Table 1. Planned Directed Research projects to start in April 2022.

KSA	TOR ID Number	Thrust	Programme	Title	Budget	Duration (yr)
1	1009842	Water resources and ecosystem protection and utilization	Resource directed measures	Ecological infrastructure-climate change and economy nexus through revised present ecological state (PES) lens	R2 500 000	3
1	1009841	Governance and institutional arrangements	Policy, science, and implementation	Mobilising knowledge and capacity to support ongoing water law reform in South Africa.	R500 000	1.5
3	1009847	Water sensitive and resilient settlements	Smart water supply management	smart water metering, trends, opportunities, risks and policy	R450 000	2
3	1009848	Water sensitive and resilient settlements	smart water supply management	Exploring next generation water loss tracking, compliance, management and performance solutions.	R450 000	2
3	1009849	Water sensitive and resilient settlements	Smart water supply management	Scoping study to transition Municipalities into a smart water management model within the current legislation environment.	R700 000	2
3	1009850	Water sensitive and resilient settlements	Water services Institutional and management programme	A survey into the municipal water by-laws and its application in terms of improving the water services environment.	R500 000	2
3	1009851	Water sensitive and resilient settlements	Water services Institutional and management programme	The DDM model and its implications on Water Services Legislation, planning and regulation	R500 000	2
3	1009852/ 1009840	Water sensitive and resilient settlements	Water services - institutional and management issues	Towards a systematic review of the Water Services Authority model	R600 000	1.5
3	1009853	Water Quality Futures	Emerging issues and substances of concern in water	Scoping study on the use of water fingerprinting techniques for water pollution monitoring and assessment	R2 000 000	3
3	1009845	Sustainable Integrated Wastewater Resource Futures	Quantification and Minimization of Water Use and Effluent Production	Natsurv 15: Water and wastewater management in the oil refining and re-refining industry (Edition 2) and update of Natsurv 4 on water and wastewater management in the dairy industry.	R1 500 000	2
3	1009846	Sustainable Integrated Wastewater Resource Futures	Quantification and Minimization of	Natsurv 19: Water and wastewater management in the Winery Industry (Edition 1)	R1 130 000	3

KSA	TOR ID Number	Thrust	Programme	Title	Budget	Duration (yr)
			Water Use and Effluent Production			
3	1009843	Sustainable Integrated Wastewater Resource Futures	Effluent Treatment, Volarization and Reuse	Piloting irrigation using partially-treated gold mine-impacted water as a long-term sustainable solution for mine water from the Witwatersrand Basins	R3 000 000	3,5
3	1009844	Sustainable integrated wastewater resources futures	Advanced technologies and processes for resource recovery	Piloting energy audits and energy efficiency as a climate change mitigation and adaptation strategy for the South African wastewater sector and framing its use in the Drop Certification Programme	R1 500 000	2
3	1009854	Saniti	Sanitation Sensitive Design	Development of a Framework and Model for Designing Sanitation Sensitive Cities	R600 000	2
3	1009855	Sanitation-Sensitive Design (SSD)	Municipal Sludge Valorisation	Development of curricula for Non-Sewered Sanitation & Sludge Valorisation	R250 000	2

"Annexure A"

TERMS OF REFERENCE FOR A SOLICITED PROJECT

KEY STRATEGIC AREA	Water Resources and Ecosystems
THRUST: 3	Water resources and ecosystem protection and utilization
PROGRAMME: 1	Resource directed measures
TITLE	Ecological infrastructure-climate change and economy nexus through revised present ecological state (PES) lens.

Overall aim:

The research has followed silo approach in most cases, where Ecological infrastructure, or resilience to climate change, green economy are not thought and dealt with as a complex, yet they are inter-dependent as in a nexus. The country is missing the state of water resources report, particularly on water quality. Present Ecological State (PES) has the ability to generate this, provided the decade old PES is reviewed and enhanced with latest scientific advancement such as the ecological infrastructure, climate change and economy in a nexus. Therefore the overall aim of this call is to develop a decision support framework that brings the real world of socio-ecological complexity through integrating the economic development demands and impacts of climate change on water resources health.

Specific:

1. Update the data (PES/EIS and the REC) of rivers, estuarine and wetlands according to quaternary catchments for each of the 9 WMAs
2. Provide information on the state of rivers, Ramsar wetlands and estuaries ecological states in the country
3. Input information to determining ecological conditions for the assessment of Water Use Licence Authorisations (WULAs), water resource reconciliation, planning and management plans
4. Monitoring benchmarks and compliance to recommended management ecological categories (REC), including resource health, restoration and mitigation/resilience measures
5. Mapping of country water resources with their associated aquatic health state (PES and REC)
6. A framework to assist in decision-making where economic development, climatic changes and ecological infrastructure are considered in a nexus

Rationale:

Present Ecological Sate (PES) refers to overall condition or health of a water resource type (ecostatus) which is based on its biophysical characteristics. The health of a river, wetland or estuary indicates its ability and capacity to provide a variety of services to society.Ecological importance (EI) refers to the diversity, rarity or uniqueness of the habitats and biota. Consequently, it reflects the importance of protecting these ecological attributes, from a local, national and international perspective (e.g. Ramsar site). Ecological sensitivity (ES) refers to the ability of the ecosystem to tolerate disturbances and to recover from certain impacts (resilience). Therefore, the more sensitive the system is, the lower its tolerance will be to various forms of alteration and disturbance. This serves as a valuable indication of the degree to which a water resource can be utilized without putting its ecological sustainability at risk or beyond its threshold. This is the recommended ecological management class, an output of

water resource classification (REC)
The ecologisl importance and sensitivity (EIS) data is used in the eco-classification process of DWS to determine ecological sensitivity of a water resource reach (e.g. a river) as well as the current (present) ecological state of such a water resource reach.The Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) were determined a decade ago for all main stem rivers in one thousand nine hundred and forty six (1946) Quaternary catchments in the country. Since the completion of the first PES/EIS study the need for more accurate and higher confidence data has become dire (DWS). Important management decisions are dependant and based on the ecological targets set for catchment sites. Decisions that influences increased protection and conservation measures (including biodiversity), impact on future development and subsequent economic investment in SA, as well as decisions around the social equitable and efficient use of the countries scarce water resources, all rely greatly on the accuracy and confidence of the PES/EIS and REC data.

Chapter 3 of the NWA, places an obligation on Minister to determine the Class, setting Resource Quality Objectives (RQO), and determining the suit of associated Reserve categories for significant water resources. The main objective being to balance the flow needs for the natural water resource (EFR or EWR) and its future use for socio economic development. This ensures sustainable development. The pressure on natural resources in a rush to green economy recovery post the COVID-19 pandemic is on global agendas, such as World Economic Forum list of Risks to humanity. On the other hand all our water resources in South Africa (and globally) have been degraded well beyond the 50%, some estimated as high as 78% for wetlands (NBA, 2018). The situation is progressively made worse by climate change and lack of resilience, the spread of thirsty alien invasive plants, as well as unlicensed mining activities which have no mitigation/rehabilitation measures in place post the mining lifespan and pollution from irresponsible agricultural activities. No economy will propser on a sick catchment (World Economic Fofum-UNEP), hence the urgent need to focus more on restoration of the degraded ecosystems that can in turn provide benefits to society. It is therefore imperative that drought impacts driven by climate change, ecosystem degradation due to poor landscape or ignored recommended ecological management categories (REC) provided by the water resource classification processes are all conceptualized together (as opposed to current silo approaches) as the country tries to recover the economy so critical in creating job opportunities where unemployment is currently above 40% and worsening following the COVID 19 impacts on business.

Deliverables:

The main aim of this project is to assess and update the PES/EIS/REC data for appropriate use in the several environmental processes as outlined under objectives section. The Recommended Management ecological categories (REC), the ecological importance and sensitivity (EIS) as well as the present ecological states (PES) will be determined according to quaternary, and in some cases sub-quaternary catchments depending on the sensitivity of the ecosystem's biota versus the threats posed by economic development, climate change on the ecological infrastructure status. The PES/EIS/REC assessment will be done for all of the nine (9) WMAs, thereby generating a map of the current state of rivers, wetlands and estuarine health in SA at a glance. A framework to assist in the decision-making where economic development, climatic changes and ecological infrastructure are considered in a nexus will be the key final deliverable of this study.

As it is most unlikely that a single organization will have all the expertise required, it is strongly recommended that a consortium of expert and organizations with full appreciation of the climate change risks/mitigation, ecological infrastructure and green economy principles is formed in order to provide the highly specialised knowledge required.

Impact Area:

Policy support and other related Knowledge tree impact areas
The estimated budget over a 36-month long study is available from KSA 1-2

Time Frame: 36-months
Total Funds Available: R 2 500 000
Budget for 1st year: R 500 000

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	**1&2 (Water resources and ecosystems)**
THRUST	**1 (Governance and institutional arrangements)**
PROGRAMME	**2 (Policy, science, and implementation)**
TITLE	**Mobilising knowledge and capacity to support ongoing water law reform in South Africa.**

Objectives

General:

Review the state of capacity and knowledge on water law, together with identification of gaps and needs, to renew attention on water law as an essential field of research, training and practice.

Specific:

1. Map the current community of practice (academic, public and private sector, civil society) active in the field of water law, including assessment of the current levels of capacity to produce law graduates specialising in water law.
2. Identify key themes, trends and gaps in the current body of knowledge on South African water law
3. Contribute to development of an agenda for future investments in research and capacity building on water law
4. Organise a mock trial/moot court on a current hot topic in South African water law

Rationale

The advent of democracy in South Africa in 1994 set in motion a fundamental overhaul of the policy and legal frameworks pertaining to water. The Constitution ushered in a new system of intergovernmental relations, along with the articulation of human rights to access to water and environmental protection, and imperatives for redress of the effects of past racial discrimination. This in turn served as a major driving force for the development of new national water policy and its legislative instruments, the 1997 Water Services Act and 1998 National Water Act.

A radical departure from their predecessors, the National Water Act and Water Services Act repealed and replaced the body of water law inherited from the colonial and apartheid past. At the time, the National Water Act was celebrated as a global pioneer and became a trendsetter for a new wave of water sector reform in several countries. However, the period between these statutes coming into force in the late 1990s and the present has exposed a number of substantive challenges in realising their respective intentions. A subsequent suite of legislation pertaining to the functioning of local government has added to the complexity of the legislative framework for provision of water services. Much research has been done to inform the original drafting of the legislation, to study the legislative process (of the National Water Act) itself, and to engage with the implementation of the legislation.

The anticipated amendment of the National Water Act and Water Services Act over the next few years will be the most substantial overhaul of water laws since the 1990s. This process provides a window of opportunity to turn attention to the capacity and knowledge base that underpins the ability to continue to develop and implement water law in South Africa. Considering the magnitude of the shift in water law brought on by the democratic era and the learning that has happened in the process of implementing these laws, there is value in drawing on the evidence base that has been built during this time. Part of this entails mobilizing existing capacity and knowledge to provide relevant, credible resources to support the pending law reform process. It also entails identifying gaps and needs in water law capacity and knowledge, and visioning potential means for addressing these in the longer-term.

The objectives of this project examine both the capacity and knowledge to support the further development and implementation of water law in South Africa. This includes building on recent work by the WRC on water-related postgraduate and short course training, to examine the extent to which universities are adequately producing law graduates specializing in water law. Similarly, water law aspects of recent work funded by WRC on the state of water governance knowledge requires deepening and sharpening in order to contribute towards the generation of future research agendas. The intention is not to repeat relevant work already done, but to extract and add value to the components relevant to water law. The mock trial/moot court, to be organized with the WRC and at least one university partner, provides an opportunity to renew attention on the training of law graduates with a specialty in water law, while tackling a contemporary issue in water law.

Deliverables
The following deliverables are indicative and may be tailored to suit the proposed research approach:

1. Community of practice database
2. At least one stakeholder workshop
3. Mock trial/moot court event, including preparatory documents and summary report
4. Draft final report for peer review
5. Final report and policy support documents, covering aspects researched as per specific objectives

Time Frame
15 months (start date 1 April 2022)

Total Funds Available
R500,000 inclusive of VAT

Year 1 (2022/23):	R400,000
Year 2 (2023/24):	R100,000

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	**1. WATER SENSITIVE AND RESILIENT SETTLEMENTS**
PROGRAMME	***1: Smart water supply management***
TITLE	**Smart water metering, trends, opportunities, risks and policy.**

Objectives

General

The previous decade saw the introduction and growth of smart water advancements in the water metering industry. Growth in the space of platforms such as IoT and advanced communications systems, have allowed water utilities around the world to improve control of their water systems and better understand them. As the industry moves into a new space, the growth of these technologies is expected to not only increase but also help revolutionize water system management for decades to come.

WRC has been in the forefront of the subject matter and have lead some of the developments in smart metering in its early years. This pioneering work driven by water conservation saw the development of bi-directional communication meters as a future pathway. Unfortunately, our own industry leapfrogged the developments and the direction of the solutions moved into the space of meter control devices. Largely targeted at controlling water use of poor people as water management devices and free basic water.

The WRC has kept pace with developments and also produced a smart water meter guide. However, the signals nationally are becoming stronger that this is the future direction the sector needs to evolve towards as the IoT tools and platforms become more user-friendly and cost effective. As water distribution pipelines across the country continue to age well beyond their expected lifespan, reducing non-revenue water (NRW) to keep a lid on production costs should be a primary goal of every water utility. Although some NRW can occur through the inaccuracy of older meters along with other factors, leaks that go undiscovered encompass the most significant portion of the problem. Even with a robust

replacement program, clearing up every leak can take decades for municipalities to accomplish. Advanced devices are streamlining the effort to attack NRW. Meters that are equipped with pressure and temperature sensors are transforming meters into Industrial Internet of Things (IIoT) sensor solutions. The additional information from these devices throughout the system provides deeper insights that allow utilities to be more proactive. It is therefore imperative that a scan of developments and uptake of smart water metering be undertaken towards understanding the new opportunities this subject offers for future management of revenue, operations and water use. Further the issues of cyber security and other risks need to be established as we chart a future for smart water metering in South Africa.

Specific

The specific objectives are:

- Update and understanding of technology development and trends in smartwater metering
- Scan of uptake and application (readiness) of smart water metering, including strategies and demonstrations.
- Technology and market opportunities for smart metering
- Identifying O&M models and capacity needs for this technology.
- Developing a national strategy for the rollout of smart metering in industry – regulatory requirements, standards, quality control and consumer protection.

Expected outcomes and impacts:

- **Research report**
- **Strategy for smart meter rollout**
- **Position paper**

Lighthouse:

- Water-Energy-Food Nexus
- Climate Change

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years

Total Funds Available: R450 000.00 inclusive of VAT. (2022 – 250k, 2023- 200k)

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	**2. WATER SENSITIVE AND RESILIENT SETTLEMENTS**
PROGRAMME	***Programme 1: Smart water supply management***
TITLE	**Exploring next generation water loss tracking, compliance, management and performance solutions.**

Objectives

General

The problem of excessive water losses from drinking water distribution networks is a growing concern in South Africa where the annual total water loss is breaching 50% of total water supply. Many water utilities have either developed or are developing strategies to reduce losses. Reducing water losses save the energy required to abstract, transport, treat, and distribute water. Additionally, less water losses reduces the expenses for water supply systems and contributes to sustainable water management.

Water losses can be either real (physical) or apparent (commercial) losses. Real losses are mainly due to leakage from joints in water pipes, service connections, pipe bursts, pipe cracks and overflows from storage tanks. Apparent losses are mainly due to illegal water consumption and inaccurate customer metering. Reducing and controlling water losses is becoming more crucial as demand increases in many parts of the country.

As the ICT platforms and tools are improving several smart and modern solutions are being developed which offer better integration of water loss management together with daily O&M management. There is a move toward next generation cloud-based Water Loss Tracking Platforms that will help water agencies and its customers to track water use effectively by lowering the non-revenue water and be compliant with legislations. It also offers several additional value in managing pressure, flows and asset management. It enables smarter management processes by attaching artificial intelligence which relates to significant savings in water, chemical use and energy savings.

Specific

The specific objectives are:

- International and national scan of evolving solution, new developments and tools in the management of water losses.
- Explore the linkages to smart water networks.
- Explore the ICT platforms and requirements for these new systems.
- Capture successful case studies.

Expected outcomes and impacts:

- Report on trends and developments on water loss management
- Position paper and technical brief.

Lighthouse:

- Water-Energy-Food Nexus
- Climate Change

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years
Total Funds Available: R 450 000.00 inclusive of VAT. (2022 – R250k, 2023 – R R200k)

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	**3. WATER SENSITIVE AND RESILIENT SETTLEMENTS**
PROGRAMME	***Programme 1: Smart water supply management***
TITLE	**Scoping study to transition Municipalities into a smart water management model within the current legislation environment.**

Objectives

General

Smart Water Management (SWM) is the use of Information and Communication Technology (ICT) to provide real-time, automated data for use in resolving water challenges. SWM can be used for planning and operational purposes, from daily use to organisational and policy planning at a range of scales, across contexts and regions. SWM enables governments, industries and utilities from around the world to integrate smart principles (using ICT) into their urban, regional and national strategies. The potential application of smart systems in water management is wide and by applying SWM infrastructure real-time solutions can be implemented and broader networks can work together to reduce current water management challenges.

The rate of urbanization in some cities exceeds the capacities of governments (both local and national) to effectively plan and transition in an efficient and sustainable manner. Since the infrastructure design and capacity of water distribution and treatment plants are reliant on forecasted water demands and socio-economic data, unforeseen urban growth can lead to severe inequalities in service provision, thus constraining public access to water and sanitation. Population growth in developing countries is often accompanied by increasing socio-economic challenges. For most cities in the developing world, a lack of revenue has translated into the lack of investment, limiting the city's ability to repair deteriorating infrastructure or improve aging facilities, while fostering the spread of informal infrastructure. Aging infrastructure is one of the most pressing concerns for the water utility industry.

From their inception, information and communication technologies (ICTs) have played a pivotal role in the lives of cities. Historically, cities have been generating economic growth by developing institutions and assembling human resource to achieve prosperity, but unfortunately, this was often done at the expense of their water resource base. With rapid urbanization becoming an inevitable fact, cities are facing increasing challenges to secure financially sustainable water and sanitation services for its citizenry.

If matched with appropriate and effective ICT solutions, in the form of smart water management (SWM), water issues within cities can be properly addressed and managed. Smart water management (SWM) in cities seeks to alleviate challenges in the urban water management and water sector through the integration of ICT products, solutions and systems in areas of water management and sanitation, as well as stormwater management. By promoting the coordinated development and management of water in cities and towns, SWM allows cities to strengthen institutional capacities, while striving to improve the sustainability and to realize opportunities inmanagement of climate change, energy and resource recovery and water reuse as well as support to achieving the United Nations Sustainable Development Goals (SDGs).

Specific

The specific objectives are:

- Develop a strategy and framework for smart water management in cities and towns
- Determine the sector progress and readiness in the use of SWM
- Identify list of new tools and evolving local and international tools and products for SWM
- Develop a guideline for Municipalities to adopt SWM
- Policy and position paper on transition the SA municipal industry towards SWM

Expected outcomes and impacts:

- South African Municipal Framework for SWM
- Guideline on implementing SWM
- Literature review on latest developments
- Position paper
- Policy guidelines

Lighthouse:

- Water-Energy-Food Nexus
- Climate Change

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years

Total Funds Available: R 700 000.00 inclusive of VAT. (2022 - 400k/ 2023 -300K)

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	**4. WATER SENSITIVE AND RESILIENT SETTLEMENTS**
PROGRAMME	***Programme 4: Water services Institutional and management programme***
TITLE	A survey into the municipal water by-laws and its application in terms of improving the water services environment.

Objectives

To determine the effectiveness of by-laws and its use

General

The Constitution of South Africa gives municipalities the power to pass their own legislation, in the form of by-laws, for particular subject areas. These by-laws hold the same power and force as other national and provincial legislation. By-laws are laws that are passed by the council of a municipality to regulate the affairs and the services the municipality provides in its area of jurisdiction. A municipality derives the power to pass a by-law from the Constitution of the Republic of South Africa, 1996, which gives specified powers and competencies to local government as set out in Part B of Schedule 4 and Part B of Schedule 5. By-laws are laws managed by municipalities. As per the Constitution this is determined as follows:

Powers and functions of municipalities

156. (1) A municipality has executive authority in respect of, and has the right to administer—

(a) the local government matters listed in Part B of Schedule 4 and Part B of Schedule 5; and

(b) any other matter assigned to it by national or provincial legislation.

(2) A municipality may make and administer by-laws for the effective administration of the matters which it has the right to administer.

(3) Subject to section 151(4), a by-law that conflicts with national or provincial legislation is invalid. If there is a conflict between a bylaw and national or provincial legislation that is inoperative because of a conflict referred to in section 149, the by-law must be regarded as valid for as long as that legislation is inoperative.

(4) The national government and provincial governments must assign to a municipality, by agreement and subject to any conditions, the administration of a matter listed in Part A of Schedule 4 or Part A of Schedule 5 which necessarily relates to local government, if—

(a) that matter would most effectively be administered locally; and

(b) the municipality has the capacity to administer it.

(5) A municipality has the right to exercise any power concerning a matter reasonably necessary for, or incidental to, the effective performance of its functions.

Municipal by-laws form part of the legal foundation for effective service delivery and cooperative communities. In many municipalities, however, the by-laws are out of date or difficult to find. Municipalities are required by the Municipal Systems Act to make their by-laws publicly available on their website. However, most municipalities lack the capacity to do so. There are in many cases where these by-laws are ignored and mismanaged, without the community having any form of recourse and consequence.

Specific

The specific objectives are:

- Survey on the application and use of Municipal water by-laws by Municipalities
- Identifying challenges and problems in the application of by-laws
- Determining the impact and effectiveness of bye-laws.

Expected outcomes and impacts:

- Research report
- Policy recommendations
- Guidelines

Lighthouse:

- Water-Energy-Food Nexus
- Climate Change

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years

Total Funds Available: R 500 000.00 inclusive of VAT. (R300k/200K)

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	**5. WATER SENSITIVE AND RESILIENT SETTLEMENTS**
PROGRAMME	***Programme 4: Water services Institutional and management programme***
TITLE	The DDM model and its implications on Water Services Legislation, planning and regulation.

Objectives

General

The President in the 2019 Presidency Budget Speech (2019) identified the "pattern of operating in silos" as a challenge which led to "to lack of coherence in planning and implementation and has made monitoring and oversight of government's programme difficult". The consequence has been non optimal delivery of services and diminished impact on the triple challenges of poverty, inequality and employment.

The President further called for the rolling out of "a new integrated district based approach to addressing our service delivery challenges [and] localise[d] procurement and job creation, that promotes and supports local businesses, and that involves communities…" The President is cognisant of the fact that such an approach will require that "National departments that have district-level delivery capacity together with the provinces … provide implementation plans in line with priorities identified in the State of the Nation address".

The Model consists of a process by which joint and collaborative planning is undertaken at local, district and metropolitan by all three spheres of governance resulting in a single strategically focussed One Plan for each of the 44 districts and 8 metropolitan geographic spaces in the country, wherein the district is seen as the 'landing strip'.

The District Development Model builds on the White Paper on Local Government (1998), which seeks to ensure that "local government is capacitated and transformed to play a developmental role". The White Paper says developmental local government "is local government committed to working with citizens and groups within the community to find sustainable ways to meet their social, economic and material needs and improve the quality of their lives".

To which end, developmental local government is seen as having four interrelated characteristics of "maximising social development and economic growth; integrating and coordinating; democratising development; and leading and learning". In order for local government to advance this, the Constitution calls on "national and provincial governments [to] support and strengthen the capacity of municipalities to manage their own affairs".

Therefore, the model is a practical Intergovernmental Relations (IGR) mechanism to enable all three spheres of government to work together, with communities and stakeholders, to plan, budget and implement in unison.

In so doing the vexing service delivery challenges can also be turned into local level development opportunities, through localised procurement and job creation which "promotes and supports local businesses, and that involves communities…" This will also require national and provincial departments provide implementation plans and budgets which address local challenges and developmental opportunities whilst aligning with national, regional, continental and global goals and objectives.

The objectives of the District Development Model are to:

- Coordinate a government response to challenges of poverty, unemployment and inequality particularly amongst women, youth and people living with disabilities.
- Ensure inclusivity by gender budgeting based on the needs and aspirations of our people and communities at a local level.
  Narrow the distance between people and government by strengthening the coordination role and capacities at the District and City levels.
- Foster a practical intergovernmental relations mechanism to plan, budget and implement jointly in order to provide a coherent government for the people in the Republic; (solve silo's, duplication and fragmentation) maximise impact and align plans and resources at our disposal through the development of "One District, One Plan and One Budget".
- Build government capacity to support to municipalities.
  Strengthen monitoring and evaluation at district and local levels.
  Implement a balanced approach towards development between urban and rural areas.
- Exercise oversight over budgets and projects in an accountable and transparent manner.

The District Development Model (DDM) is an operational model for improving Cooperative Governance aimed at building a capable, ethical Developmental State. It embodies an approach by which the three spheres of government and state entities work in unison in an impact-oriented way, and where there is higher performance and accountability for coherent service delivery and development outcomes. It is a method of government operating in unison focusing on the municipal district and metropolitan spaces as the impact areas of joint planning, budgeting and implementation.

This method refers to all three spheres of government, sector departments and state entities operating like a single unit in relation to achieving developmental objectives and outcomes in these district and metropolitan spaces over a multiyear period and over multi-term electoral cycles.

Although each sphere, sector or entity has its distinct constitutional powers, functions and responsibilities, they cooperate and undertake collaborative planning, budgeting and implementation processes converging efforts at the district/metropolitan level. This joint work is expressed through the formulation and implementation of a "One Plan" which is a long-term strategic framework guiding investment and delivery in each district and metropolitan space. (Sourced from DDM website https://www.cogta.gov.za/ddm/index.php/about-us/

This new DDM model will impact of water services planning and legislation at all levels. It therefore become important that the aspect of the DDM be unpacked and allow alignment to the water services requirements and implications for greater integration to wards a seamless process as envisioned.

Specific

The specific objectives are:

- An unpacking and understanding of the DDM model in context of water services delivery
- Unpacking the alignment to water services planning and legislation
- Providing guidance on alignment of the DDM model to water service process and requirements.
- Alignment of programmes with National and Provincial Governments
- Unpacking if the DDM is an enabler in accelerating service delivery

Expected outcomes and impacts:

- Research report
- Policy recommendations
- Guidelines

Lighthouse:

- Water-Energy-Food Nexus
- Climate Change

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years
Total Funds Available: R 500 000.00 inclusive of VAT. (R300k/200K)

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA:	**3: Water Use, Wastewater Resources and Sanitation Futures**
THRUST:	**1: Water Sensitive and Resilient Settlements**
PROGRAMME:	**2: Water services - institutional and management issues**
TITLE:	**Towards a systematic review of the Water Services Authority model**

Objectives

General

Consolidate existing knowledge, capturing successes and failures, and identify gaps for future research, to inform an evidence-based approach for future improvement of the Water Services Authority (WSA) model.

Specific

1. Consolidate and analyse existing knowledge on the WSA model, including:
    - Overview of performance of WSAs in providing water services
    - Strengths and weaknesses in the current legislative framework governing regulation and provision of water services by WSAs
    - Strengths and weaknesses in the current institutional landscape for regulation and provision of water services by WSAs, including mechanisms for cooperative government
    - Performance to date of mechanisms for intervention should a WSA not fulfil its obligations
    - Identification of systemic factors influencing WSA performance
2. Provide a consolidated set of recommendations for areas of further improvement of the WSA model.
3. Identify knowledge gaps and recommendations for future priorities for research investment.

Rationale

The advent of democracy in South Africa in 1994 set in motion a fundamental overhaul of the policy and legal frameworks pertaining to water. The Constitution enshrined the right to access to water and assigned local government the executive authority for provision of water and sanitation services. Within the new system of intergovernmental relations, responsibility was placed on national and provincial government to support and regulate the exercise of executive authority by local government.

The 1997 Water Services Act established a system of Water Service Authorities (WSAs), in the form of municipalities that have primary responsibility for ensuring access to water and sanitation services. There are currently 144 metropolitan, district and local municipalities designated as WSAs. The Water Services Act interfaces with, and was partly superseded by, a subsequent suite of legislation that prescribes how the local government sphere will go about its business. As a result,

the institutional landscape for the regulation and provision of water services includes the Department of Water and Sanitation, Department of Cooperative Governance, water boards and municipalities.

While significant progress has been made since 1994 in providing water and sanitation to people who previously lacked access to these services, difficulties have been identified in the ability of many WSAs to consistently provide these services to the required minimum standards. Challenges remain in the ability of government to fulfil its responsibility with respect to the rights to access to water and environmental quality enshrined in the Constitution. One of the consequences of the current legal framework and institutional arrangements is a degree of overlap, potential conflicts and lack of agreement on roles and responsibilities.

Constitutional mechanisms have been invoked for the intervention of provincial and national government in the event of a WSA not being able to fulfil its functions. Common law remedies, through approach to the courts, have resulted in recent precedent-setting judgements, such as those concerning Kgetlengrivier and Makana local municipalities. The performance of such remedies and mechanisms in resolving the identified problems, and their broader implications, need closer examination.

Some WSAs have now been in place for over 15 years and clear signals have emerged that the WSA model requires revisiting. Yet no major review of the WSA model has been undertaken. Systemic factors influencing WSA performance have been identified and long-term trends have emerged. Linkages to broader governance and financing challenges facing local governments across the country have been made. Recent developments, such as the District Development Model and discussions around modalities for economic and performance regulation in the water sector, also require interrogating in the context of water service delivery.

Considering the magnitude of the shift in governance arrangements brought about by the 1996 Constitution, and the steady evolution of these arrangements in the relatively short intervening time, there is much to learn from a thorough reflection on the WSA model in order to guide future improvements. This project provides an opportunity to consolidate and analyse the considerable existing body of knowledge that has been generated on WSAs and water service delivery. This will enable both the packaging of current knowledge in accessible form for policy makers, and the identification of knowledge gaps for future research, to inform an evidence-based approach for future improvement of the WSA model.

Deliverables:

The following deliverables are indicative and may be tailored to suit the proposed research approach:

- Inception workshop (online) and report
- At least one stakeholder workshop at appropriate stage/s of the research process
- Draft final report for peer review
- Final report and policy support documents, covering all aspects researched as per specific objectives

Time Frame: 15 months (start date 1 April 2022)

Total Funds Available: R600,000 inclusive of VAT

Further details on these ToR can be accessed here and information on submission of proposals can be accessed here.

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	KSA 3: Water Use, Wastewater Resources and Sanitation Futures
THRUST	Thrust 2: Water Quality Futures
PROGRAMME	Programme 4: Emerging issues and substances of concern in water
TITLE	Scoping study on the use of water fingerprinting techniques for water pollution monitoring and assessment

Background and Rationale

Environmental water quality monitoring and pollution assessment is a fundamental tool for water resources management and it is important for safeguarding against adverse effects from multiple chemical and biological contamination arising from anthropogenic diffuse emissions and point sources. The nature and source, temporal-spatial pattern, transfer process and intensity of pollution vary significantly area to area. Knowing the source(s) of pollution, loads and associated impacts in a water body is of great value in water quality management as it can inform pollution control and remedial actions required. In particular, management of non-point source (diffuse) water pollution has been identified as a matter of high priority in the Department of Water and Sanitation Integrated Water Quality Management Strategy. To date, there has been a number of studies that have been funded by the Water Research Commission to support non-point source water pollution management, for example, WRC Report No. WRC Report No: TT 142/01, titled; A guide to non-point source assessment. Since the publication of this report there has been a few developments in water quality monitoring and pollution assessment. The emergence, detection and management of various substances of concern in water sources has been one of major challenges for water quality management. Recently, a number of water fingerprinting techniques have been developed and tested for pollution early-warning and pollution source identification. Similarly, a number of effect based approaches have been optimised for assessing the impact of wastes on water quality and for assessing fitness for different uses. Thus, the aim of this study is to assess and demonstrate the applicability these techniques with respect to their ability to attribute the source(s), loads, fate and impact of known and emerging substances of concern in water bodies. Findings from this study must support the development and implementation of a draft national Non-Point Source Strategy (NPSS), and provide recommendations on how this can be applied within the context of a waste discharge charge system.

Objectives:

The objectives of the project are to:

- To provide a state-of-the art literature assessment on water quality monitoring and pollution assessment, with emphasis on non-point source pollution and its management
- To conduct a series of case studies to evaluate and illustrate the application of various water sampling techniques, target, suspect and non-target analyses, source attribution, as well as an array of bioanalytical methods for water quality monitoring and non-point source pollution

assessment
- To update and revise the current guidelines, titled, A guide to non-point source assessment.
- To compile a comprehensive report, including policy recommendations for the development and implementation of a draft national Non-Point Source Strategy (NPSS) under the current legislation, and insights on how this can be applied within the context of a waste discharge charge system.

Specific:
- Project scope – Both chemical and biological contaminants should be considered in the study
- Site selection – Case studies must be conducted in at least four geologically distinct water management areas

Deliverables:
- Inception report
- Annual progress report
- Final report

The deliverables above may be sub-divided by the proposers, if desired, into not more three deliverables per financial year. The first year deliverables may include an advance (an initiation payment of R 160 000) and must include a final deliverable of the print-ready final report, valued at R 400 000.

Time Frame: April 2022 – March 2025

Total Funds Available:
R 2 000 000 over 3 years with R 800 000 available in year 1.

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA 3:	**Water Use, Wastewater and Sanitation Futures**
THRUST 3:	**Sustainable Integrated Wastewater Resource Futures**
PROGRAMME 1:	**Quantification and Minimization of Water Use and Effluent Production**
TITLE	**Natsurv 15: Water and wastewater management in the oil refining and re-refining industry (Edition 2) and update of Natsurv 4 on water and wastewater management in the dairy industry.**

Objectives:

General:

To review and document water and wastewater management within the refining and re-refining industry as part of the first stage of revisions of the Natsurv series and provide an update of Natsurv 4 on water and wastewater management in the dairy industry.

Specific Aims:

1. Provide a detailed overview of the refining and re-refining industry in South Africa, its changes since edition 1 was published, and its projected change(s) and provide an update of Natsurv 4 on water and wastewater management in the dairy industry. It is important that representative samples of the respective industries are used as case studies.
2. Critically evaluate and document the "generic" industrial processes of refining and re-refining industry in terms of current practice, best practice and cleaner production.
3. Determine the water consumption and specific water consumption (local and global indicators, targets; benchmarks, diurnal trends) and recommend targets for use, reuse, recycling and technology adoption.
4. Determine wastewater generation, and typical pollutant loads (diurnal trends) and best practice technology adoption.
5. Determine local electricity, water, and effluent prices and by-laws within which these industries function and critically evaluate if the trends and indicators are in line with water conservation demand management and environmental imperatives.
6. Critically evaluate the refining and re-refining industry water (including wastewater) management processes adopted and provide appropriate recommendations
7. Evaluate the industry adoption of the following concepts: cleaner production, water pinch, energy pinch, life cycle assessments, water footprints, wastewater treatment and reuse, best available technology and ISO 14 000 to name a few.

8. Provide recommendations on the best practice for this industry.

Rationale:
In the 1980s the Water Research Commission and Department of Water and Sanitation embarked on a series of national surveys. These reports were referred to as Natsurv documents. The review of the first four Natsurv projects was launched in 2012/2013. This Terms of Reference aims to launch revision of Natsurv 15 on water and wastewater management within the oil refining and re-refining industry and provide an update of Natsurv 4 on water and wastewater management in the dairy industry..

The Natsurv reports for different industries have been well used since they were developed by the sector. However, South Africa and its industrial sectors have either grown or in some cases shrunk considerably since the 1980s. Thus, the landscape has changed. New technologies and systems have been adopted by some of the industries, and therefore, certain information contained in the national surveys can be regarded as obsolete. Furthermore, initiatives like the UN CEO mandate, water stewardship, water allocation and equity dialogues, amongst others suggests growing awareness related to: water use, water security, and waste production. Thus, it is considered an opportune time to review the water and wastewater management practices of the different industrial sectors and make firm recommendations. This project will revise and update Natsurv 15: Water and Wastewater Management in the oil refining and re-refining industry and provide an update of Natsurv 4 on water and wastewater management in the dairy industry.

Note:
Successful applicants need to demonstrate a strong ability for capacity building by supporting Masters degree/s in the project.

Deliverables:
1. Reports on key aspects researched as per specific objectives
2. Workshop/s with key stakeholders
3. Draft Final Report
4. Final Report

Lighthouse:

- Water Quality and Health

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years
Total Funds Available:
R 1,500,000 inclusive of VAT (R700,000 available in year 1).

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA 3:	**Water Use, Wastewater and Sanitation Futures**
THRUST 3:	**Sustainable Integrated Wastewater Resource Futures**
PROGRAMME 1:	**Quantification and Minimization of Water Use and Effluent Production**
TITLE	**Natsurv 19: Water and wastewater management in the Winery Industry (Edition 1)**

Objectives:

General:

To review and document water and wastewater management within the winery industry and generate the first edition Natsurv report for the South African winery industry.

Specific Aims:

1. Provide a detailed overview of the winery industry in South Africa, its projected future change(s). It is important that representative samples of the respective industries are used as case studies.
2. Critically evaluate and document the "generic" industrial processes of winery industry in terms of current practice, best practice and cleaner production.
3. Determine the water consumption and specific water consumption (local and global indicators, targets; benchmarks, diurnal trends) and recommend targets for use, reuse, recycling and technology adoption.
4. Determine wastewater generation, and typical pollutant loads (diurnal trends) and best practice technology adoption.
5. Determine local electricity, water, and effluent prices and by-laws within which these industries function and critically evaluate if the trends and indicators are in line with water conservation demand management and environmental imperatives.
6. Critically evaluate the winery industry water (including wastewater) management processes adopted and provide appropriate recommendations
7. Evaluate the industry adoption of the following concepts: cleaner production, water pinch, energy pinch, life cycle assessments, water footprints, wastewater treatment and reuse, best available technology and ISO 14 000 to name a few.
8. Provide recommendations on the best practice for this industry.

Rationale:

In the 1980s the Water Research Commission and Department of Water and Sanitation embarked on a series of national surveys. These reports were referred to as Natsurv documents. The Natsurv reports for different industries have been well used since they were developed by the sector. As the landscape changes with new industries emerging it is important to give consideration to such industries and review their water and wastewater management in support of water security. One such industry that

has grown over the years is the wine industry with a contribution to the country's GDP exceeding $2.6 billion annually and creating about 290,000 direct and indirect jobs.

According to the Water Footprint Network the average water footprint of wine grapes produced in South Africa is 603 m^3/ton compared to the global average of 869 m^3/ton. Despite this, the annual production of wine in South Africa has stabilised at approximately 900 million L per annum over the last five years, with an estimated over one billion litres of effluent generated each year. In most small to medium sized wineries, cellar effluent undergoes primary settling before used for beneficial irrigation. Winemakers agree that large quantities of primary winery wastewater sludge are generated at wineries each year, but the amount is not currently quantified by wineries. The primary winery wastewater sludge exhibits an unpleasant smell and potentially toxic to the environment, mainly due to a high concentration of (poly)phenolics. Currently, many wineries contract commercial companies to remove the primary winery wastewater sludge for disposal to landfill. This in turn is an economic burden on the industry and also an environmental burden on landfill sites. It is therefore critical to have a deeper understanding of the water use and wastewater management practices within the South African winery industry and also review current practices within this industry including benchmarking with international best practice.

This Terms of Reference aim to launch the first national survey on water and wastewater management for the winery industry.

Note:
Successful applicants need to demonstrate a strong ability for capacity building by supporting Masters degree/s in the project.

Deliverables:

9. Reports on key aspects researched as per specific objectives
10. Workshop/s with key stakeholders
11. Draft Final Report
12. Final Report

Lighthouse:

- Water Quality and Health
- Water-Energy-Food Nexus

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 3 years

Total Funds Available: R 1,130,000 inclusive of VAT (R500,000 available in year 1).

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	Sustainable Integrated Wastewater Resource Futures
PROGRAMME	Effluent Treatment, Volarization and Reuse
TITLE	Piloting irrigation using partially-treated gold mine-impacted water as a long-term sustainable solution for mine water from the Witwatersrand Basins

Objectives

General

The Eastern, Central and Western Basins of the Witwatersrand goldfields straddling Johannesburg and surrounding towns has witnessed mass-scale cessation of gold mining operations since the late-1990s. Termination of pumping of water from the mines in these Basins has resulted in mine flooding, leading to acid mine drainage (AMD) formation in the mine voids. AMD associated with these Basins is documented as one of the biggest risks to water security in the Vaal River System (VRS) due to its adverse implications, thereby provoking water-related socio-economic risks and inducing a host of other risks for the natural and built environment. Government, having noted these potential risks established the 2010/2011 Inter-Ministerial Committee (IMC) on AMD to address the then-looming challenge presented by AMD, with cabinet sanctioning six (6) discrete recommendations in support of addressing this challenge. These recommendations included treatment through neutralisation, ingress control, AMD-re-use, evaluating other AMD sources such as surface mine wastes residues, improved monitoring and funding options for AMD treatment.

To date, despite limited and partial progress on some of the recommendations, it is worthy-noting that AMD neutralization has been fully implemented as a short term solution (STS) and its currently operational in all the three (3) Basins. In order to ensure that the water security risks posed by AMD for the VRS, implementation of AMD desalination for re-use as a long-term solution (LTS) was considered to ensure full treatment of AMD and to derive beneficial socio-economic uses. A feasibility study on this was finalised in 2013, but implementation deferred pending resolution of concerns on existing off-budget funding mechanism.

A draft report by the IMC on AMD constituted early January 2019 to review the LTS options have, based on previous studies, identified irrigation using partially-treated gold mine-impacted water as a viable, cost-effective and sustainable solution for mine water as a potential viable, cost-effective and sustainable long-term solution for the 3 Basins. The objective of this study is to evaluate at a pilot scale the technical, financial, economic and environmental feasibility (waste implications) of irrigation with gold mine-impacted water at a pilot scale in support of water security in the Vaal River System.

The specific objectives are:

1. To identify key considerations for locating intermediate to large-scale pilot mine water irrigation schemes in the landscape based on geo-hydrological characteristics, water use authorisation requirements, and identification of monitoring needs and thresholds for action for such schemes.
2. To pilot irrigation of selected crops using partially-treated gold mine-impacted water and evaluate the technical and financial feasibility of this approach as a LTS for the three (3) Basins.
3. To monitor and model field scale water and salt balances for the mine-impacted water irrigation schemes of up 30 ha so as to predict the long term impact and sustainability of gold mine-impacted water irrigation.
4. To simulate waste assimilation in soil profiles (if any) and propose corresponding remedial interventions, if needed
5. To quantify the economic sustainability of irrigation using gold mine-impacted water.

Outcomes and impacts:

The project outcomes should be useful in contributing towards a cost-effective, long-term solution that provides an alternative to desalination of neutralised gold mine-impacted water and offers a viable option promoting sustainable water management for the Vaal River System in support of both water security and economic development.

Deliverables

The following deliverables will be expected:

1. Progress Report on project planning – water use authorization, site selection, pivot installation and instrumentation of fields at selected pilot site(s)
2. Report on first summer season crop growth, water and salt/metal balance of the pivots at selected pilot site
3. Report on summer crop response and effect on soil characteristics of irrigation with neutralised gold mine-impacted waters
4. Report on first winter season crop growth, water and salt/metal balance of the pivots at selected pilot site
5. Report on winter crop response and effect on soil characteristics of irrigation with neutralised gold mine-impacted waters

6. Report on economic sustainability of irrigation using mine-impacted water
7. Report on the feasibility of irrigation as alternative long term solution for the three (3) Basins
8. Final Print Ready Report incorporating progress reports 1 – 7

Lighthouse:

- Water-Energy-Food Nexus
- Water Quality and Health
- Water Re-use and Water Security

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 3 - 4 years
Total Funds Available: R 3,000,000 inclusive of VAT.

TERMS OF REFERENCE FOR A SOLICITED WRC PROJECT

KEY STRATEGIC AREA	Water Use, Wastewater Resources and Sanitation Futures
THRUST	Sustainable Integrated Wastewater Resource Futures
PROGRAMME	Advanced technologies and processes for resource recovery
TITLE	Piloting energy audits and energy efficiency as a climate change mitigation and adaptation strategy for the South African wastewater sector and framing its use in the Drop Certification Programme

Objectives

General

Climate change effects such as temperature increase, drought, floods, more frequent storm events and rising sea levels cause negative impacts at wastewater treatment plants (WWTPs. These impacts include declining wastewater quality, higher energy demand and increased treatment requirements. Since climate change is here to stay, the impacts need to be proactively addressed for long term sustainability of wastewater treatment operations. Energy efficiency and audits, in addition to saving operating costs in the face of rising energy costs, have been identified as areas that can significantly contribute to climate change mitigation and adaptation at WWTPs, through reduction of greenhouse gas (GHG) emissions, thereby meeting increased future energy demand. In South Africa a combination of high electricity cost and shortages is already posing a threat to wastewater operations. This threat is made even more significant considering that the majority of municipal WWTPs (487 of about 824) in South Africa are energy intensive activated sludge processes (ASPs) that are required to meet stringent effluent standards. The energy consumption at these plants is estimated to be ~ 650 GWh/yr contributing about 55% of municipalities' water operations energy bill and carbon footprint since all the electricity used is derived from coal. Studies conducted in South Africa to date have indicated that adopting energy efficiency could save energy costs by up to 60% and generate more than 15% of energy requirements. These studies have however not yest demonstrated these savings at full scale operation in support of uptake. The impacts on GHG emissions and adaptation to climate change have also not been assessed. Thus there is a need in the country to evaluate the full benefits of implementing energy efficiency and apply the results to help shape policy and legislation on

climate change mitigation and adaptation as well as sustainability which are now critical aspects of wastewater management. Furthermore, with the resumption of the Drop Certification Programme by the Department of Water and Sanitation, there is need to frame energy audits and energy efficiency practices for incorporation into the Green Drop Certification Programme as part of supporting local government response to climate change. The overall objective of the project is therefore to assess the benefits (financial, social and environmental) of conducting energy audits and implementing energy efficiency practices at full scale WWTPs using three (3) case studies. The project should also frame the incorporation of energy audits and energy efficiency practices into the Drop Certification Programme.

Specific

The specific objectives are:

1. Conduct pilot energy and GHG emission audits for selected three (3) WWTP case studies and benchmark with international best practice
2. Identify feasible energy efficiency technologies for the selected WWTP case studies and assess the potential impacts of their implementation on energy savings and carbon footprint
3. Develop a climate change mitigation and adaptation framework that will serve as a mitigation and adaptation strategy for climate change impacts focusing on energy efficiency
4. Demonstrate potential future operating cost savings that may be derived from implementation of sustainable and resilient energy-efficient wastewater operations
5. Frame the energy audits and energy efficiency practices for their incorporation into the Drop Certification Programme and pilot test their use for Drop Certification Audits

Outcomes and impacts:

The project outcomes should be useful in contributing to the future national policy on climate change adaptation strategies (planning, operational and capital/ infrastructure) in the wastewater sector.

Deliverables

The following deliverables will be expected:

9. Progress report on the pilot energy and GHG emission audits
10. Progress report on the feasible energy efficiency technologies, their impacts on energy savings and carbon footprint
11. Progress report on developed climate change mitigation and adaptation framework
12. Progress report on potential future operating cost savings derived from implementation of energy efficiency practices
13. Progress report on framing energy audits and energy efficiency practices for incorporation into the Drop Certification Programme, including pilot audits
14. Final Print Ready Report incorporating progress reports 1 – 5

Lighthouse:

- Climate Change
- Water-Energy-Food Nexus

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Sustainable Development Solutions

Time Frame: 2 years
Total Funds Available: R 1,500,000 inclusive of VAT.

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA	**KSA 3: Water Use and Waste Management**
THRUST	**4: Saniti**
PROGRAMME	**2: Sanitation Sensitive Design**
TITLE	**Development of a Framework and Model for Designing Sanitation Sensitive Cities**

Objectives:

General:

The vision of a Sanitation Sensitive City is one where water and sanitation and circular economy principles is given due prominence in the design of urban area. The premise is that future cities will need to transition into sustainable ecocities in which uses of resources are reduced, recycled and reused. At the same time, it aims to protect society from disease-causing and environmentally degrading waste and introduce business approaches linked to recycling and re-use. The aim is to enable economies and societies in general to become more sustainable, autonomous, sustainable and in aligned with the realities of limited environmental resources, including water, energy and food.

The vision is particularly relevant in South Africa and other developing countries that are struggling to address the challenge of rapid urbanisation, increasing population growth and resource scarcity. Water is recognised as a strategic national resource under considerable stress, with increasing concerns about future water supply and poor water quality within, and originating from urban areas. As water and sanitation are intrinsically linked to each other, there needs to be focus on sanitation as well. Inadequately treated sanitation waste plays a major role in deteriorating water quality and poses a threat to public health. There exists the opportunity to re purpose sanitation waste from a biological and environmental hazard into value-add products, such as energy, water and various chemicals. Multiple sanitation-derived products may be produced considering that most South African cities utilise a variety of technological approaches. Understanding the options based on a city needs may be key to long-term sustainability planning and management approaches.

It is clear that an innovative approach such as this, which involves the planning, design and implementation of ecocities that employ circular economies in both water and sanitation is required in South Africa. The proposed research aims to provide a framework and model for designing Sanitation Sensitive Cities and in doing so, describe a way forward for an integrated circular economy-based management approach for urban water and sanitation. The proposed research, supported by stakeholder engagement, would define what ‘sanitation sensitive design’ might mean in the South African context and outline the research, vision, narrative, and implementation support strategy that will be required in order to transition to sanitation-sensitive ecocities.

Specific Aims:

9. Develop the framework and model for designing sanitation sensitive cities.
10. Undertake stakeholder engagement to define and benchmark Sanitation Sensitive Design, including Circular Economy aspects, for the South African sector.
11. Outline the vision, narrative, research and implementation support strategy that will be required in order to transition to sanitation sensitive ecocities.
12. Produce dissemination material linked to outputs of study.

Rationale:

There is a need to put forward a conceptual framework for visualising and 'benchmarking' the evolution towards Sanitation Sensitive Cities. While concept of Water Sensitive Urban Design has been explored in South Africa, the sanitation component, specifically the latest developments around sanitation innovation (e.g. off-grid) and resource recovery from sanitation waste, has not been explored. As water and sanitation are intrinsically linked to each other, sanitation (and the latest advances) need to be included as part of the strategic planning and management of future cities. The proposed research would outline the research, vision, narrative, and implementation support strategy that will be required in order to transition to sanitation-sensitive ecocities.

Deliverables:

13. Reports on key aspects researched as per specific aims.
14. Workshop/s with key stakeholders to define and benchmark Sanitation Sensitive Design.
15. Draft Final Report.
16. Final Report.

Lighthouse:

- Water Sensitive Design

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- Informing policy and decision-making
- Sustainable Development Solutions

Time Frame: 2-years

Total Funds Available: R600,000.00 (Year 1: R300,000, Year 2: R300,000) (VAT Inclusive)

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA	**KSA 3: Water Use and Waste Management**
THRUST	**4: Saniti**
PROGRAMME	**3: Municipal Sludge Valorisation**
TITLE	**Development of Curricula for Non-Sewered Sanitation including Municipal Sludge Valorisation Approaches**

Objectives:

General:

The *Water Research Commission* (WRC) has generated a plethora of world-leading research into non-sewered sanitation. This includes ground-breaking research into pit latrine science, the drying kinetics of faecal sludge and the development and science advancement of various novel household and community-based sanitation systems. Despite the generation of this knowledge, there has little uptake of this research into university curricula with conventional systems, specifically sewered system design, remaining entrenched within the academic learning space. Under the constrained resource availability and urbanisation trends expected, the next generation of sanitation engineers, scientists and decision-makers need exposure to alternative approaches in this field.

It is well-known that developing countries have cities and towns that use more than sanitation technology and that non sewered sanitation approaches are equally as important as sewered approaches in delivering sanitation services. The development of a curricula on non-sewered sanitation would serve several vital functions that a critical to the needs of the country:

- Building the next cohort of skills to support non-sewered sanitation.
- Introduce learners to Faecal Sludge Management and its importance as part of Public Health.
- Provide the scientific and engineering fundamentals and required information for the design and selection of non-sewered approaches.
- Introduce learners to new and latest innovative non-sewered sanitation approaches, including circular economy principles.
- Provide a dissemination and learning platform for WRC non-sewered sanitation products.
- Stimulating and developing grassroot engineering and scientific capacity in non-sewered sanitation.
- Would assist current and / future municipal and government employees in understanding integrated sanitation planning that includes sewered and non-sewered approaches.

The development of the curricula through the WRC would allow universities and other learning centres to make use of the material that will be designed and formatted for learners. There is also opportunity to have the developed material used as virtual courses, including *Massive Open Online Courses* (MOOCs). The effects of the COVID-19 pandemic has shown the benefits of virtual learning tools during social distancing measures. While there are other MOOCs available for internationally for Faecal Sludge Management, there is a need to have content that is tailored to the South Africa context and be aligned to the WRC's vision

and strategy for sanitation.

Specific Aims:

13. Develop a curricula on Non-Sewered Sanitation that includes WRC Reports, Circular Economy principles and latest non-sewered engineering approaches.
14. Provide a support and implementation strategy for learning (including virtual platforms) based on the material developed.
15. The design of the learning material must be formatted to according to learning approaches.
16. Produce marketing material linked to outputs of study.

Rationale:

Non-sewered sanitation systems is not covered within curricula for grassroot engineers and scientists who will eventually be involved in sanitation decision-making. Most cities in South Africa are not fully sewered; the development and adoption of the learning material will allow for knowledge transfer and exposure to alternative sanitation approaches at grassroot level.

Deliverables:

17. Reports on key aspects researched as per specific aims.
18. Draft Final Report.
19. Final Report.

Lighthouse:

- Water Sensitive Design; Water-Energy-Food Nexus

Impact Areas:

- Water and the Economy; Water and the Environment; Water and Society

Knowledge Tree

- HCD in Water and Science Sectors
- Sustainable Development Solutions

Time Frame: 2-years
Total Funds Available: R500,000.00 (Year 1: R250,000, Year 2: R250,000) (VAT Inclusive)