners and the business developers is required to continuously strengthen the income and diversification strategy.

Figure 39: 5-year leverage plan vs realized leverage

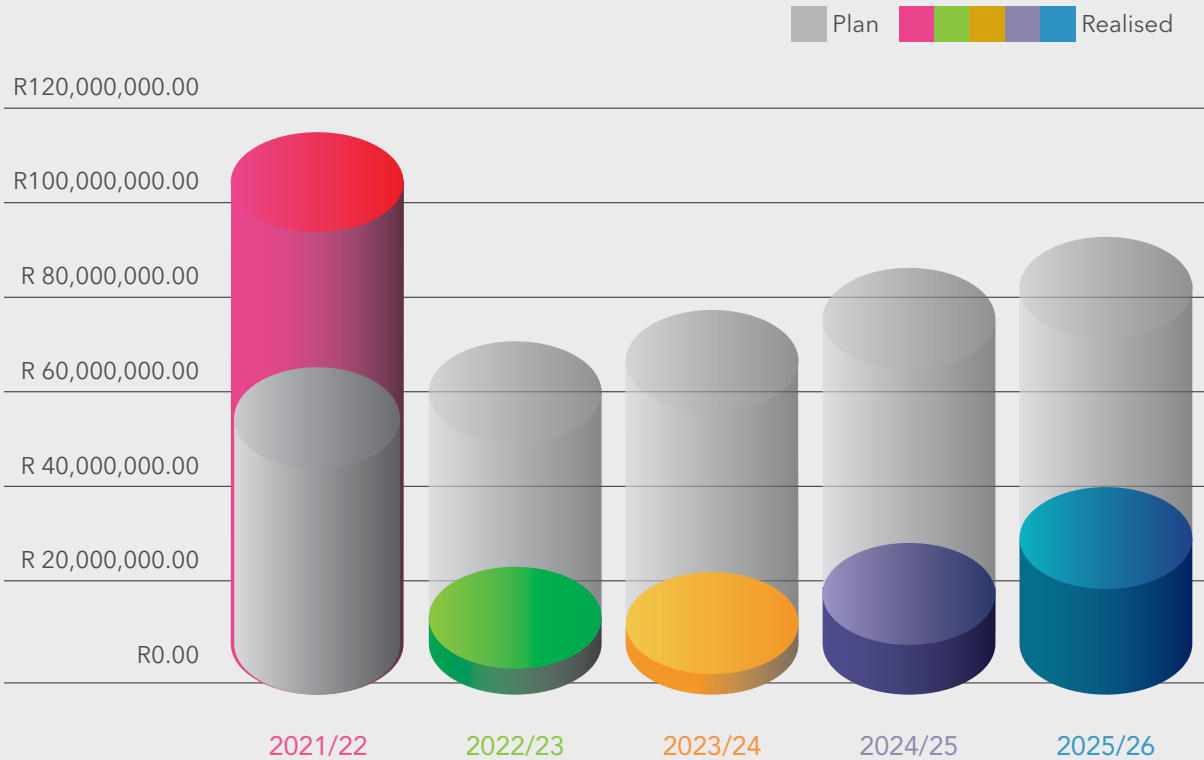


Figure 40: Strengthening leverage pipeline processes



It is important to note that the threats will continue to remain for the WRC in a low economic growth and high-risk aversion and compliance environment.

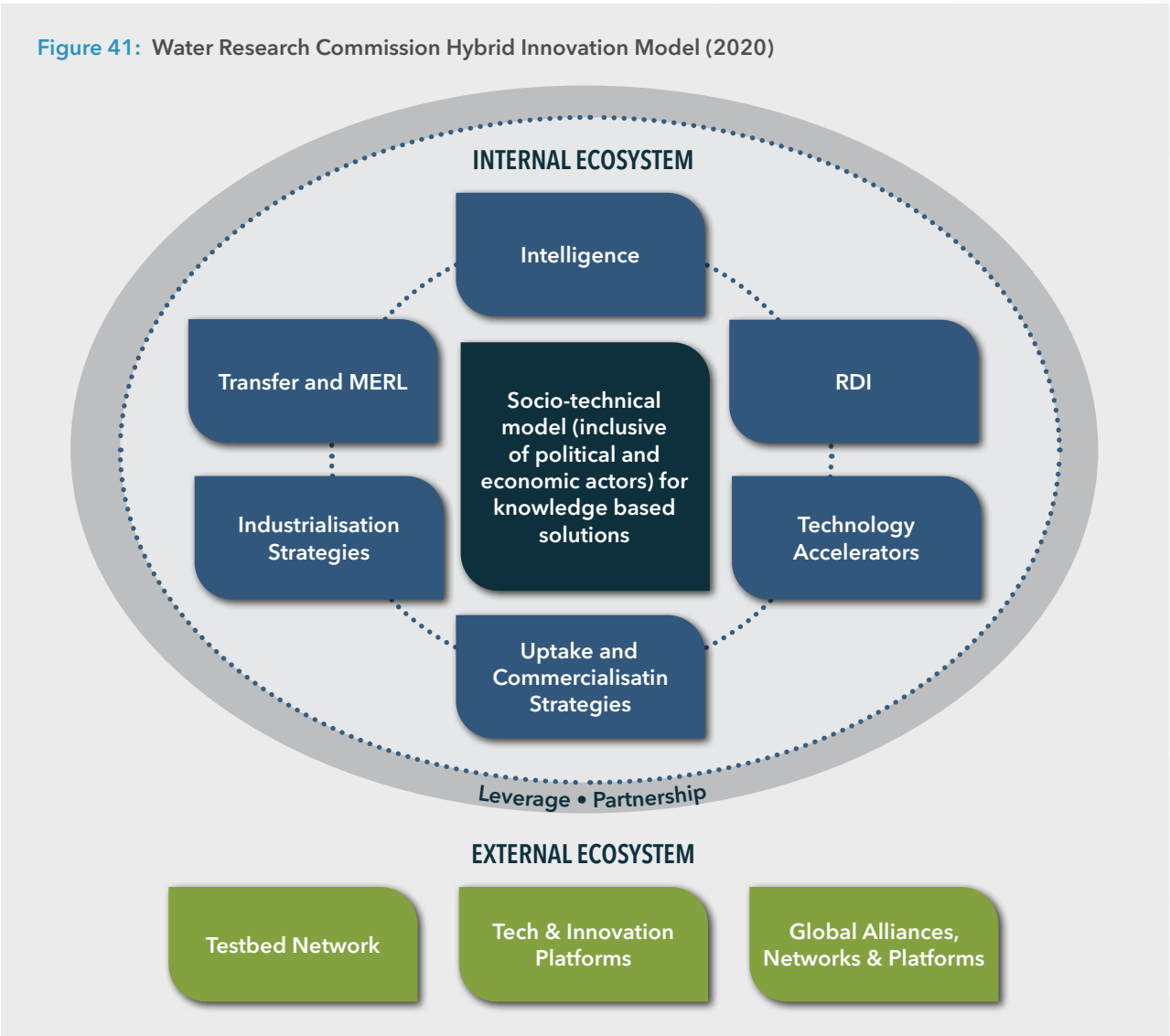
Innovations

The WRC strategy on funding for research and development is moving toward the obligation to show tangible impact by turning knowledge into solutions for communities, service delivery, wealth creation and a better future for all. Innovations in the WRC stem from research and development funded through the water research levy, special funds through programmes like WADER and SASTEP which look at early- and late-stage innovations from both the academic environment and private sector and from walk-ins from the public.

Over the past 4 years the WRC has been ramping up the internal ecosystem of innovations management for impact. It has operationalized new processes for innovation management within the WRC and integrated existing innovation processes (Figure 41). These compromise:

- 1. Intelligence
- 2. RDI
- 3. Technology Accelerators
- 4. Uptake and Commercialization
- 5. Industrialization
- 6. Transfer & Monitoring and Evaluation

Figure 41: Water Research Commission Hybrid Innovation Model (2020)



Intelligence

This business process comprises the use of tools such as foresight studies, national sectoral roadmaps, supply-side and demand side innovation analysis, policy analysis and technology scans and trends. It includes internal portfolio analysis. The foresight and roadmap studies set high level strategic needs of the sector and are done periodically. The WRC traditionally through its research processes assesses the supply side innovation needs and policy enablers. However, the demand side innovation, trends and tech scans need to be further developed in the new 5-year strategy.

Research, Development & Innovation (RDI)

This follows the traditional WRC processes which funds largely projects in the national system of innovation supporting universities, science councils and SMME's. This funding focus typically produces about 30 to 40 innovations per year. The WRC RDI portfolio has a 50:50 ratio of technological and non-technological innovations, which is expected as the WRC funds new knowledge generation and many innovations are in the form of decision support material, frameworks, models and tools. If one takes the entire portfolio (inclusive of the additional funds from WADER and SASTEP) into consideration then the split is closer to a 70:30 ratio of technological to non-technological innovations as the independent programmes tend to drive product-based innovations from innovators, technology developers and entrepreneurs. The categories of innovations strategic to the sector that are scanned and evaluated include, viz:

- Technologies to explore alternative sources of water
- Smart water technologies
- Technologies promoting water use efficiency and conservation
- Water purification technologies
- Sanitation technologies
- Water quality innovations
- Groundwater technologies
- Social innovations
- Valorization innovations

Technology Accelerators

The WRC in partnership with the DSI created and implemented the WADER (Water Technologies Demonstration Programme) based on a Technology Accelerator model which scans, sorts, funds demonstrations, provides independent evaluations, and brokers partnerships. SASTEP (South African Sanitation Technology Enterprise Programme) which is also a technology and business accelerator was formed in partnership with the Bill and Melinda Gates Foundation and Department of Science and Innovation to catalyze the off-grid (next generation) sanitation industry. SASTEP amplifies the WADER model by dealing with policy, markets, technology toolboxes, standards, business investment and training.

The WRC RDI, WADER and SASTEP teams work closely with business development and technology transfer teams to accelerate innovations to the market and applications using either social entrepreneurship models or commercialisation/localisation or industrialisation investment pathways. As such, the innovations team supports the WRC's mandate and vision through the provision of analysis, support and advice to innovators, entrepreneurs, SMMEs and the R&D branch, as well as the water sector as a whole. Special programmes like SASTEP add enormous learning opportunities for the WRC as we strengthen the innovation value chain in both the internal and external environments.



WATER TECHNOLOGIES DEMONSTRATION PROGRAMME
An initiative of the Department of Science and Technology
and the Water Research Commission

Uptake and commercialisation

The technology transfer team has strengthened the service offerings for internal WRC innovations and external innovators, entrepreneurs and enterprises by:

- Providing IP advisory services
- Guiding technology transfer strategies
- Supporting technology transfer
- Categorizing technology transfer routes for higher impact.
- Awareness training (to be evolved into entrepreneurship training)

The latter service of categorizing innovations into either a mass market (direct sales opportunities to private sector and consumers) or a public sector (sales to public sector institutions like water boards, Department of Basic Education, and municipalities) will further strengthen innovation management in the WRC and for the water sector. It will enhance WRC decision making in terms of:

- Increased R&D spend
- Invest using a risk model for future revenue generation through equity, shares or royalties
- Invest using a shared risk model in collaboration with water sector institutions or partners for socio-economic or environmental impact
- Invest using a shared opportunity with leverage funds for social impact

All of the above options will evolve and be tested over the 2021 to 2026 strategic cycle.

Industrialisation

The SASTEP programme in partnership with the Bill and Melinda Gates Foundation (BMGF) and DSI are positioning the WRC to reframe Water RDI investment into economic goods and services and develop industrial paths. The WRC will continue to learn and develop how to strengthen internal business processes to improve uptake, commercialization and where relevant industrialization. These lessons may lead to

recommendations on new approaches to partner with the public and private sector. The SANITi strategy for sanitation through the SASTEP programme is testing a model that develops a new sunrise industry (Figure 42). The model frames the vision with all sector partners, aligns all policy partners, creates market access and market development engagements using research to drive actions, creates a toolbox of technology options with SMME's and businesses to strengthen due diligence, value chain development and readiness, plays a brokerage role with investors, funders, buyers to strengthen manufacturing, scale up and localization. Finally, in order to embed the paradigm shift in new sanitation it is envisioned that an appropriate university partner will offer training, scientific and advisory services.

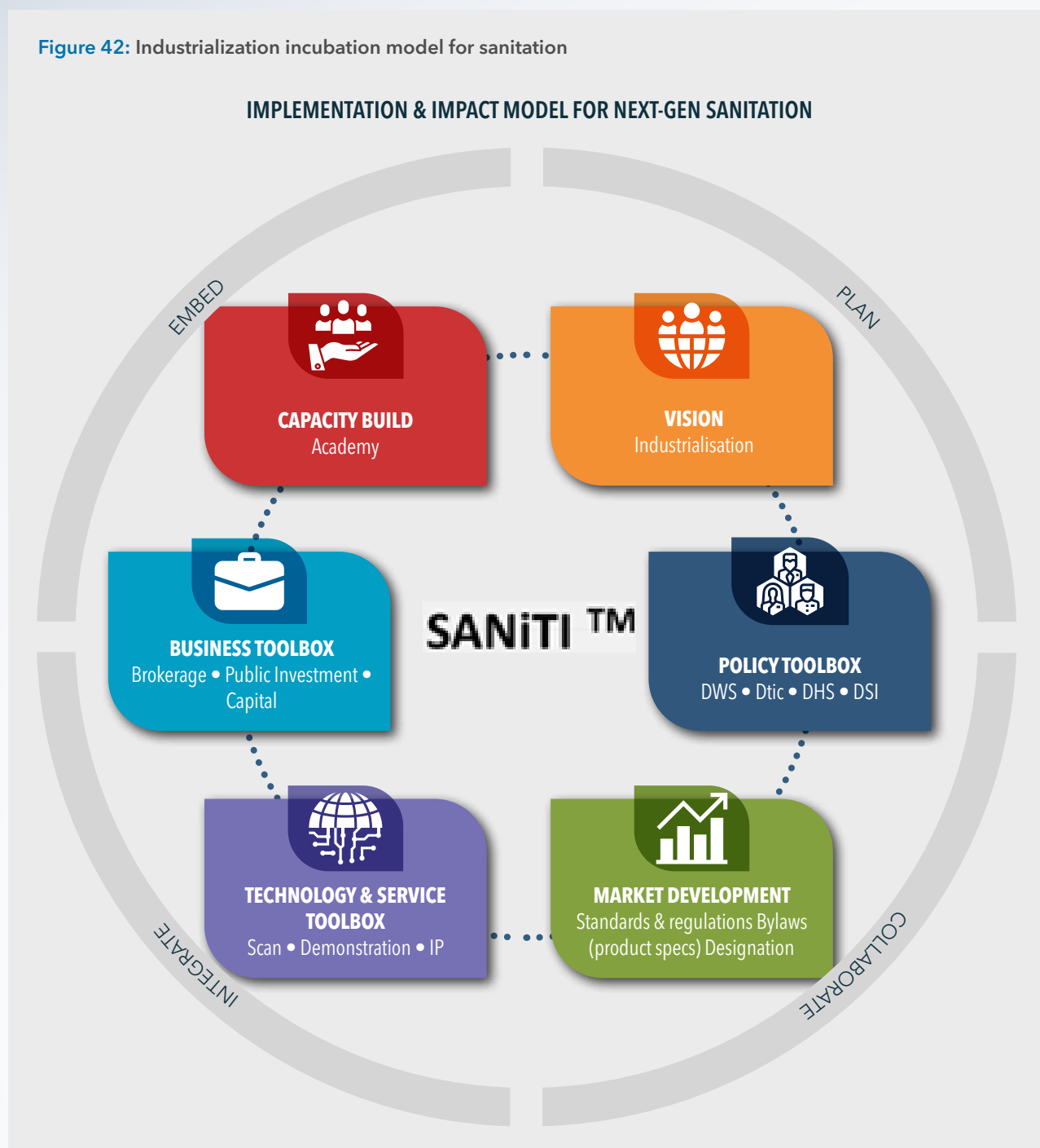
Transfer and Monitoring, Evaluation, Reporting and Learning

The WRC is using a portfolio approach with a multi-year analysis to assess success factors for the transfer of technology into the water and sanitation market. It is also testing standard NIPMO approaches and business approaches such as fail fast models to fast-track innovation development. These processes of learning are ongoing and will continue to be strengthened in the 2021/2026 strategic plans.

9.4 INTERNATIONAL COLLABORATIVE (NON-COMMERCIAL) PARTNERSHIPS AND STAKEHOLDER ENGAGEMENT

The WRC International Cooperation and Partnerships and Stakeholder Engagement portfolios have been merged since 1 April 2019, further expanding the portfolio to cover the collaborative partnerships established with the local and other strategic partners beyond the South African borders. The reconfiguration will allow for smooth integration of international stakeholders and partners within the WRC's stakeholder engagements and better coordination of strategic collaborative partnerships that will enhance the profile and position of the WRC as a key partner and facilitate disseminate the WRC projects' outputs beyond South African stakeholders.

Figure 42: Industrialization incubation model for sanitation



International partners including representatives from the WRC partnership clusters are one of the key stakeholder groups of the WRC that have not been fully exploited or integrated within the WRC stakeholder engagements and dissemination activities. The portfolio will be driven through two integrated strategies aimed to position the WRC as a global knowledge and development partner of choice for water and sanitation RDI programmes, especially with partners on the African continent.

The stakeholder engagements and the collaborative partnerships will not only strengthen the WRC position in the South African water sector but will also extend the WRC footprint in the rest of the African continent and globally providing opportunities to facilitate knowledge and resource sharing, joint learning and uptake leading to greater impact of the WRC and partners' knowledge and innovative solutions through the multiplier effect.

International stakeholders in this section refers to all stakeholders and partners residing outside the borders of South African, including neighbouring and other African countries.

Collaboration partnerships

The WRC will continue to forge collaboration partnerships with strategic international and local stakeholders bilaterally or under multilateral partnership arrangements. Priority will be given to partnerships with like-minded institutions and platforms (common interest and course) with clear and mutual value add for better coordination of effort while also enjoy the benefit of each other's strengths and shared resources.

The collaborative partnerships activities i.e. programmes and projects will be designed to add value to the WRC business and services for the benefit of South Africa and the African continent as a whole. The engagements with existing or/and potential partners will be guided by five objectives of:

- Global positioning of the WRC as a competitive, key development player and a leader on water and sanitation knowledge-based solutions
- Influencing and contributing to the global and continental water RDI and policy agendas
- Securing international resources for the WRC, for South Africa and for projects implemented in the rest of the African continent
- Contributing to strengthening capacity on the continent
- Facilitating impact-driven research, innovation and value-adding engagements

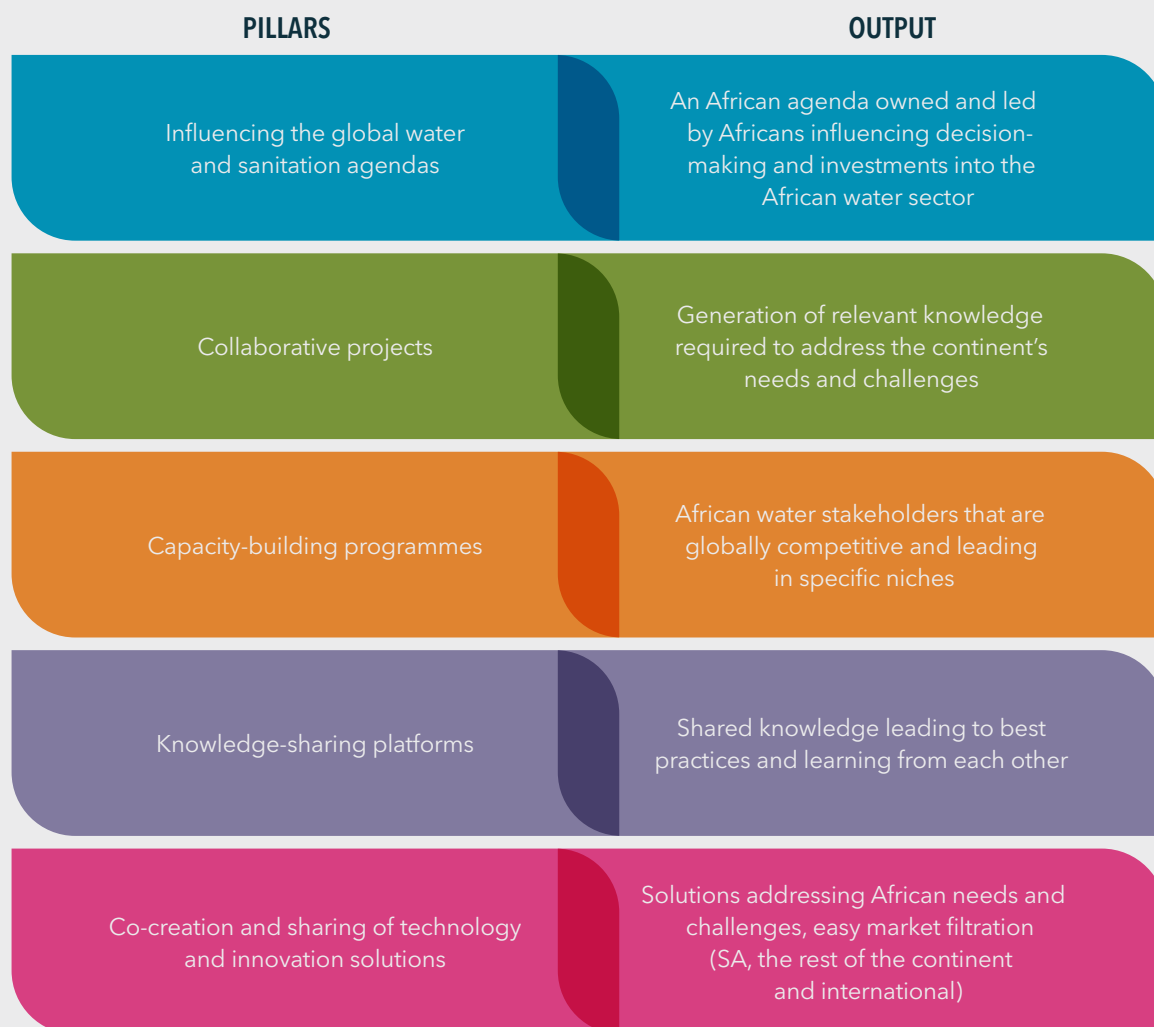
The WRC will, in the next 5 years, strengthen and improve its local and international collaborative partnerships targeting strategic and priority stakeholders that could jointly implement or coordinate impact-driven engagements, programmes and projects for the benefit of the SA and other African water sector and stakeholders with the WRC. The WRC will put additional effort towards establishing Africa water and sanitation RDI flagship programmes with key African partners to

build the required capacities to efficiently respond to the water and sanitation challenges facing the continent, build resilience and a water, energy and food secured continent. The Africa flagship programmes will draw on international partnerships to facilitate access and exchange of knowledge and technical expertise while also leveraging financial resources to complement the African commitments. Regular monitoring, evaluation and maintenance of the existing partnerships will still remain key to ensure healthy status, relevance and continued value of each partnership. The collaborative partnerships will be rooted on four pillars and will incorporate a range of activities specifically designed to derive maximum benefit and value from each partnership, as highlighted in Figure 43.

The short-term goals for collaborative partnerships will include to:

- Establish strategic partnerships with key local, other African and international partners to jointly implement or better coordinate water and sanitation RDI programmes on the continent.
- Influence prioritisation of water and sanitation RDI programmes in local, regional, continental and international agendas.
- Develop the value proposition and marketing material for the WRC collaborative partnerships together with Knowledge Management and Communications team.
- Explore the feasibility and value of being a global connector of the international and African water sector stakeholders providing a platforms to engage, share, learn and establish solutions to the African water and sanitation challenges.
- Identify opportunities for the WRC to join forces with existing or lead the establishment of new local, continental and international water and sanitation programmes, projects and strategic and activities.

Figure 43: WRC Collaborative Partnerships pillars and outputs



The long-term goals for collaborative partnerships:

- Positioning the WRC as a preferred African knowledge and development partner for water and sanitation RDI programmes implemented in the continent.
- The WRC hosting or co-hosting water and sanitation and related regional and continental knowledge and innovation hubs.
- Sustainable African water and sanitation flagship programmes.
- WRC as a strategic partner to implement African water sector relevant research and capacity building programmes.

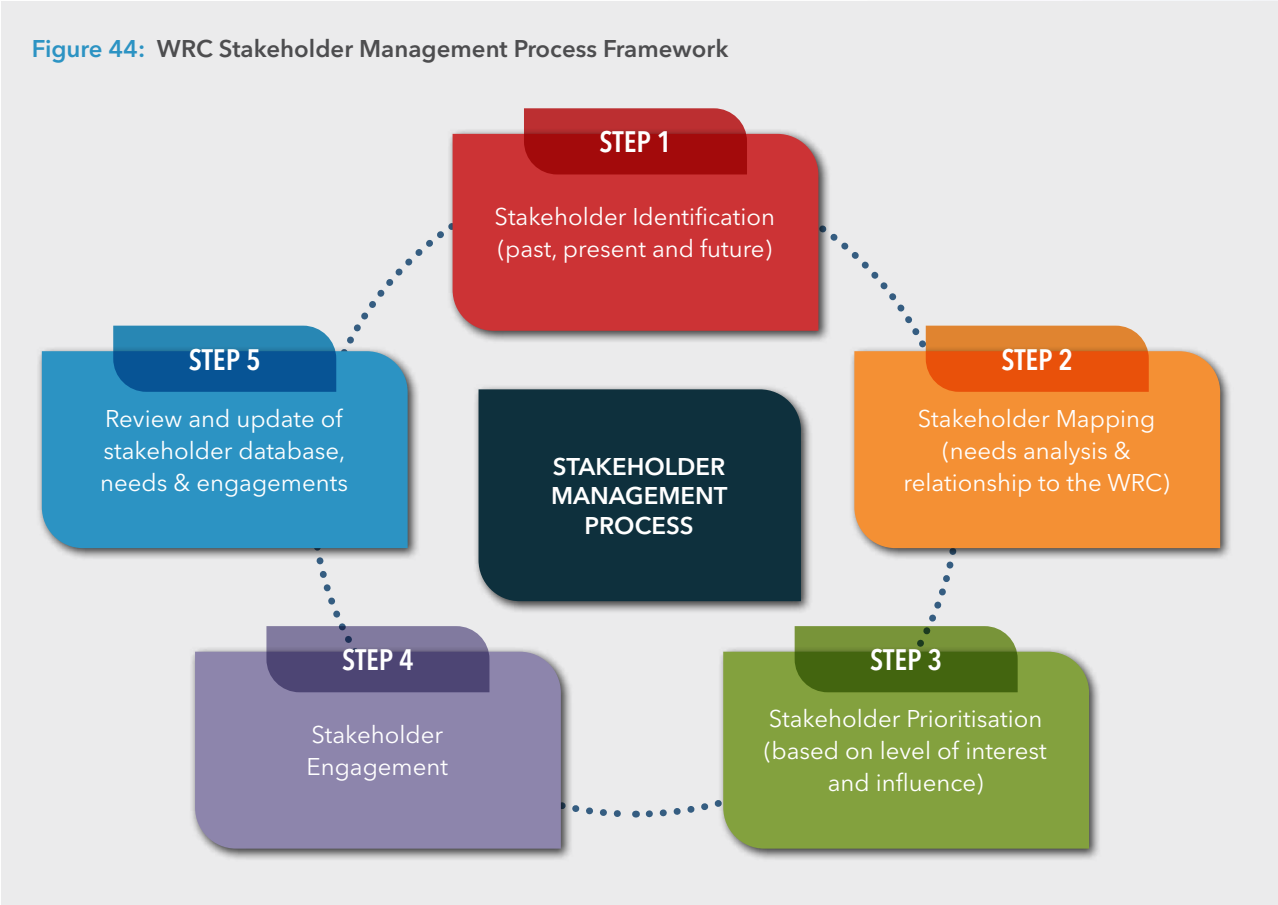
Stakeholder engagement

The WRC has been guiding, facilitating and funding water and sanitation research, development and innovation (RDI) for over 48 years and has produced a lot of value-adding knowledge and products. Over the past decade, the WRC further made a strategic decision to strengthen its efforts and re-organised its business to derive greater social, economic, policy and environmental impact. Effective stakeholder management has, therefore, become more urgent for a knowledge-generating organisation like the WRC to ensure that its stakeholders have access to the research outputs and use the knowledge to influence their

strategic planning, operations and decision making. It is in line with this objective that the WRC is refocusing its stakeholder engagement and dissemination strategies to ensure that the knowledge, research and innovation products and solutions reach and impact their intended stakeholder groups and beneficiaries.

The WRC will during this financial year (2021-22) finalise its stakeholder management strategy which will

guide the WRC’s approach and tactics to get a better understanding of its stakeholders needs, establish and maintain meaningful relations and conduct valued adding stakeholder engagements. The stakeholder management framework (Figure 44) will also include an update of the WRC stakeholder ecosystem further segmenting it into clusters and sub-clusters and prioritising each stakeholder cluster to clearly highlight the primary, secondary and tertiary stakeholders.



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The stakeholder mapping and prioritisation will take into cognisant, the immediate, medium and long-term aspirations of the WRC and will inform and guide the WRC stakeholder engagements (Figure 45). The stakeholder engagement framework will be updated

on an annual basis to reflect the new and emerging stakeholder and needs, reprioritisation, review and update of stakeholder database and engagements. The WRC as part of its needs analysis will embark on bilateral, cluster engagements with selected strategic stakeholders to get a better understanding of their research and innovation (R&I) needs and jointly identify potential WRC offerings (existing or new solutions) further packaged to suite the stakeholder's needs. More effort will be dedicated to building and strengthening engagements and partnerships with strategic stakeholders (primary and secondary) who will add value during implementation of activities to facilitate uptake of research knowledge, product and solutions leading to improved water sector services and decision making. This strategic stakeholder groups include all levels of government and its entities, knowledge and solution providers, implementation partners, water services institutions and funding institutions. The WRC will also maintain the existing WRC engagements with other key stakeholders including the general public, community representatives and influencers ensuring that they are efficiently engaged, well informed and monitored.

The WRC will during the 2021-2026 cycle establish and pilot new strategic platforms to engage and facilitate potential collaborative and business partnerships with key local, African and international partners. The platforms will include but not exclusive to:

- Water Innovations Acceleration and Implementation Forum** - a learning platform to close the gap between the current and the desired future for the South Africa and the African water sector enabled by research and innovation. The forum will be targeted at water services institutions (municipalities, waterboards, utilities and others) and the interested institutions will form part of the WRC technology and innovations testbed network and be included as recipients of WinSA. The WRC will explore and pilot 2 forums in a short to medium-term, one targeted at the SA stakeholders and the other servicing the broader continent.
- Briefing sessions with the water sector** - a platform where the WRC, its partners and water sector stakeholders will share and engage with existing research and also establish the value and contribution of RDI in addressing topical water related local and international challenges.
- Water Institutes Alliance** - a multi-stakeholder, multi-disciplinary collaboration system (network of networks) aimed at facilitating a series of programmes, projects and engagements to improve water security for Africa. The first phase of the Alliance will pilot activities in the Southern African Development Community (SADC) region and in a medium to long-term open up to include other regions when the processes and cooperation models that have proved effective in the SADC region. The Alliance will facilitate joint effort and shared resources (data, knowledge, infrastructure, human and financial) in addressing the common objective of building a water secured continent also addressing the impact of water on energy and food security and broader economic activity. The Alliance will help to address institutional fragmentation, build a culture of complementarity and provide an opportunity for a robust debate on the transformation agenda for the institutions. The Alliance will bring together South African, other African and international stakeholders from the primary and secondary stakeholder groups of the WRC i.e. government and its entities, knowledge and solution providers, implementation partners, water services institutions, funding institutions and other relevant stakeholders.

Figure 45: Stakeholder engagement framework

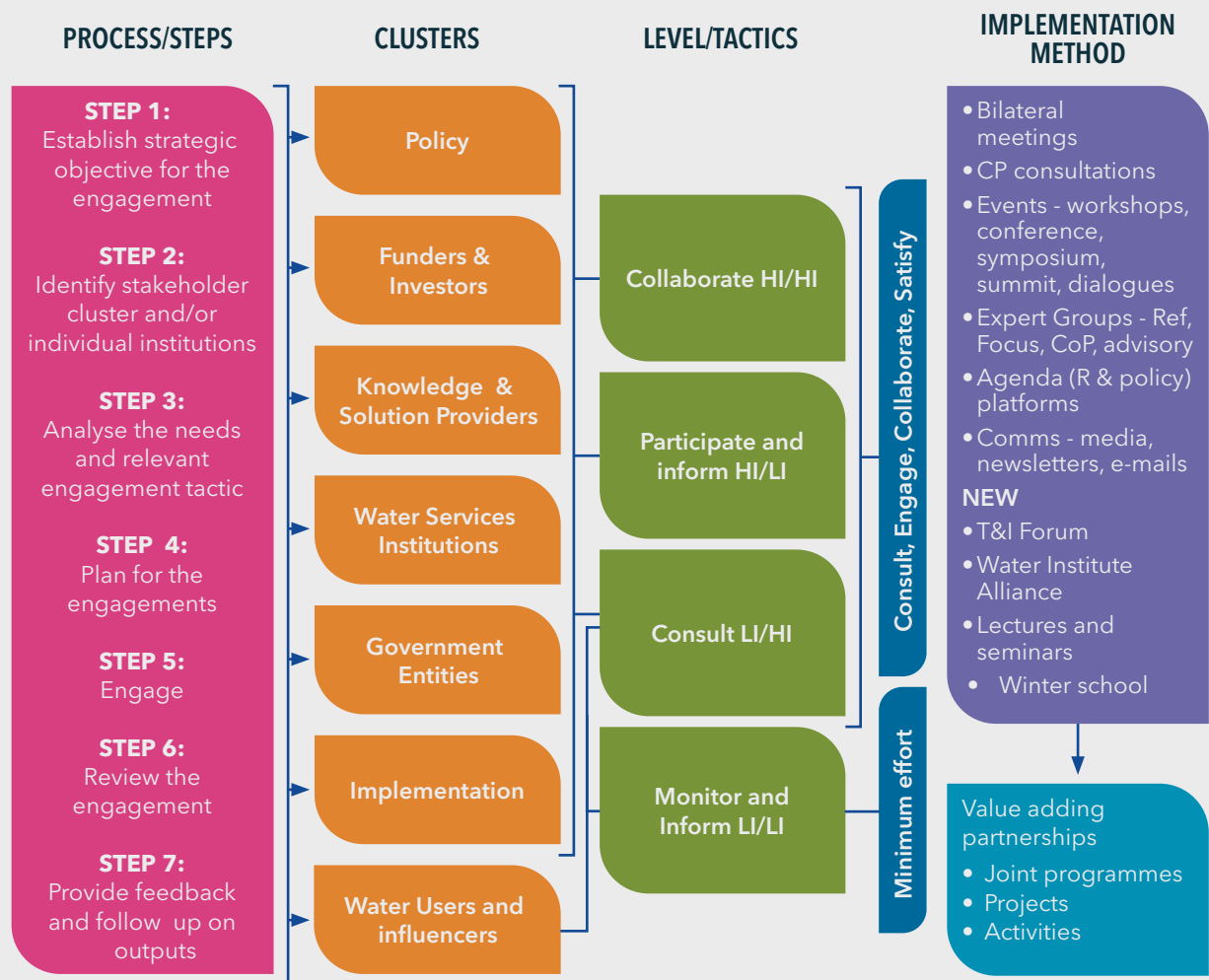


Figure 46: Innovation and Impact branch structure



10 | Finance

10.1 INTRODUCTION

Over the CP21 period the Finance branch will continue to focus on retaining the WRC's clean audit status and this means ongoing emphasis on financial reporting and compliance as core elements, which is an imperative in providing our partners and key stakeholders with the assurance of the organisation's financial soundness.

The Finance branch will continue to enhance the financial administration, supply chain management (SCM) and reporting business processes and systems to ensure the realisation of improved efficiencies and effectiveness within those core support services.

The branch will focus on providing the required financial planning, structuring and support tools to contribute towards WRC remaining financially sound and

sustainable. During this period skills development and empowerment of the Finance team, refining of business processes and IT systems deployed within the finance domain will be fundamental to ensure the successful attainment of the finance goals and objectives contained in CP21.

The key strategic focus areas (Figure 47), more fully described below, include:

- Improved efficiencies and effectiveness within the WRC Supply Chain Management (SCM) function to ensure improved turnaround times
- Enhancing the financial planning capabilities which will contribute towards creating an appropriately funded and financially stable operating environment

Figure 47: Finance branch focus areas





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The branch will focus on providing the required financial planning, structuring and support tools to contribute towards WRC remaining financially sound and sustainable.

10.2 SCM AND FINANCE PLANNING FOCUS TO SUPPORT THE WRC STRATEGY DURING CP21

Enhancing the effectiveness and efficiency of the SCM function

SCM is responsible for the sourcing and procurement of all goods and services that are non-research related. This function has the potential of significantly impacting on the effectiveness of the overall WRC business operations. We recognise that over the next five years there is an expectation that the WRC must concentrate on greater impact and this means greater emphasis on non-research procurement including demonstrations and piloting of the research. The WRC will be working with a more diverse partnership base and this will require it to have an SCM capability that can adapt to the dynamic requirements associated with working in a partnership model, where cognizance of various stakeholder processes may have to be accommodated.

What this means is that there will be an increase demand for more sophistication with respect to SCM. Specifically, the sourcing of materials and possibly other associated professional services that may require dealing with international suppliers and service providers. This will require the following -

- Ongoing skills development and empowerment of the SCM team
- Refining the SCM business processes and making these less cumbersome without compromising the legislative requirements and compliance with the various SCM prescripts
- Where appropriate ongoing refinement and customisation of the IT systems and technologies that are deployed within the SCM environment

The WRC sourcing and procurement strategy will continue to include:

- Awarding multi-year contracts for specific goods and services to appropriate service providers after following the required procurement and tender frameworks; this approach allows the WRC to obtain competitive pricing and enhances the efficiency of the procurement process
- Where appropriate and advantageous the WRC

will consider sourcing goods and services utilising existing transversal contracts if this is favourable

In addition to being a key role player with regard to ensuring compliance with legal and other relevant prescripts SCM must always have a client service orientation. The ongoing engagement with various stakeholders and recipients of the SCM services therefore remain paramount during the design, development and implementation of the various elements required to build a more responsive and effective SCM function.

Enhancing the financial planning business processes and capability

Figure 48 provides an overview of the key financial planning and budgeting elements that are coordinated by the Finance branch.

Over the planning period the areas of focus that will support the WRC goals with respect to financial sustainability include:

- Ongoing focus on the coordination of the Budget planning and formulation processes to ensure:
 - o Emphasis on key financial performance indicators
 - o That revenue generation activities, in particular diversification of income streams are planned and prioritised
 - o Cost containment and cost-saving measures are fully explored and implemented
 - o Formalised engagement and discussions between the various WRC branches to allow the budgets and financial projections to be realistic and informed
- Ongoing cost control and expenditure monitoring processes that includes:
 - o Dedicated monthly and quarterly WRC financial performance meetings where revenue and expenditure analysis are reviewed
 - o Ensuring corrective measures are devised where financial performance is not on target for specific areas
 - o Following up on the progress in relation to corrective measures taken

Diversification of income streams

The current WRC funding model that is premised on a

Figure 48: Key financial planning and budgeting elements

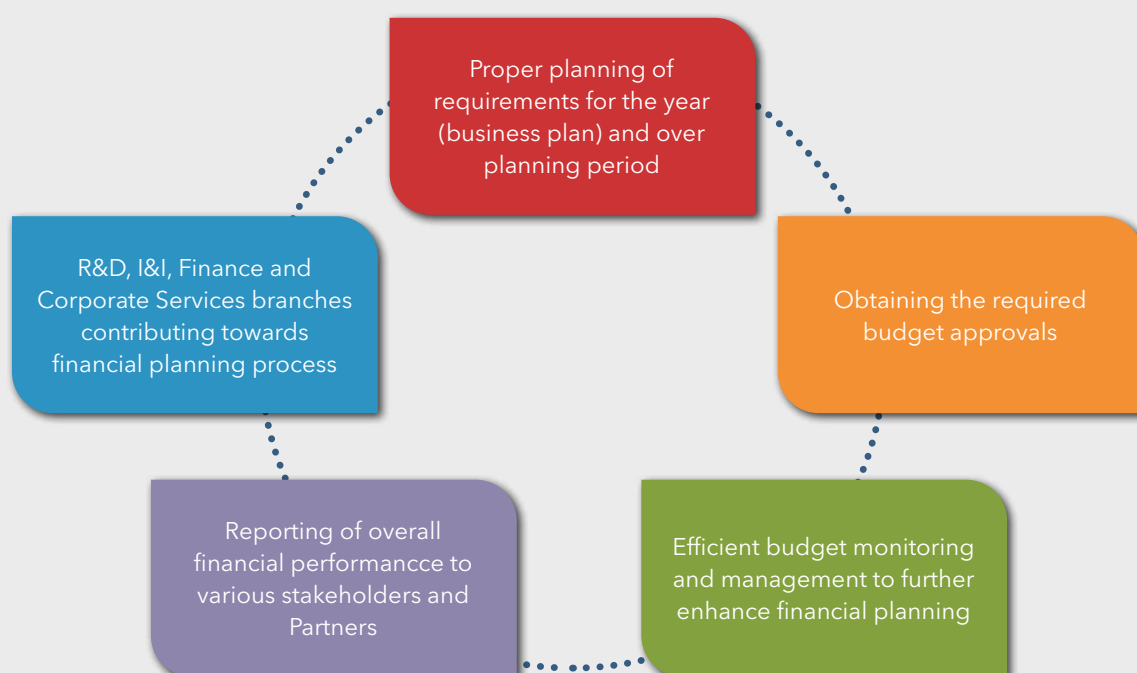


Figure 49: Finance branch structure



high reliance on levy income as its primary source of funding is likely to continue in the foreseeable future. However, the reality is that there are no guarantees regarding availability of funds and like other research institutions we are faced with the ongoing uncertainty related to the various phases of the economic and business cycles. There is also still a predominant view

that spending on RDI is not an Investment. Over the next five years the WRC will be focused on developing a portfolio of diversified income streams and this will be founded on partnerships, be impact driven, and support water and sanitation sector entrepreneurs in order contribute to the overall development of the South African economy.

11 Corporate Services

11.1 INTRODUCTION

The WRC's workplace is being defined by technology and the employees that are using it, corporate social responsibility, good governance and the physical work environment.

The Internet of Everything (IoE) is enabling new forms of connectivity, changing communications and fostering new ways of working. With the plethora of devices, apps and solutions now available and growing at a phenomenal rate, to remain relevant and competitive, the WRC must move with the times, while striking a balance between current and future employee and business needs.

The Internet of Everything, enabling people globally to be connected wherever they are and whatever they are doing, has led to the rise of 'Supertaskers' - members of Generation X and Y who have honed their skills of completing several tasks efficiently and simultaneously. The dynamic is changing and the lines between work and home life are blurring as technology enables employees to make the most of what used to be wasted hours sitting in a traffic jam or a doctor's waiting room. This flexibility minimizes downtime during load shedding, which can often be a challenge in South Africa, as staff can work anywhere that they find power and a Wi-Fi connection.

For the workplace, this means the emergence of a generation of workers with the potential to be highly productive. It also suggests the need to ensure that employees are given the variety of tasks they need to tap into this skill and lead to their fulfilment. It will therefore be essential to create a working environment that engages and encourages this way of thinking.

Together with ICT, another important aspect of the world of work is corporate social responsibility. This is a business management practice that incorporates social and environmental concerns into regular business activities. It encompasses many objectives ranging from the ethical treatment of employees and members of the supply chain, to safe and healthy ingredients, to environmentally friendly/sustainable product manufacturing.

As consumers, employees expect a high level of corporate social responsibility, and not meeting those expectations can be a major turnoff.

Essentially, the WRC's Corporate Services Strategy straddles the fine line between what has traditionally worked and what will work in the future, based on the needs, strengths and mindset of the future workforce. Each new generation is progressively more Internet- and technology-focused, and also more social-responsibility focused. With this in mind, the world of work must focus on human resources, information technology, governance and Facilities in an integrated approach (Figure 50). This approach will ensure that the WRC will move to the next level in terms of business success and employee satisfaction.

11.2 INFORMATION TECHNOLOGY

Macro-context

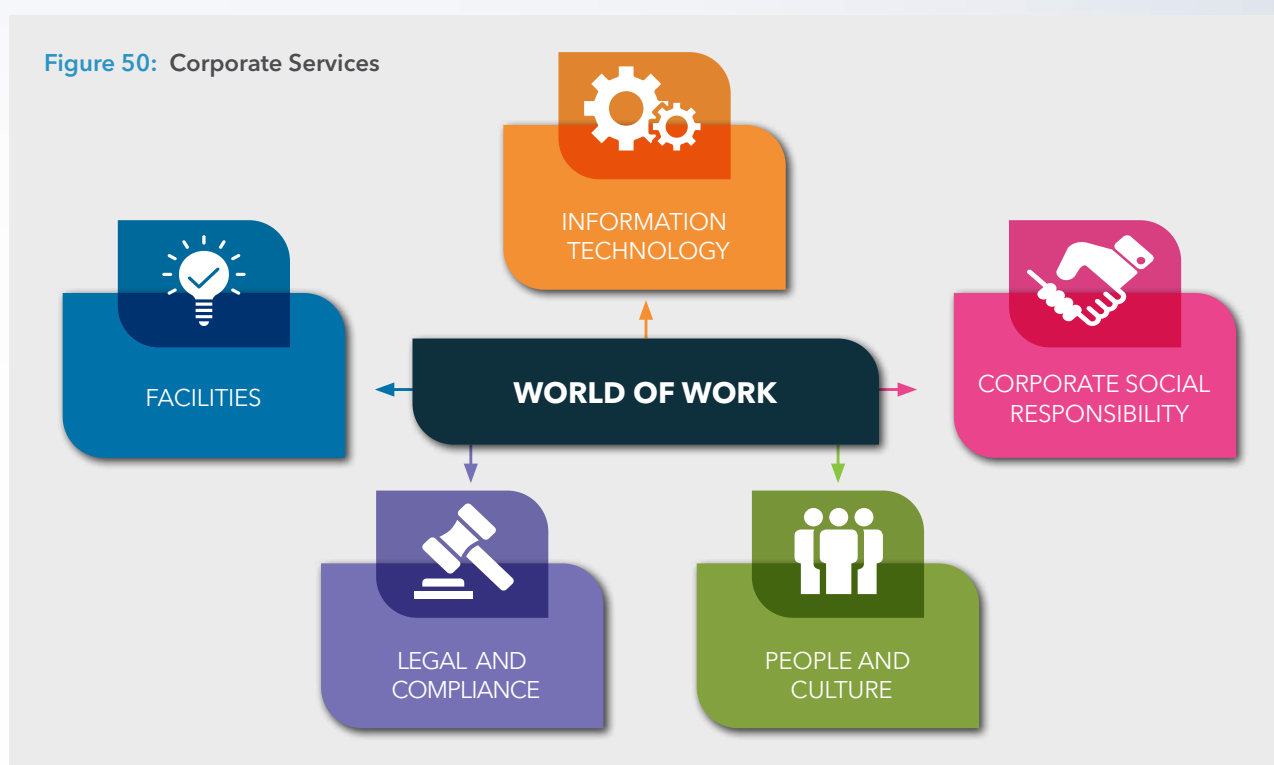
The coronavirus pandemic has had a trembling impact on virtually every facet of life and business – IT has been no exception. As lockdowns end and many businesses begin to reopen (at least on a limited basis), we at the WRC are looking forward to returning to some semblance of normalcy.

It is a given that the worldwide health crisis has dramatically changed the way IT departments provide services to their organizations. That includes what hardly anyone could have fathomed a year ago - supporting the forced, immediate, and massive shift to a work-from-home or remote working model. Considering this need for redefining and redesigning office workspaces to make business processes post-2020-ready, IT will focus on a few cardinal topics as we embed learnings from the impact of the virus into how we will endeavour to build our business to be future-ready.

A culture of agility

The one thing we have been reminded of over the past

Figure 50: Corporate Services



year is that change is inevitable, and the role culture plays in adapting to change is pivotal.

Whilst our colleagues within the organisational development team focus their efforts on transforming our thinking as an organisation from being resistant to change to embracing it, our IT team will be challenged to think more like a business and thus increase the value of IT's delivery to our stakeholders. Adopting a mentality that focuses on the value IT will be providing for each stakeholder (internal or external), asking the 'why' questions, embracing change and thinking and acting like a small company will drive the team to be even more nimble. Increasing our ability to maintain our systems (replacing equipment, adding, or subtracting hardware and resources, etc.) in response to market realities or opportunities will ensure we remain an agile and value-adding arm within the WRC.

Enabling a remote working environment

The WRC views this shift that has been made to having a remote workforce as long term, which will take the form of a hybrid working environment, which has been supported by the increased use of mobile technology and cloud services, as indicated in Figure 51.

The above platforms and tools have been tested sufficiently during the pandemic and will be further

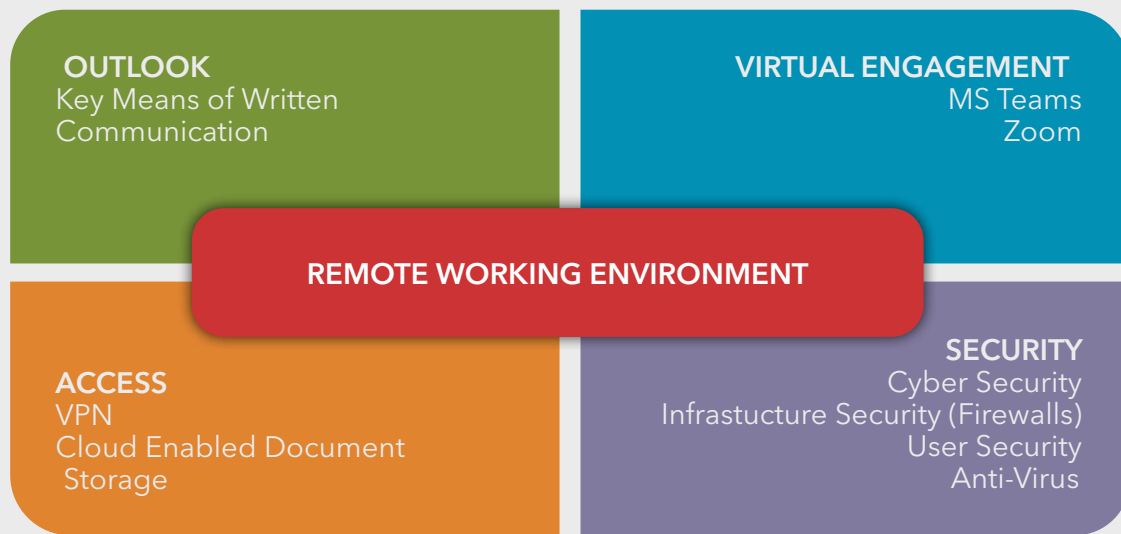
strengthened and expanded to enable the business to effectively track and monitor productivity in the hybrid working environment. This will be done through the introduction of an employee availability matrix, that will aid in managing through a synchronous operating environment. The further enablement of the environment will take the form of ensuring that we re-engineer processes to optimise and introduce lean principles, automate manual processes in partnership with business owners and further expand on the virtual tools and platforms made available in the growth and development of our workforce in the new world of work.

To enable performance ultimately is to ensure that our employees remain connected. Whilst there are many connectivity technologies available that function optimally our goal is to ensure that the most sustainable and reliable technologies, like 5G, are made available to our employees.

Cloud and virtualisation

Being a cloud-first company leapfrogged the WRC's business continuity capability and allowed us to quickly enable 97% of our workforce to work from home during the first 24 hours of us feeling the impact of the pandemic. The cloud will continue to help accelerate the adoption of advanced, fit-for purpose technology, across the organisation. It won't be long before the 'phone call'

Figure 51: Elements of the remote working environment



is near completely antiquated as the WRC increases the frequency and dependency on ways of working that were previously not the standard – such as collaborating over MS Teams on video.

The WRC will continue its focus in the cloud arena by rolling out and maintaining collaboration tools, and more easily deliver applications, capacity, and storage to a far-flung workforce.

Flexible strategy + flexible software platforms

Never has there been such a high demand for technology than the one seen since the onset of this pandemic. In our effort to future-proof our organisation, recognising that it is vital to be able to quickly and seamlessly implement functionality, we will develop a set of platforms that will be implemented and have the ability to scale to support varied operational and opportunistic needs.

Research into other available technologies that support the strategy and launch of the WRC Water Research Observatory will be investigated and aligned with the research and development needs.

Simplification and standardisation is vital

The emergency caused by this pandemic highlighted that the less complexity there is in IT, the better it is for the business. We will spend a lot of energy and manpower

focusing on the simplification and standardisation of our technologies. The company has already invested in Microsoft Dynamics 365 as its fund/project management tool. This will be extended to being the customer relationship management tool as well as the internal business process automation tool. These investments in simplifying, automating, and standardising will be essential to our ability to remain agile and simple.

IT security - the people-centric approach

Since the onset of the pandemic, what has been noted is a significant rise in hackers targeting remote workspaces and not systems. The WRC (like most businesses around the globe) has traditionally focused its efforts on creating security for systems. We will pivot to focus our efforts on developing security for people. Recognising that a remote worker will likely abandon security procedures that interfere with their workflow and productivity, and as a result be willing to bypass data protection checks, a balance between security and the user experience and productivity will have to be found and implemented. Our IT team will build and provide a streamlined, hassle-free work experience whilst building transparent cyber-security controls.

Learning and relearning

Technology is a fundamental skill set that all employees require to remain productive into the future. In order

to create this a learning and re-learning approach will be adopted in order to guide the learning process of employees and speed up the adoption rate of technologies used to drive productivity and success within the business. Only through adoption and use of the provided technologies will the shift occur.

The way forward

As the coronavirus paralyses businesses and society worldwide, it might be tempting to place on the backburner any digital strategy. The WRC, however, does not have to shift its focus as our business continuity and resilience has to-date proven to be highly effective and reliable. We will rather focus our efforts on accelerating our business transformation drive now to place us in a better position after the pandemic passes.

Recent research indicates that by the year 2022, at least 80% of revenue growth will be hinged on digital offerings and operations. The WRC will continue to invest in our digital journey while balancing our short-term efforts with the long-term measures that will see us become more competitive. We recognise that a sound model for success incorporates the best people, lean processes and effective (yet simple to use) technologies.

We will reduce our on-premise solutions toolbox and expand further into our cloud-first strategy, which is a linchpin of any digital business. As a cloud-first company, we will continue to adopt and invest in software-as-a-service (SaaS) and infrastructure-as-a-service (IaaS) technologies.

We will boost and improve resilience in a way that aligns with our business' corporate objectives by enabling critical activities that the WRC requires to keep moving forward. The picture of long-term resilience is painted by the reduction of threats and vulnerabilities – cyber, natural disasters, pandemics and otherwise – to the business. We will work to reduce the likelihood of failure, and should failure occur, we will have our IT team thinking and acting more carefully on service delivery as part of our business continuity planning. Whilst historically, business continuity was viewed as an operational discipline, we at the WRC will evolve it to be exercised more as a strategic element of our business. This implies that our branches will be communicating and working in-concert rather than working in siloes.

11.3 CORPORATE SOCIAL RESPONSIBILITY

Corporate social responsibility is the commitment by the WRC to behave ethically and contribute to economic development while improving the quality of life of its employees as well as the community and the environment in which it operates.

The specific objectives of the strategy are as follows:

- Support inclusive growth
- Enhance access to basic services
- Promote environmental sustainability

CSR alignment with Sustainable Development Goals

The WRC sees it as its responsibility to contribute, either directly, partially or indirectly, to the UN Sustainable Development Goals (SDGs) (Figure 52, Table 8).

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.

Originally, the Sustainable Development Goals (SDGs, a follow-on from the Millennium Development Goals, or MDGs) were established as a response to world poverty, inequality, and insecurity, but they have developed into drivers of the management of resources. The SDG agenda builds on the achievements of the MDGs and addresses areas that the MDGs did not achieve. The 2030 Agenda for Sustainable Development was adopted by the United Nations' Heads of State and Government for guiding the world towards a sustainable development path. The 17 SDGs target the addressing of social, economic and environmental problems facing countries by 2030. Specifically, the challenges that triggered the development of the SDG agenda include an increasing world population, climate change, increased urbanisation, environmental degradation and critical water shortages for domestic and agricultural purposes. The SDGs are focused on human livelihoods, with a total of 169 targets which are global in nature and universally applicable. Additionally, the targets recognise different national realities, capacities and levels of development and varying national policies.

Figure 52: WRC corporate social responsibility in relation to the UN Sustainable Development Goals








- | | |
|--|--|
| 1 End poverty in all its forms everywhere | 10 Reduce inequalities within and among communities |
| 2 End hunger, achieve food security and improve nutrition and promote sustainable agriculture | 11 Make cities and human settlements inclusive, safe, resilient and sustainable |
| 3 Ensure healthy lives and promote wellbeing for all at all ages | 12 Ensure sustainable consumption patterns |
| 4 Ensure inclusive and equitable education and promote lifelong learning opportunities | 13 Take urgent action to combat climate change and its impacts |
| 5 Achieve gender equality and empower all women and girls | 14 Conserve and sustainably use the oceans, seas and marine resources for sustainable development |
| 6 Ensure availability and sustainable management of water and sanitation for all | 15 Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and reverse land degradation and halt biodiversity loss |
| 7 Ensure access to affordable, reliable sustainable and modern energy for all | 16 Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels |
| 8 Promote sustained inclusive and sustainable economic growth, full and productive employment and decent work for all | 17 Strengthen the means of implementation and revitalise the goal partnerships for sustainable development |
| 9 Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation | |

Table 8: WRC alignment with the Sustainable Development Goals

SUSTAINABLE DEVELOPMENTAL GOALS	
	<p>End poverty in all its forms everywhere</p> <p>The WRC through the water-energy-food nexus aims to facilitate the integration of existing water, energy, food policies and strategies to increase food production, water availability and sustainable energy generation. This ensures that existing knowledge is used to inform policies for integrated sustainable resource management among the WEF sectors.</p> <p>The WRC aligns to this goal by funding research projects that focus on the improvement of household food security, nutrition and health. Providing support to meet nutritional requirements of households in different rural villages with rain-fed and supplementary irrigated food production.</p>
	<p>End hunger, achieve food security and improve nutrition and promote sustainable agriculture</p> <p>The strategic focus for Water Utilisation in Agriculture division is on increasing 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. Priority is therefore given to knowledge application and skills development of homestead food gardeners and smallholder farmers. The focus for this division is purposefully directed towards overcoming poverty, hunger and malnutrition and promoting resilience amongst members of the rural and urban population.</p>
	<p>Ensure healthy lives and promote wellbeing for all at all ages</p> <p>Secure and sustainable access to water is essential for human health, economic growth and food security. However, in South Africa's semi-arid environments conventional water sources are not enough to meet the ever-growing demand. Therefore, the WRC through the Water Quality and Health Lighthouse endeavours to increase understanding and assessments of alternative sources of water such as fog water, desalination and water transfers. The WRC has positioned itself as a leader in emerging pollutants research, by funding projects on emerging chemical contaminants (for example microplastics, pharmaceuticals, agrochemicals, engineered nanoparticles). The results of these studies have re-energised national conversations on water pollution prevention, control and waste management. Research focused on protecting and monitoring sources of drinking water is prioritised.</p>
	<p>Ensure inclusive and equitable education and promote lifelong learning opportunities</p> <p>The WRC is committed to providing South Africa with future researchers as well as a source of skilled human capital for other institutions within the water sector. This is done by investing in student training; project leaders are encouraged to include students on their projects, enabling them to participate in water research through the various projects supported by the WRC. Currently the WRC has 387 students training in its projects.</p>
	<p>Achieve gender equality and empower all women and girls</p> <p>Those who live in remote rural settings remain largely absent from water-related decision-making processes, as do women, who are affected but whose voices have not yet been adequately heard. The WRC endeavours to capture the narratives and voices of women, and in so doing to bring the wisdom, experience and concerns of women facing the effects and impacts of climate change and water scarcity in their everyday lives to the fore. Accordingly, through the Women in Water Empowerment Programme (an initiative of the DWS) the WRC continues to increase opportunities for women to work in the water and sanitation sector as consultants, contractors, suppliers and innovators.</p> <ul style="list-style-type: none"> • Towards gender-sensitive strategies for responding to challenges posed by climate related impacts <p>The WRC endeavours to increase the representation of female researchers in its research teams.</p>

SUSTAINABLE DEVELOPMENTAL GOALS

	<p>Ensure availability and sustainable management of water and sanitation for all</p> <p>The WRC through the Water Quality and Health Lighthouse seeks to guide integrated water quality management in South Africa, by providing an understanding of the water quality conditions over time, the contribution of global and anthropogenic factors to water quality, and the impacts of water quality changes on the economy, ecosystem and human health, as well as to develop solutions to address the identified challenges. A suite of guidelines on alternative water sources and quality (e.g. rainwater harvesting, greywater harvesting and treatment, desalination and water reuse) have been developed to support this initiative.</p>
	<p>Ensure access to affordable, reliable sustainable and modern energy for all</p> <p>The WRC aligns to this goal by channelling resources to renewable energy generation. Through the WEF nexus, specific attention is paid to efficient energy use for food production.</p>
	<p>Promote sustained inclusive and sustainable economic growth, full and productive employment and decent work for all</p> <p>The WRC through its Green Economy Lighthouse funds research that leads South Africa towards a resource-efficient, low-carbon and pro-employment growth path. The strategic objectives of the Lighthouse are:</p> <ul style="list-style-type: none"> • To lead and align research, development and innovation (RDI) with key national and international poverty, unemployment and inequity eradication aspirations • Enterprise development to empower communities, especially women and youth through green innovation • To unlock economic wealth beyond the environmental processes by engaging the market value chain • To encourage partnership, particularly that leads to co-funding and implementation • Positioning RDI products in leadership, nationally and internationally, through dialogues, conferences, and community interventions • To develop an adaptable and integrated green innovation framework critical in entrepreneurship/business, community empowerment and influencing of policy
	<p>Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation</p> <p>The WRC capitalises on 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. Requirements for entrepreneurial development and establishment of viable smallholder irrigation farming businesses has been determined for selected irrigation schemes in Limpopo, Eastern Cape and KwaZulu-Natal Provinces.</p>
	<p>Reduce inequalities within and among communities</p> <p>The WRC aligns to this goal by funding projects that have a direct impact in uplifting rural economies through commercial food production and reducing income inequalities. Attention is given to building capacity to ensure post-project sustainability:</p> <p>The WRC is committed to supporting national transformation and redress, ensuring that the new dispensation brings about the intended redress. Through the Water Utilisation in Agriculture business division, the WRC addresses the needs of Black emerging farmers (BEF), contrasting with those of commercial White farmers, in accessing water for productive purpose</p>

SUSTAINABLE DEVELOPMENTAL GOALS	
	<p>Make cities and human settlements inclusive, safe, resilient and sustainable</p> <p>The management of the combined effect of urbanisation, industrialisation and population growth on water resources is a challenging task and the increasing demands for water for different uses require a broad range of water management strategies and tools. The WRC has through the Water Sensitive Settlements Lighthouse adopted an integrated approach to manage hydrological and biochemical processes within catchments and ensure sustainable development in both urban and rural communities.</p>
	<p>Ensure sustainable consumption patterns</p> <p>Through its Water Resources and Ecosystems business division, the WRC aligns to this goal by funding research that provides knowledge on sustainable use of natural resources. This is to ensure that basic human needs are met and that resources necessary for long-term survival are not destroyed for short-term gain. This division also focuses on research that enhances knowledge on healthy ecosystems and preservation of biodiversity.</p>
	<p>Take urgent action to combat climate change and its impacts</p> <p>The WRC through its Water Resources and Ecosystems business division has identified the potential adverse effects climate change has on ecosystems, resources and society. Secondary impacts (due to lack of access to adequate good quality water) negatively impact economic growth, food security, health and services. Consequently, to reduce vulnerability as a country/global community it is crucial that we adapt to the currently highly variable climate, as well as to projected climate change impacts on water availability.</p> <p>The WRC climate change flagship programme encompasses collaborative research and development on priority water-related climate issues across the spectrum leading to impacts that will be felt at both national, regional and global scales. The ultimate purpose of this Lighthouse is premised entirely upon improving the adaptive capacity of the people and the sector to increase resilience and development of a knowledge base for climate change adaptation and decision support, while providing strategic guidance and framework for sectoral response.</p> <p>Accordingly, below are some of the WRC's projects that focus on developing the understanding of global climate change and hydro-climatic variability impacts, crafting methodologies for vulnerability assessments and development of appropriate adaptation options and solutions at various scales.</p>
	<p>Conserve and sustainably use the oceans, seas and marine resources for sustainable development</p> <p>The WRC Through its Green Economy Lighthouse aims to provide an improved conceptual understanding of ocean-atmosphere linkages to hydroclimatic variability in Southern Africa, to understand the role of the adjacent ocean in moisture transport, rainfall and extreme weather and climate of South Africa, and to understand the role of the ocean on decadal variability of the Southern African climate and explore potential decadal forecasting thereof.</p>
	<p>Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and reverse land degradation and halt biodiversity loss</p> <p>Global environmental change has negative effects on ecosystems and these are aggravated by stressors such as unsustainable use of water, deteriorating water quality, and land use and demographic changes in time and space. The focus is also on developing appropriate quantitative understanding, tools and strategies for managing the impacts of climate variability and change, as well as human interventions on the hydrological cycle and related water resources, with the aim of supporting the development of policy responses, at regional, national or catchment scale, to existing and emerging problems. This includes development of tools and systems for managing floods and droughts and the effects thereof on the resources and the people who rely on those resources.</p>

SUSTAINABLE DEVELOPMENTAL GOALS	
	<p>Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels</p> <p>The WRC seeks a multi and trans-disciplinary approach – drawing on expertise in natural and social science, as well as engineering, humanities, sustainability science, and other professions such as planning, law, and business.</p>
	<p>Strengthen the means of implementation and revitalise the goal partnerships for sustainable development</p> <p>Meeting the global water challenges is not a one-country or one-stakeholder effort. It requires an ongoing, collective, co-operative and coordinated effort to address common water and sanitation challenges. The WRC actively seeks local and international partnerships that address the WRC service pillars: research, technology innovation, knowledge sharing, capacity development and funding. These include research partnerships, implementation partnerships and innovation value chain partnerships.</p> <p>The WRC endeavours to become an African partner of choice for water and sanitation research, development and innovation (RDI) and focuses on building partnerships with the purpose of:</p> <ul style="list-style-type: none"> • Contributing to setting and implementing a water and sanitation RDI agenda • Building water and sanitation RDI capacity • Supporting water and sanitation technology innovation through: <ul style="list-style-type: none"> a. Linking African technology innovations with South African partners b. Linking South Africa technology innovations with African partners c. Providing support for piloting of technology innovation in South Africa • Facilitating knowledge sharing between South African, other African and global stakeholders • Issuing Joint Calls for water and sanitation RDI (co-funding of RDI)

11.4 PEOPLE AND CULTURE

Macro-context

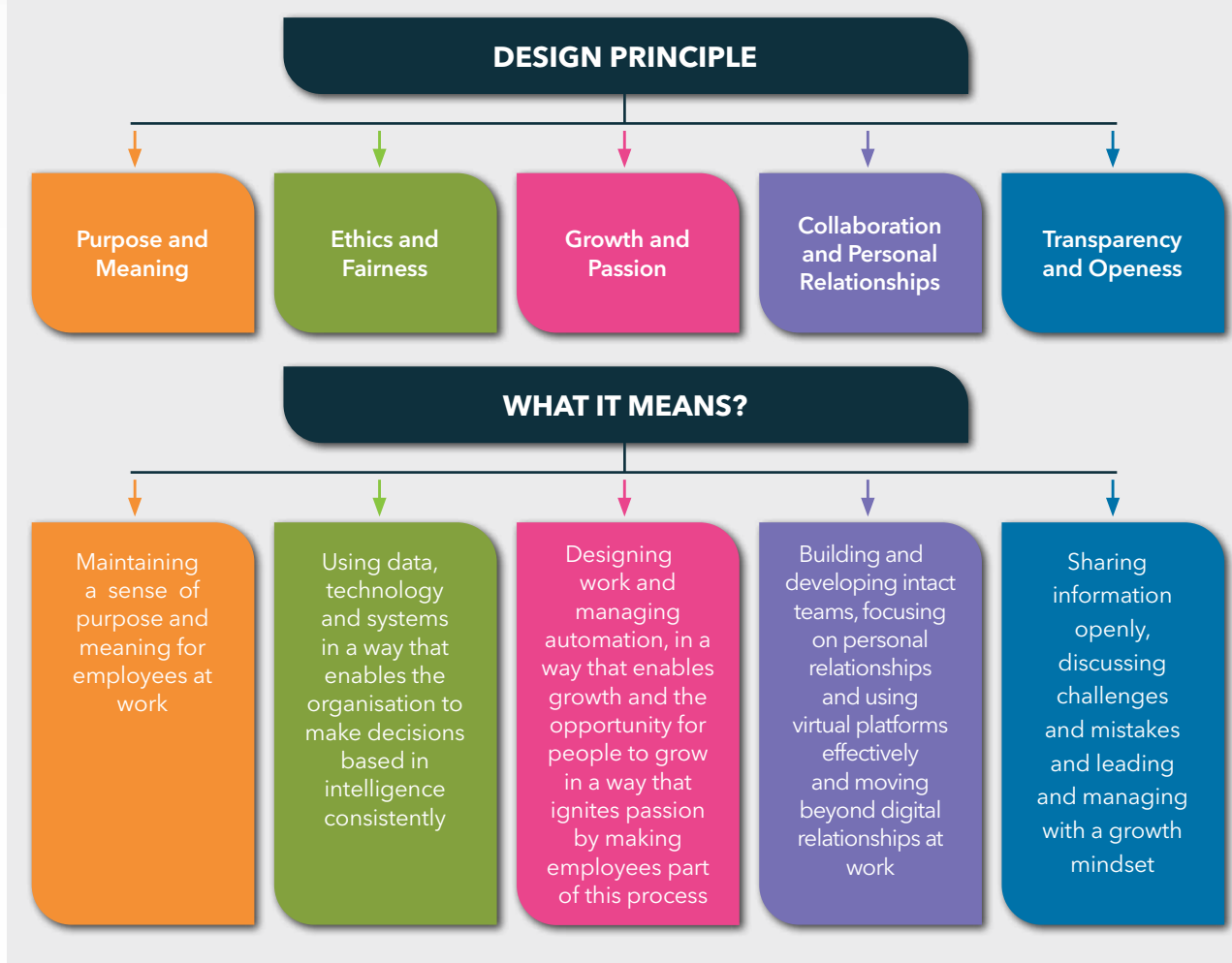
Our vision is to enable the WRC through creating an environment around people, practices and culture, in partnership with the leaders of the organization, in order to create an employee value proposition that amplifies the meaning of work in alignment with our WRC strategy.

While technology is helping the organization to gain a competitive advantage, if not managed appropriately it can simultaneously mean that employees lose their identity in the workplace. To bring meaning back into the workplace, and a human identity back to the employee, it is clear that traditional human resource programmes, processes and policies should be reinvented, to create opportunities for continuous learning, accelerated development and professional and personal growth. Human potential is and always will be what moves us forward.

The magnitude of the disruptions to the workforce and the workplace, as a result of the COVID-19 pandemic and the 4th industrial revolution – and their consequent impact – is the very reason why we need to be intentional around reinventing our people, practices and processes in alignment with shifts in our infrastructure, technology and spaces within the WRC. In addition to this we need to enable our current environment in such a way that we are able to scale these to integrate our new operating model, which includes the Water Research Observatory, Water Academy and the Water Innovations Company, in the near future. This is all playing out in a world where hybrid working environments, new job design and robotic process automation, is a real-life scenario.

To guide the reinventing journey, the principles depicted in Figure 53 will direct our strategy and transition of our people and culture environment with clear intent.

Figure 53: Principles to guide the reinvention of People and Culture

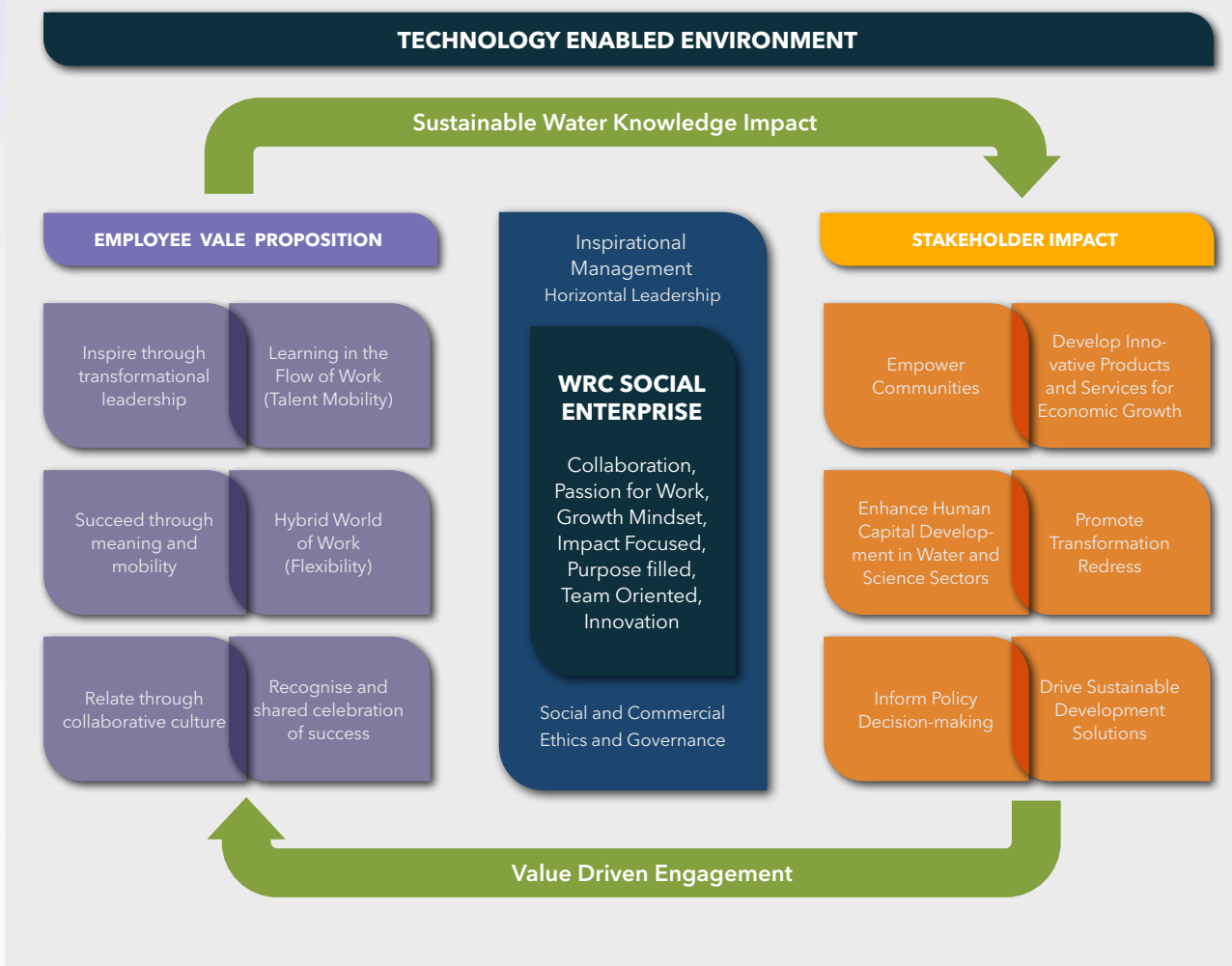


These principles will extend into our Corporate Social Responsibility landscape, where the internal alignment around meaning and purpose is amplified, as we enable employees to live out and experience the meaning and impact through dedicated initiatives focused on environment, community impact and employee wellbeing. This is in alignment with the Sustainable Development Goals that we contribute to directly through our research portfolio, as we continue to build our brand as a social enterprise. These elements are brought together in our proposed Employee Value Proposition framework, which ensures the integration of our overall design principles and impact through our WRC Knowledge Tree.

This strategic context will play out in an environment where collaboration and strategic partnerships within and external to the WRC are key and will be facilitated through the strategic objectives driven through our People & Culture and Corporate Social Responsibility (CSR) within the WRC.

Changing worlds of work, and the introduction of new modalities of work in response the COVID-19 pandemic have drastically changed the way work plays out across the globe. The virtual world of work and the quick introduction of this has and will continue to require workforces to remain agile to change and introduce environments where innovation and collaboration happens intentionally. In creating meaning what we

Figure 54: The WRC social enterprise, employee value proposition and stakeholder impact



hope to see in the outcomes of our employee workforce are the following:

- **Agility.** Through creating a culture of radical and incremental innovation and transitions in driving both efficiency and growth in our day to day environments
- **High performance culture.** Through a high-calibre, motivated workforce that is results focused, drives solution-oriented collaboration, and focuses on personal and team performance.
- **Shared responsibility.** Through driving shared accountability for the success of the WRC, in working together to improve our ability to deliver on the WRC's mission, knowing that we are ultimately accountable to each other.

Strategic objectives

Hybrid way of work

The organizational benefits of hybrid worlds of work are being engaged the world over. In this the WRC has an opportunity to explore ways in which a different modality of work allows us to access talent globally in a very same way as it enables us to form strategic partnerships. Our virtual platforms have been put in place and our IT environment will ensure that we continue to grow in this regard. In alignment with this we need to ensure that our leaders are equipped with the skills to navigate a hybrid world of work in a way that we can capitalize on the benefits of peak performance throughout the organization.

Talent and technology

The use of technology to integrate talent management into the fabric of everyday business is key to ensuring that we transition towards the optimization of existing talent, through seeing talent beyond acquisition. Talent data and our ability to over time express real-time intelligence around our talent risks and talent opportunities, will enable the WRC to maintain a lean and agile organization that shifts people skills along with business requirements, and resources future capabilities through development.

Talent access and mobility

The fast-paced development of business environments requires the WRC to think beyond the buying of talent and move towards winning the war for talent from the inside out. This could be done through setting new norms that govern the mobility of talent as an outflow of talent development. When thinking talent acquisition, we should be reflecting on ways that we could create different working relationships to meet delivery needs, the exploration of 'superjobs' and alternative workforces will shape our workforce into the future. Our focus will include the specific capability requirements in terms of our WRC operating model, which includes the Water Research Observatory, Water Academy, and the Water Innovations Company.

Learning in the flow of work

Learning is no longer an event, and qualifications alone no longer guarantee performance in an ever-changing vibrant world. A culture of learning within a learning organization is key. To this end, we look to expand our leadership capability with mentorship and coaching as well as to set virtual platforms, complementing the traditional learning mechanisms through which employees could augment their learning journeys to be more agile.

Success through collaborative culture and meaning

The shift from hierarchies to teams is well underway. Yet most have not yet refreshed their leadership, job design and rewards to adapt to this shift. As technology is making team models of work easier, we must now refresh the rest of our talent practices to keep up. This

means the development of team performance metrics, and individual and team recognition in support of a well-defined remuneration model.

Managing risk and privacy

As access to information becomes more fluid, HR is required to adopt new risk management strategies to ensure the protection of private information and data. The overall risks include ensuring that an overall talent risk approach is adopted in all processes covering the employee lifecycle and effective controls are put in place to navigate this.

Strategic business partnership

To achieve all of the above, the future HR operating model is defined by partnership with the business. This means, having a detailed understanding of the internal and external environment our business operates in, delivering HR services seamlessly and with high levels of integrity, whilst collaborating with other parts of the business to deliver on the employee value proposition of the WRC. This requires a shift from a fragmented operating model to a fluid, agile operating model where there is clear accountability across the people and culture value chain. This model further relies on centres of excellence, which are designed around talent management, employee wellness, leadership, employee and team development, to enable transformational initiatives within the defined areas of responsibility in order to ensure both transactional and transitional management of people practices.

11.5 LEGAL AND COMPLIANCE

The WRC's Legal & Compliance strategy is centered around ensuring a legal advisory framework and a well-defined compliance landscape (integrated into processes), guide decision-making across all levels within the WRC.

Overall legal and compliance within the WRC is a solid environment where legal advice is provided timeously and effectively to mitigate risk within the Organisation. The legal landscape in which we operate is expanding along with changes to our operating model which leads

to the introduction of new capabilities centred around learning and data, further stretching into the companies act with the addition of the companies act within the WRC stable.

No matter how organised, talented or in a class of their own, even the best legal departments still face different and sometimes complex challenges when leading an in-house legal office. As today's regulatory obligations on Organizations such as the WRC become more complex, they also tend to become more stringent, demanding KPA's to be more dynamic whilst dealing with external pressure and the internal organization's need to reduce and manage costs. To this end it is crucial to have a governing framework, aligned to the WRC's business strategy to focus the activities for the legal and compliance function within the WRC.

Therefore, to address the many managerial, legal, financial, and organisational challenges, the WRC's Legal and Compliance has established a role that goes beyond merely monitoring legal matters, overseeing operations, and allocating resources. The WRC's Legal and Compliance operations demand the capability to impact the organization from the ground up to improve

efficiency and prevent unnecessary expenditure due to litigious matters, non-compliance, and poor governance. Therefore, providing proactive and strategic guidance and advice on:

- Policy, Process and Procedure alignment to ensure compliance (the 3p's).
- Efficiency around Risk Management.
- Definition and guidance on the compliance landscape and overall governance.
- Compliance landscape and effective governance.
- Legislative changes; and
- Business transitions and changes.

Legal and Compliance have formal strategic plans and supporting objectives that are cohesive and highly aligned with the WRC's respective business operations to ensure effectiveness, enhance stakeholder value, and capitalizes on the WRC's long-term direction

Overall View of Legal and Compliance Role and Operational Opportunities:

The following strategic shifts are key in ensuring efficiency in the overall legal and compliance landscape within the WRC to set it up for future operations.

	LEGAL & COMPLIANCE OPERATIONAL ROLE	STRATEGIC OPPORTUNITIES
1. Avoidance	Serves in an emergency role, fending off legal threats and crises in a reactionary mode.	Regulatory arbitrage
2. Compliance	Plays a policing and oversight role, to ensure legal conduct by and within the WRC	Non-compliance
3. Prevention	Works with Management to identify specific future operational risk that can be addressed through legislation	Business landscapes are strategically addressed
4. Transformation	Acts as a partner when the WRC is in the process of strategic decision making and structural transformation	Long-term resource when law is combined with the WRC's business model and core competencies and governance of the organisation coupled with new structural transformations.

To continually improve our role in supporting and enhancing the mandate of the WRC, Legal and Compliance as part of Corporate Services has defined the following objectives:

- To establish unified business processes to create a unified administration, by conducting a full gap analysis on all policies, process and procedures and incorporating virtual mechanisms and platforms for training and workshopping and collaboration within the business.
- To enable the integration of the WRC's processes into the governance and management of the organisation, through Organizational Governance and Compliance Checklists.
- To keep the WRC's governance and compliance structure under review to ensure that it is fit for purpose. Such review is to incorporate an automated process that provides a flexible and responsive legislative and decision-making framework for the organisation that is succinct and efficient.
- The review and updating of contracts and legal documents for a smooth and efficient approval process with fewer repetitive errors as well as up to date on legislative insight on the necessary statutory requirements.
- Distinguish between decision-making, consultation and communication therefore bringing greater transparency to the decision-making process
- Review of legislation and incorporation of statutory changes in an effective way to ensure that the WRC is a responsible Corporate citizen.
- Establish a portfolio of priorities that drive differential resource allocation and differential targets across the legal department.
- Recognize Legal and Compliance core capabilities (and constraints), enabling optimal utilization of outside counsel.
- Achieve system sustainability and "repeatability" by creating a competitive advantage for the WRC through "learning curve" effects.

The ultimate strategic goal for Legal and Compliance is to reach its full organizational and functional potential, by creating an environment in which Legal and Compliance is a proactive advisor & regulator to the WRC. This role will expand through business changes and transitions as it pertains to the future operating model as well as

transitional and cultural changes because of technology shifts.

In order to continually improve our role in supporting and enhancing the mandate of the WRC, Corporate Services also has the objectives to:

- To establish unified business processes in order to create a unified administration
- To enable the integration of the WRD's processes into the governance and management of the organisation
- To keep the WRC's governance structure under review to ensure that it is fit for purpose, i.e., it provides a flexible and responsive legislative and decision-making framework for the organisation
- Review of legislation
- Shorten lines of decision-making
- Distinguish between decision-making, consultation and communication; bring greater transparency to the decision-making process

11.6 FACILITIES

Facilities at the WRC is responsible for creating an optimal environment for the organisation's primary functions, taking an integrated view of the business infrastructure, and using this to deliver satisfaction and best value through support for and enhancement of the core business. Thus, facilities management can be described as something that will:

- Deliver effective and responsive services
- Enable changes in the use of space in the future
- 'Sweat the assets', i.e., make them highly cost effective
- Create competitive advantage for the organisation's core business
- Enhance the organisation's culture and image
- Ensure that the work environment enhances stakeholder satisfaction

Managing facilities efficiently and effectively is achieved by a robust strategy that is developed within the context of the WRC's Corporate Plan and space/accommodation strategy. These involve development of strategic objectives and a plan for facilities management, with proper reference to the overall Corporate Plan

and space/accommodation strategy within which it is contained, and which considers the needs of the organisation, differentiating between core and non-core business activities.

Facilities strategic objectives

- Identify and establish effective and manageable processes for meeting those needs
- Establish the appropriate resource needs for providing services, whether obtained internally or externally
- Identify the source of the means to finance the strategy and its practical implications

11.7 STRATEGIC PROJECT FOR 2021: WRC WATER ACADEMY

A significant gap in the sector is the capacity building of key stakeholders. There is a growing need in the industry to develop professional and build capacity in the South African water sector. The WRC through its research develops guidelines and training material and having a central coordination point (The Academy), this academy will be able use the material produced, either on its own or in partnership with equipped training providers transfer knowledge and build capacity in the water community with the skills and knowledge needed to respond to the challenges facing the country. The

aim of the Water Academy will be to provide easily accessible, user-friendly, and continuous skill-based learning through collaboration, knowledge exchange, and networking to bridge the learning and innovation gap that currently exists.

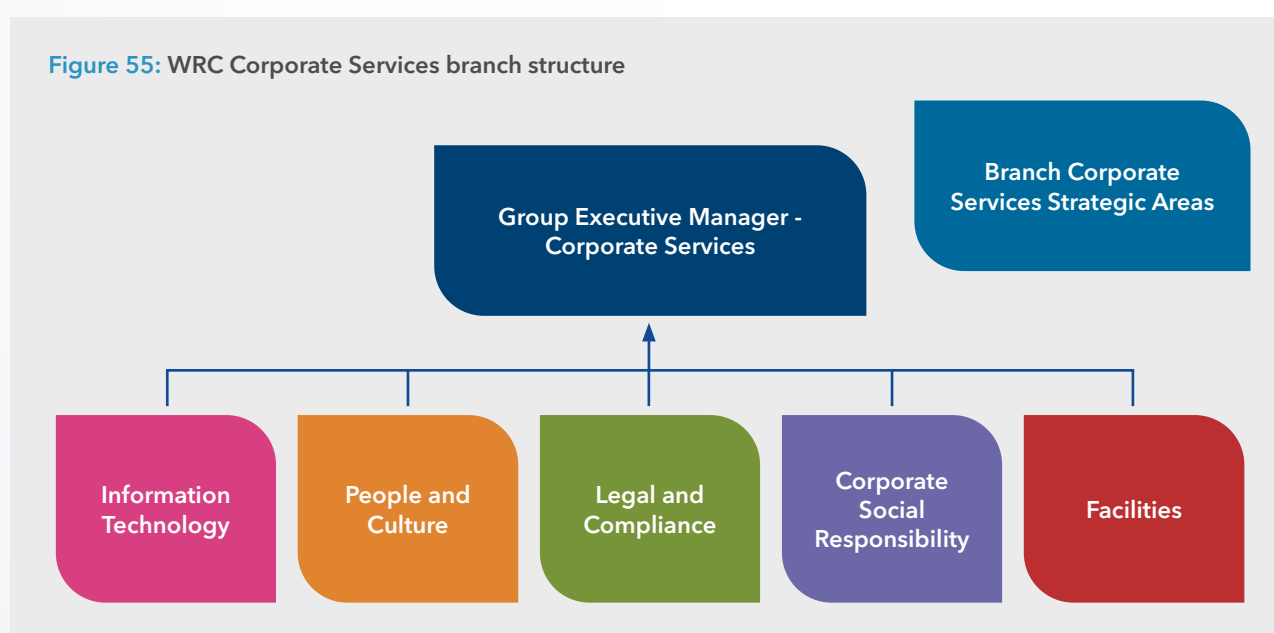
The aim of the academy is to be a sustainable training concept especially on a practical level and a main goal to use material from WRC research to enhance capacity both on the technical and practical level.

Proposed areas:

- Training for practical level - Training and knowledge sharing aimed at the "field workers", individual from communities e.g. Farmers / municipal workers.
- Training for professionals and by professionals - The participants are trained by professionals from the water sector itself.
- Customized courses - Based on identified needs. Training that can be developed for the specific needs of the stakeholder
- Summer Schools /Bursaries and Internship programmes- Introducing students (university and schools) to the concepts of water innovation and solution for the water sector will start the capacity building at an early stage

In the 2021/22 year, this will be run as a pilot where the business case will be developed out.

Figure 55: WRC Corporate Services branch structure



12 | Risk Management

Recent events in the world have raised the profile of risk management, e.g. terrorism, extreme weather events and the global financial crises represent the extreme risks that are facing society and commerce. Evaluating the range of risks impacting the WRC's operations is the core of risk management. Events that can impact the

WRC may inhibit what it is seeking to achieve (hazard risks), enhance that aim (opportunity risks), or create uncertainty about the outcomes (control risks). The fourth category of risk that impacts the WRC is related to mandatory obligations placed on organisations and these risks are referred to as compliance risks.

Figure 56: Risk management structures at the WRC



The WRC's risk management framework (Figure 56) offers an integrated approach to the evaluation, control and monitoring of its risks. The WRC's risk assessment (Table 10) 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.

Table 10: Summary of WRC Risk Register

RISK NAME	LINK TO STRATEGIC OBJECTIVE
1. Limited availability, continuity and growth of adequate research and innovation expertise to deal with the increasing complexity in the water and sanitation sector, both institutionally and externally	<ul style="list-style-type: none"> To promote transformation, redress and enhance human capital development. To enhance knowledge across the water knowledge and innovation cycle. To enhance corporate and social responsibility To invest in the multiplier effect by building partnerships for greater uptake and diffusion of research outputs
2. Financial sustainability	<ul style="list-style-type: none"> To maintain financial sustainability To develop innovative products and services for economic growth To enhance corporate and social responsibility To drive sustainable development solutions
3. Limited application and packing of research, solutions and technologies to maintain the water sector primarily but also across sectors (energy, industry, agriculture, mining etc)	<ul style="list-style-type: none"> 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 enhance corporate and social responsibility To invest in the multiplier effect by building partnerships for greater uptake and diffusion of research outputs
4. Inadequate participation of South Africa in Research, Development and Innovation activities and projects in Africa	<ul style="list-style-type: none"> To drive sustainable development solutions To maintain financial sustainability To enhance social responsibility and corporate responsibility To invest in the multiplier effect by building partnerships for greater uptake and diffusion of research outputs
5. Inability to recover quickly in the event of a disaster	<ul style="list-style-type: none"> To maintain financial sustainability To enhance corporate and social responsibility
6. Fraud and corruption	<ul style="list-style-type: none"> To maintain financial sustainability To enhance corporate and social responsibility
7. Non-compliance to Acts, Regulations, Legislations, Policies and Procedures	<ul style="list-style-type: none"> To maintain financial sustainability To enhance social responsibility and corporate responsibility To inform policy and decision making



“

Evaluating the range of risks impacting the WRC's operations is the core of risk management.

13 | Budget

13.1 BUDGETS FOR CP21

The budget estimates for the five-year period (2021/22 to 2025/26) are summarised in Table 11.

Table 11: Budget for the five-year period 2021/22 to 2025/26

Description	Budget estimates 2021/22	Budget estimates 2022/23	Budget estimates 2023/24	Budget estimates 2024/25	Budget estimates 2025/26
Income					
Levy income	271 859 804	295 429 754	324 972 729	357 470 002	393 217 002
Leverage income	56 128 294	61 741 123	67 915 236	74 706 759	82 177 435
Interest received	4 185 198	3 766 678	3 390 010	3 051 009	2 745 908
Sales/ commercial income	6 952	7 286	7 635	8 002	8 386
Miscellaneous income	137 737	144 348	151 277	158 538	166 148
Total income	332 317 985	361 089 189	396 436 888	435 394 311	478 314 880
Expenditure					
Fixed costs	12 330 337	13 232 592	14 201 906	15 243 323	16 362 266
Running costs	17 153 250	18 298 091	18 506 915	19 437 898	20 326 462
Human resource costs	122 835 977	132 691 108	143 948 382	156 210 814	169 679 935
Research, development and innovation costs	171 902 522	186 754 189	212 088 689	234 476 526	260 419 621
Corporate expenses	2 736 449	2 878 487	3 017 117	3 162 425	3 314 732
Capital expenditure	5 359 450	7 234 723	4 673 879	6 863 326	8 211 864
Total expenditure	332 317 985	361 089 189	396 436 888	435 394 311	478 314 880
Surplus/(deficit)	-	-	-	-	-

13.2 BUDGET ESTIMATES FOR THE PERIOD 2021/22 TO 2025/26

Where applicable, the inflation projections utilised for the period 2021/22 to 2025/26 were obtained from the latest 2020 MTEF Technical Guidelines issued by National Treasury in June 2019, which are as follows:

- 2021/22 financial year: 5.0%
- 2022/23 financial year: 4.8%

The National Treasury inflation estimate of 4.8% for 2022/23 has been carried through in the WRC budget estimates for the 2023/24, 2024/25 and 2025/26 financial years.

Levy income

The water consumption trends from the Water Boards were used as the best estimates to forecast consumption volumes over the planning period. Historical and

current trends indicate a decline in water consumption volumes and these trends have been incorporated in the determination of the levy income budget estimates over the period under consideration.

To date the Minister of Finance has not published a levy tariff increase for the 2020/21 financial year. This, together with the profound negative economic impact that the COVID-19 pandemic has had on the South African economy, has further strained the ability of water users to make payments and has necessitated the WRC to apply a conservative approach in respect of the revenue estimates over the planning period. The levy income budget includes a 4.5% increase for the 2021/22 financial year and a 10% increase year on year from 2022/23 to 2025/26.

Leverage income

The leverage income forecasts for the period 2021/22 to 2025/26 are based on detailed business plans that are underpinned by a combination of signed funding agreements and, in some instances, partnership opportunities that are still in the business development phase. The reality is that there are no guarantees regarding availability of funds from research partners and, like other research institutions, the WRC also faces the ongoing uncertainty related to the various phases of the economic and business cycles, including the impact of the COVID-19 pandemic. These budget projections thus incorporate the best estimates based on available information.

Based on the risks and uncertainty related to the above, the budget estimates for the 2021/22 financial year remain at the same level as in the 2020/21 financial year. During the 2022/23 to 2025/26 period we are reflecting a 10% annual increase as the WRC expects that the ongoing groundwork performed in cultivating relationships and leverage opportunities will start to materialise, coupled with a more stable economic environment.

Human resources

The human resources budget forecast is based on a moratorium on the filling of vacancies (except for key leadership roles in line with the recent Ministerial directive in this regard) over the planning period (2021/22 to 2025/26). All unfilled vacancies will be revisited as the income prospects of the WRC are crystalised and this will be impacted by both levy and leverage income.

The human resources budget forecasts and expenditure for 2021/22 to 2025/26 are based on the DPISA annual cost of living increases, which are inflation-linked, and also includes performance-based increases.

Research, development and innovation expenditure

As reflected in Table 12 the investment in Research Development and Innovation (RDI) equates to more than 60% of total WRC expenditure over the planning period. Tables 13 and 14 shows that levy income remains the WRC's primary funding source and accounts for more than 70% of the investment in RDI.

Table 12: Research and development expenditure as a percentage (%) of total expenditure

Description	Budget estimates 2021/22	Budget estimates 2022/23	Budget estimates 2023/24	Budget estimates 2024/25	Budget estimates 2025/26
Total research, development and innovation expenditure **	214 135 016	232 759 526	262 070 540	288 789 845	319 496 005
Total expenditure	332 317 985	361 089 189	396 436 888	435 394 311	478 314 880
RDI expenditure as a % of total expenditure	64%	64%	66%	66%	67%

**Total research, development and innovation (RDI) includes expenditure on RDI projects plus human resources costs dedicated to RDI activities.

Table 13: Research and development expenditure analysis of funding sources

Description	Budget estimates 2021/22	Budget estimates 2022/23	Budget estimates 2023/24	Budget estimates 2024/25	Budget estimates 2025/26
Leverage RDI	56 128 294	61 741 123	67 915 236	74 706 759	82 177 435
Levy RDI	158 006 722	171 018 402	194 155 304	214 083 086	237 318 570
Total research, development and innovation expenditure **	214 135 016	232 759 526	262 070 540	288 789 845	319 496 005

****Total research, development and innovation (RDI) includes expenditure on RDI projects plus human resources costs dedicated to RDI activities.**

Table 14: Research and development expenditure percentage of funding sources

Description	Budget estimates 2021/22	Budget estimates 2022/23	Budget estimates 2023/24	Budget estimates 2024/25	Budget estimates 2025/26
Leverage RDI	26%	27%	26%	26%	26%
Levy RDI	74%	73%	74%	74%	74%
Total research, development and innovation expenditure **	100%	100%	100%	100%	100%

****Total research, development and innovation (RDI) includes expenditure on RDI projects plus human resources costs dedicated to RDI activities.**

Appendix 01 | Key Performance Indicators

Multi-Year Performance Plan

The WRC's Annual Performance Plan indicator set is a lifecycle approach to measuring performance that integrates strategy, people, resources, processes and measurements to improve decision-making, transparency and accountability. The management of performance allows the WRC to learn from experiences, reflect on what has worked and what has not and adapt to the changing environment. In using the streamlined

indicator set, the WRC is able to monitor and report on results through the development and provision of integrated financial and non-financial information. This information will be used for both internal management purposes and for external accountability to the Minister of Human Settlements, Water and Sanitation, Parliament, and the public.

1. IMPACT PORTFOLIO

OBJECTIVE	INDICATOR	2020/21	2021/22	2022/23	2023/24	2024/25
Strategic Objective: To promote transformation and redress						
To better enable researchers to participate in WRC funding instruments, specialized contracts, and general water and sanitation management issues	The number of WRC 101 workshops held in the financial year	6	6	6	6	6
	The number of WRC Roadshows to rural communities	4	4	5	5	6
To promote the participation of youth in water and sanitation RDI	A youth strategy approved by executive	1	n/a	n/a	n/a	n/a
Strategic Objective: To drive sustainable development solutions						
To ensure that the WRC increasingly drives to sustainable solutions for the Water Sector by hosting events that promote robust engagement around critical emerging water management issues	The number of WRC Dialogues.	12	12	14	14	15
To promote the uptake and application of sustainable solution by the water sector through broader engagements	The number of conferences / summits with WRC as a host	2	2	2	2	2
Strategic Objective: To inform policy and decision making						
To influence policy and decision makers with research-based knowledge	The number of policy briefs produced and distributed to relevant government departments and other entities	12	12	12	12	12
	The number of ministerial briefs produced by the WRC and received at the Minister's Office	12	12	12	12	12
	The number of Parliamentary briefs produced and disseminated	6	8	8	10	10
	The number of working papers produced that support decision makers with research-based knowledge	12	14	16	18	20
	The number of public lectures by international speakers on Water and Sanitation and related matters hosted	3	3	4	4	4

2. PARTNERSHIPS

OBJECTIVE	INDICATOR	2020/21	2021/22	2022/23	2023/24	2024/25
Strategic Goal: To develop innovative products and services to economic growth						
To support innovation business incubation services	The number of completed validation and IP due diligence reports issued.	8	8	8	8	8
To develop products and services that are demonstrated in the field or scaled environment	The number of demonstrations and pilots initiated through WADER, SASTEP and RDI portfolio	12	12	14	14	14
Strategic Objective: To drive sustainable development solutions						
To position the WRC as a competitive and key development partner and leader in water and sanitation RDI globally and a specific focus on Africa.	Number of Keynote invites, global board meeting participation and presentations on the South African Water and Sanitation RDI	20	20	20	20	20
	The number of strategic engagements (meetings, dialogues, hosted delegations, country visits) involving other African Institutions	3	4	6	8	8
To partner with Municipality and Utility Support Services and engage in high level Sectoral Support Services	The number of planned events completed	6	6	8	8	8
Strategic Objective: To empower communities						
To ensure that the WRC invests in the multiplier effect by partnering with strategic traditional and non-traditional partners to complement the WRC's mandate on either side of the value chain for water sector and societal impact	The number of workshops held in partnership with other institutions	20	20	20	20	20
	The number of partnership agreements with leverage funding for R&D and sectoral programmes	4	4	4	4	4

3. RESEARCH, DEVELOPMENT AND INNOVATION PORTFOLIO

OBJECTIVE	INDICATOR	2020/21	2021/22	2022/23	2023/24	2024/25
Strategic Goal: To enhance knowledge across the water knowledge and innovation cycle.						
To enhance knowledge through new RDI projects initiated	The number of new RDI projects initiated in the 2019/20 financial year	70	80	80	80	80
To maintain a portfolio of RDI projects that that enhances water knowledge and the innovation cycle	The total number of RDI projects managed by the WRC in the 2019/20 year	250	260	260	260	260
To complete and finalize RDI projects scheduled in the financial year	The number of research projects that have been completed in the 2019/20 financial year	80	80	80	80	80
Strategic Goal: To promote transformation and enhance human capital development						
Growing a more inclusive water and sanitation science community of practice.	The total number of WRC managed projects led by female project leaders	80	85	90	95	95
	The number of new projects led by female project leaders	31	36	41	46	46
	The total number of WRC managed projects led by black male project leaders	70	75	80	80	80
	The number of new projects led by black male project leaders	20	25	30	30	30

OBJECTIVE	INDICATOR	2020/21	2021/22	2022/23	2023/24	2024/25
	The total number of WRC managed projects led by black female project leaders	30	30	35	35	35
	The number of new projects led by black female project leaders	15	15	20	20	25
	The total number of students on WRC managed projects	300	300	350	350	400
	The number of students supported on all WRC managed projects: Postgraduate, PHD students and Postdocs	270	270	270	270	270
	The number of emerging project leaders on WRC managed projects	8	9	10	10	10
Strategic Goal: To develop innovative products and services for economic development growth						
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	24	25	25	25	25

4. FINANCIAL PORTFOLIO

OBJECTIVE	INDICATOR	2020/21	2021/22	2022/23	2023/24	2024/25
Strategic Goal: To maintain financial and income sustainability						
	Initiate contracts with other organisation's that increase leverage funding	4	0	0	0	4
To improve the response to internal audit results	The percentage of the internal audit queries fully addressed	100% of all internal audit queries fully addressed				
To improve the response to the external audit results	The achievement of a unqualified audit report vs a qualified audit report	Unqualified audit report achieved				
	The percentage of external audit queries fully addressed	100% of all external audit queries fully addressed				

5. CORPORATE SOCIAL RESPONSIBILITY PORTFOLIO

OBJECTIVE	INDICATOR	2020/21	2021/22	2022/23	2023/24	2024/25
Strategic Goal: To enhance knowledge across the water knowledge and innovation cycle.						
To ensure social and corporate responsibility	The total number of research and non-research community-based projects managed by the WRC.	60	65	65	65	65
	The number of new community-based research projects managed by the WRC	34	39	39	39	39
	The total number of SMME's on WRC research projects	55	55	56	56	56
	The total number of SMME's on new WRC research projects	15	15	16	16	16
To promote Transformation and Redress and cultivate a high-performance organizational culture	To maintain the minimum the percentage of black, female and employees with a disability at the WRC measured by:					
	• The total number of black employees	88%	88%	88%	88%	88%
	• The total number of female employees	52%	52%	52%	52%	52%
	• The total number of employees with a disability	3%	3%	3%	3%	3%
To improve employee development and growth	Maintain the number of Staff with Masters	22%	22	22	22	22%
	Maintain the number of Staff with PhD's	15%	15	15	15	15%

Appendix 02 | Materiality Framework in Terms of Treasury Regulation 28.3.

1 DEFINITIONS

Accounting Authority:	Board of Directors
Executive Authority:	Minister of Human Settlements, 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 published in Government Gazette No. 7372.

2 INTRODUCTION

In terms of Treasury Regulation 28.3, the Accounting Authority must develop and agree a framework of acceptable levels of materiality and significance with the relevant executive authority.

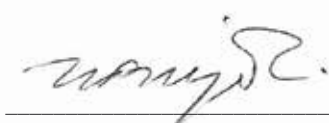
3 FRAMEWORK

1.1 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.
1.2 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;	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.

<ul style="list-style-type: none"> ii. Any criminal or disciplinary steps taken as 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. 		
1.3 Annual Report and Financial Statement (PFMA section 54)	Quantitative (Amount)	Qualitative (Nature)
<p>(3) 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:</p> <ul style="list-style-type: none"> (a) Participation in a significant partnership, trust, unincorporated joint venture or similar arrangement; (b) Acquisition or disposal of a significant shareholding in a company; (c) Acquisition or disposal of a significant asset; (d) Commencement or cessation of a significant business activity. 		<p>Any participation, outside of the approved strategic plan and budget.</p> <p>Any acquisition or disposal, outside of the approved strategic plan and budget.</p> <ul style="list-style-type: none"> 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.

4 AUTHORISATION

This framework was approved by the Board on 26 September 2019.



Chairperson of the WRC Board

Determination of Materiality

1. MATERIALITY BASIS

The audited figures as at the 31st of March 2019 have been used to calculate the 2019/20 materiality as this represents the most reliable, verifiable and objective information available.

Materiality basis	% Used	2018/19 Actuals per AFS (R)	2019/20 Materiality (R)	3 year moving average Materiality calculations	% variance current year vs 3-year average
Gross Income	0.625%	284,298,599	1,776,866	1,833,463	3%
Gross Expenditure	0.625%	283,374,606	1,771,091	1,856,111	5%
Total Assets	1.250%	223,782,647	2,797,283	2,649,038	-6%
Net Surplus for the Year	6.250%	923,993	57,750	-226,483	-126%

2. MATERIALITY BASIS SELECTED AND THE REASONS THEREFORE

The WRC is not a capital-intensive business and its operations are more aligned to skills and capability, both internally and externally. It is for this reason that total assets are not considered the most appropriate basis for calculating materiality.

Because of the uneven pattern of net surplus, i.e., in some years there is a surplus and in other years there are deficits, it is also not regarded as the most appropriate basis for determining materiality.

Gross income consists of levies, leverage income and investment and other revenue. Gross income has proven to be a stable proxy for the activities of the WRC. As can be seen from the Materiality Basis table, gross income has the lowest variance (3%) over the past 3 years compared to other bases. The availability of income is also the most significant determinant of research activity and expenditure levels that the WRC would be able to embark upon. Therefore, gross income is considered the most appropriate bases for calculating materiality within the WRC.

3. MATERIALITY FIGURE

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 776 866. In the previous financial year, materiality was set at R1 842 460. The decrease in the materiality figure amounting to R65 594 (-4%) is considered insignificant. It is furthermore noteworthy that the gross income for the 2018/19 financial year was lower than in the previous years as a result of the levy increase note being approved by the Minister of Finance.



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*“We forget that the water cycle
and the life cycle are one.”*

– Jacques Yves Cousteau

Appendix 03 | Risk Register 2021/22 Financial Year

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 management controls are in place	
1 <ul style="list-style-type: none"> To promote transformation and enhance human capital development To enhance knowledge across the water knowledge and innovation cycle To enhance social responsibility and corporate responsibility To promote transformation and redress To invest in the multiplier effect by building partnerships for greater uptake and diffusion of research outputs 	<ul style="list-style-type: none"> Limited availability, continuity and growth of adequate research and innovation expertise and infrastructure to deal with the increasing complexity in the water and sanitation sector, both institutionally and externally 	<ul style="list-style-type: none"> Insufficient skills and competencies in the country and lack of clarity on the exact nature of the skills/competencies gap Inadequate capability and capacity of partners, systems and processes available to ensure the development of skills, and knowledge uptake in the water sector (supervision, mentorship gap). Inability of the sector to retain graduates Limited career and research training opportunities Current funding model for HEI (Higher Education Institution) is inadequate Inadequate a multi-sectoral research coordination and holistically trained and exposed graduates (transdisciplinary exposure) Inadequate collaboration between vested parties (spanning across technical, vocational, business skills). Decline in monitoring networks and analytical facilities. 	<ul style="list-style-type: none"> Insufficient capacity to either identify or take advantage of opportunities Under-performance in the areas of emerging water management challenges Inadequate research outputs to service the water sector Research outputs not dealing with the complexity and trans-disciplinary nature of water problems Not meeting stakeholders needs and expectations 	Critical	Likely	
2 <ul style="list-style-type: none"> To maintain financial sustainability To enhance social responsibility and corporate responsibility To develop innovative products and services to economic growth To drive sustainable development solutions 	<ul style="list-style-type: none"> Financial sustainability 	<ul style="list-style-type: none"> Due to the inefficient and ineffective revenue collection processes and low collection results achieved by the DHSWS (Legislated Collection Agency for the WRC levies) payments of levies to the WRC are therefore substantially funded from the DHSWS own budget. In addition the current fiscal and economic climate only allows for very modest research 	<ul style="list-style-type: none"> Limited ability to grow research development and innovation portfolio due to funding uncertainty Potential negative impact on stakeholder trust relationships if cash flow and funding challenges should ever materialise. 	Critical	Almost certain	

	Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place
	High	<ul style="list-style-type: none"> • A robust and diversified WRC project portfolio to structure the sector and make it more attractive to work in at multiple levels. • Leverage additional bursary and student support funding from partners • 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 implementation • Support publication and exposure of students and training material and marketing research careers (through schools, universities etc.) • Lobby for increased research funds through Department of Human Settlement, Water and Sanitation (DHSWS) and Department of Science and Innovation (DSI) and other players / partners • Strengthening of the Lighthouse programmes that accommodates transdisciplinary collaboration. social sciences interdisciplinary programme and other transdisciplinary research programmes to address to complexity in the water sector • Technical, policy, ministerial briefs and parliamentary engagement to ensure faster exposure to research outcomes. • Periodic strategic review of research portfolio • Annual reporting strengthening and monitoring of on the Knowledge Tree objectives. • Supporting career fairs through the career guide publication. 	CEO	Satisfactory	Priority 3	Likely
	Extreme	<ul style="list-style-type: none"> • Renewed MOA (memorandum of agreement) with DHSWS that provides for monthly payments up to 2022 • Annual Levy escalation provisions governed by legislation whereby annual increase are published in the government gazette • Indefinite period agreements for direct collection of WRC levies with the two largest agencies (Rand Water and Umgeni Water) • Continuous drive to increase leverage as a way of diversifying Strategy to diversify funding to be approved by Executive • Regular interaction with the DHSWS and leverage stakeholders on funding issues • Prioritisation of available funds • Implementation of the approved Finance Diversification strategy 	CEO	Satisfactory	Priority 2	Likely

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 management controls are in place	
		<p>levy increases which is well below the R&D inflation rate given that scientific equipment and consumables are mostly imported.</p> <ul style="list-style-type: none"> Given that the DHSWS are not effectively collecting its own outstanding debts for raw water charges coupled with the significant reductions in the DHSWS, National Treasury budget allocations the DHSWS ability to continue paying WRC levies becomes significantly hampered. Challenges in attracting new leverage income partners due to changing funder priorities often impacted by changes in the economic climate. Impact of water saving solutions (reduced volumes thereby reducing water levy), and drought (climate change) on levy income. 	<ul style="list-style-type: none"> Insufficient budget to implement the strategic plan and sustain the WRC ongoing operations 			
3 <ul style="list-style-type: none"> To enhance knowledge across the water knowledge and innovation cycle To drive sustainable development solutions To inform policy and decision making To develop innovative products and services to economic growth To enhance social responsibility and corporate responsibility To invest in the multiplier effect by building partnerships for greater uptake and diffusion of research outputs 	<ul style="list-style-type: none"> Limited application and packaging of research, solutions and technologies to maintain the water sector primarily but also across all sectors (energy, industry, agriculture, mining etc) 	<ul style="list-style-type: none"> The sector not having sufficient capability, willingness to respond or translate the new technical and scientific Knowledge into policy and decision making. Institutions and strategic partners not clearly identified at beginning of research, development and innovation process and not involved in development of research questions and results and the selection of technologies Insufficient marketing & communication between researchers and the WRC across all disciplines to ensure sufficient uptake of research Lack of a policy enabling the uptake of water and sanitation technology Insufficient technical knowledge and support to maintain new innovations and systems in the sector 	<ul style="list-style-type: none"> Inability to rapidly make changes to sectoral practice to improve service delivery Less appropriate research outputs Limited ability to take advantage of developments and contribute to improved water management and development outcomes in the country No or little new knowledge created (translated into practice) and goods and services for economic development and best practice Limited uptake or implementation of research outputs Limited impact on research, development and innovation 	Critical	Likely	

	Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place
	Extreme					
	High	<ul style="list-style-type: none"> Engagement for improved Policy dialogue that Development of policy, ministerial and parliamentary briefs to influence decision making. Development of training of manuals, guidelines and support tools, e.g. dialogues, symposiums and conferences for implementation and development Continuously strengthen collaborative platforms with key (primary) stakeholders Incorporation of research uptake and interventions into WRC research proposal template and Corporate Plan and periodic strategic review of research portfolio De-risking and direct support through demonstrations, pilots, IP and market analysis and standards development through Business Development, WADER and technology transfer unit to accelerate solutions to the "market" Smart packaging of research outputs, user focussed i.e. various technical stakeholders vs packaging of solutions for practitioners Branding and communication of products (use DHSWS, DSI and WRC as test sites for technology solutions). WRC Board, EXCO, MANCO and employees also to be used as product samplers - adopt a community. Create Water activist. Strength website to better showcase and promote technology and the water solutions. 	CEO	Satisfactory	Priority 3	Possible

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 management controls are in place	
4 <ul style="list-style-type: none"> To drive sustainable development solutions To maintain financial sustainability To enhance social responsibility and corporate responsibility To invest in the multiplier effect by building partnerships for greater uptake and diffusion of research outputs 	<ul style="list-style-type: none"> Inadequate participation of South Africa in Research, Development and Innovation activities and projects in Africa 	<ul style="list-style-type: none"> Limited funding for increased international partnership engagement especially with regards to joint projects and activities Limited global partnership profile of the South African technology, Science and Technology sector. Governance systems changes (change in protocol for approval of international travel) not agile to allow quick response to partnership requests and opportunities 	<ul style="list-style-type: none"> Limited profile in the international water research field Limiting the ability to attract donor and other funding Negative impact on possible partnerships with international or non-South-African research institutions Limited potential to lead on African solutions Insufficient research output jointly produced with partners Difficult for WRC to create African footprint 	Serious	Likely	
5 <ul style="list-style-type: none"> To maintain financial sustainability To enhance social responsibility and corporate responsibility 	<ul style="list-style-type: none"> Inability to recover quickly in the event of a disaster 	<ul style="list-style-type: none"> Power and water supply failureFire, flood, negligenceIT Viruses and hacking into the WRC information systemLoss of hard copy informationPoor security control (logical access and physical control) 	<ul style="list-style-type: none"> Delays and disruptions in operationsPossible loss of life / injury on dutyFinancial lossLoss of research results / data (reports/ loss of knowledge base - intellectual property)Harm to reputationPossible rework resulting in increased costLegal implications 	Critical	Possible	
6 <ul style="list-style-type: none"> To maintain financial sustainability To enhance social responsibility and corporate responsibility 	<ul style="list-style-type: none"> Fraud and corruption 	<ul style="list-style-type: none"> Limited effectiveness of fraud and corruption prevention systems Possible unethical behaviour Non-adherence to policy and procedures Internal and external opportunists (bribes, corruption, collusion), compromising the governance integrity of the WRC. Increase in cybercrime and inadequate cyber security 	<ul style="list-style-type: none"> Financial loss Operational inefficiencies Harm to reputation Inability to meet set performance delivery targets Increased pressure from stakeholders 	Critical	Possible	

	Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place
	Serious	<ul style="list-style-type: none"> Regular update of the international strategy and annual development of the implementation plan Participation in international conferences and events etc. Increased involvement in African continent, regional or African-global, level projects, engagement and activities Conducting Africa wide projects with donor partners and establish funding partnership to fund projects and activities in the continent Increased utilisation of modern technology for improved participation in International meetings Development and submission of an annual international travel plan to the Minister of Human Settlements, Water and Sanitation before the beginning of each financial year 	CEO	Satisfactory	Priority 4	Likely
	Moderate	<ul style="list-style-type: none"> WRC continuity plan in place for all are areas (virtual operation - multiple locations and sites)Offsite backups of core systems and data, Disaster Recovery site and plans. Policy and standard procedures for backing up by individual usersUninterrupted Water and Power SupplyAnti-virus software (renewed annually and daily updates) and FirewallsInsuranceEmergency response teams Evacuation plans and procedures and drillsFully functional virtual private network (vpn)Logical and physical access controlsFire proof strong room for research contracts (Offsite) Digitisation of documentation3G and cell phone enablement24 hour security with armed responseOutsource courier service providerAnnual simulation testing 	Head of Branch Corporate Services	Good	Priority 5	Likely
	Moderate	<ul style="list-style-type: none"> 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 Ethics Compliance for Research Projects Effective SCM Unit 	CFO	Satisfactory	Priority 4	Likely

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 management controls are in place	
7 <ul style="list-style-type: none"> To maintain financial sustainability To enhance social responsibility and corporate responsibility To inform policy and decision making 	<ul style="list-style-type: none"> Non-compliance to Acts, Regulations, Legislations, Policies and Procedures 	<ul style="list-style-type: none"> Internal capacity to meet compliance demands Increasing compliance requirements and reporting burden 	<ul style="list-style-type: none"> Possible charges against Accounting Authority and/or staff Possible fines and litigation Organisational reputational damage Increased pressure from stakeholders (Treasury, Dept, etc) Qualified audit report Potential loss of donor and partner funding Focus too much on compliance rather than strategic issues Health and Safety liabilities resulting in possible injuries to staff/ suspension of activities (fatigue, anxiety, demoralised and unproductive staff) 	Critical	Possible	

	Inherent risk exposure with no management controls in place	Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness	Priority due to residual risk exposure	Likelihood of risk occurring if controls are in place
	Moderate	<ul style="list-style-type: none"> • 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 for WRC staff • Assessment by means of internal and external audits • Appointment of a Head of Legal and Compliance and Health and Safety representatives • Health and Safety awareness campaigns and reviews • Policies and procedures and associated internal controls exist, these are communicated to staff and compliance is monitored on an ongoing basis • Policies and procedures are reviewed and approved on an annual basis • A compliance checklists covering all relevant legislation has been developed and is planned for roll-out • Implementing of the compliance checklists 	Head of Branch -Corporate Services	Good	Priority 5	Likely

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*Water technology and
innovation for a better
tomorrow*

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RESEARCH
COMMISSION

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