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	***Programme 1: Smart water supply management***
TITLE	Development of an approach towards digitalization of water services sector in SA

Objectives

Development of an approach towards digitalization of water services sector in SA

General

Rapid urbanization across the African continent is impacting water demand and it is estimated that by the year 2030, the world will need 40% more purified water. In South Africa, local municipalities are losing up to 45% of bulk water supplies, mainly due to pipe leaks and misuse. Global research and insights into the current successes of the introduction of Industry 4.0 in the various industrial sectors, specially from Germany, as a strategic inventiveness the German government adopted a "High-Tech Strategy 2020 Action Plan" in 2011. Industry 4.0 has gained popularity in many countries globally and is viewed as the extension of the previous third industrial revolution that is based on mechanization. Internet of Things (IoT), Industrial Internet of Things (IIoT), Big Data, and Cyber Physical Systems (CPS) are adopted in the manufacturing sphere to move manufacturing towards the 4th Industrial Revolution (4IR) .

A key South African opportunity on water management would be skills development, maturity analysis, the development of technologies that would minimize water losses, energy losses and deliver on business optimization by adopting current technology opportunities. Current global trends in Industry 4.0 is proving beneficial to various industry sectors including petrochemical, logistics, aerospace, pharmaceutical, etc. Industry 4.0 includes the integration of all aspects under consideration, this includes the opportunity to manage/automate in "real time" all aspects influencing the system. Industry 4.0 delivers an opportunity to apply current technologies to maximize the opportunities in the water sector.

Smart water management technologies and digital management systems combined with faster response times could dramatically increase water reliability and significantly reduce losses. Globally, the water industry has been focused on ushering in a new era of water management,

with an emphasis on automation, the Internet of Things (IoT) and more sophisticated data management and analysis software that enables the water end user or plant operator to have valuable, actionable information .

This is a much needed transition required in the South African water services environment against the several challenges associated with ongoing operation and maintenance associated with the lack of skills and capacity. However, this is a long term process of bringing the value proposition and efficiency to the water services sector, and its introduction must be well coordinated and smartly introduced.

Specific

The specific objectives are:

- Develop and undertake an analysis framework, including skills development, through a co-generation approach seeking to establish the digital maturity of the water entities in SA with a focus on the IT/OT maturity.
- Review international best practice and develop the Water 4.0 digital framework
- Development of a training pack on best practice in digital water best practices
- Define a structured framework for water 4.0. based on digital knowledge management.
- Develop a data model for a Central Management Data Base (CMDB), build a theoretical data model (Software, Hardware, connectivity, network, other specification).
- Development of a training pack for data collection
- Undertake skills development in the digital water, IT/OT, digital business models, digital enablement, systems and tools for digital, digital maintenance, digital operations.

Special Requirements

Ideally, this study must be undertaken with a water services institution and leverage in terms of financial support will be encouraging.

Expected outcomes and impacts:

- Research report
- Strategy and guidelines
- Position paper
- A structured training protocol on digital water
    - How to asses current and future skill
    - Framework for skill auditing and forecasting based on tech
    - Decision on what skills is required for what system

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: R750 000.00 inclusive of VAT. (2022 – 450k, 2023- 300k)

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	***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	**1. WATER SENSITIVE AND RESILIENT SETTLEMENTS**
PROGRAMME	***Programme 2: Sustainable drainage futures***
TITLE	An investigation and analysis of the impacts of extreme weather events and climate change on current drainage designs and land-use planning.

Objectives To investigate and analyse urban infrastructure design and land-use planning during extreme weather events.

General

South Africa has been in recent time reeling with the consequences of heavy rains and catastrophic floods, which has been affecting several cities to date. The recent flooding events in the coastal city of Durban and surrounding areas resulted in damage to infrastructure, deaths and environmental degradation. These new hydro-extreme events are being worsened by the influence of climate change, with research indicating that the likelihood of an event this severe happening more frequently because of global warming.

The latest report from the Intergovernmental Panel on Climate Change concludes that extreme rainfall is likely to intensify as the planet continues to warm. South Africa is no stranger to heavy rainfall as it is. Durban has seen several similar disasters in recent years, including a devastating series of floods and landslides as recently as 2019. Yet it is not just the severity of the rainfall that led to its devastating outcome. The deep-rooted structural inequalities in the affected areas coupled with poor landuse planning deficiencies also worsened the impact, where people most vulnerable to floods and landslides in and around Durban live in informal settlements and in homes that are vulnerable to flash flooding.

An understanding of the spatial planning and settlement pattern, as well as engineering interventions, needs to be assessed to inform how the city and other cities can plan better for such extreme events.

Specific

The specific objectives are:

- Investigating and assessing the current drainage planning and implementation and its ability to deal with extreme events (floods and droughts) in three case study areas, in eThekwini Municipality surroundings and Eastern Cape surroundings.
- Identifying key problem areas in spatial planning and management, as well as coping capacity for extreme weather events and associated flash flooding or saturated soil conditions.
- Determining a set of measures and guidelines which can be implemented to deal which such challenges in the future, and should cover among others:
    - Informal settlements
    - Spatial planning
    - Engineering and built environment interventions
    - Early warning systems
    - Awareness raising

Expected outcomes and impacts:

- Reports
- Guidelines
- Position paper
- Capture lessons in a final report.

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: R800 000.00 inclusive of VAT. (2023 – 400k, 2024- 400k,)

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	***Programme 3: Water efficiency and behaviour change***
TITLE	Strategy for national scaling of behavioural nudges and other associated behaviour change tools
Objectives	Developing a strategy for scaling behavioral change interventions

General

Climate variability, growing urban communities and that of water demand is a situation facing many developing and developed countries. Besides the gap between demand and supply slowly being closed and some cases exceeded, the situation is further exacerbated by lack of change is user and usage behavior. This has been the experience both globally and now locally in the case of Port Elisabeth, where consumption patterns have responded to the growing rsiks associated with water stress. Many municipal areas in South Africa are already reaching point of water stress and find themselves having to manage the demand on their water resources. This need is likely to become more acute as the economy and population continues to grow, pushing the areas and country in water scarcity. Historically municipalities have largely relied on engineering interventions and customer management and education campaigns to, coupled with on tariffs, technical interventions (such as leakage control) to manage the demand for water. In recent years however, municipalities, mainly in the developed world, have begun implementing behavioral economics as a means for more sustainable behaviour change in the use and management of water.

WRC has been instrumental in supporting such initiatives to date and have had this absorbed into the COCT initiatives during its drought interventions, where the tools and products have been widely effective. As we enter into this hydro-extreme environment, it is time we influence water usage behaviour for the long term sustainability and security, since behaviour change is possibly the only water alternative of huge opportunity remaining in our arsenal. Driving efficient use and management is the key to future water security.

The intent of this study is to develop a high level strategy and action plan on how as a country we can scale up and improve uptake of behavioral interventions at a municipal level tackling all layers of decision making.

Specific

The specific objectives are:

- Developing a strategy to infuse the uptake and application of behaviroal strategies and tools
- Identifying key interventions and plans including training, capacity building and practice.
-

Expected outcomes and impacts:

- Reports
- Guidelines
- 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: 3 years

Total Funds Available: R600 000.00 inclusive of VAT. (2023 – 300k, 2024- 300k,)

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	***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. (2023 - R300k, 2024 -200K)

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA	**KSA 3**
THRUST	**4 - SANITI**
PROGRAMME	**1 – Re-Engineered Toilet**
TITLE	**Proof-of-Concept for urban, household re-engineered toilet that carbonises human faecal waste.**

Objectives:

General:

Progress in sanitation is falling short of time-based targets. Part of the challenge lies in the technology paradigm that has seen little innovation is the last 150 years. The current sanitation paradigm is binary in nature – flush toilets connected to wastewater treatment works via sewered network and on-site alternatives that main serve as containment receptacles in which faecal sludges needs to emptied and transported to a treatment facility. Both approaches have their known technical shortcomings.

There is a strong need to innovate toilet technologies to address the technical limitations of current approaches. These solutions need to safely treat human excreta and match societal needs without relying on sewers and constant water and energy supply. Toilets that utilize "in-situ" treatment processes offer the potential to apply circular economy principles of "reduce, recycle and reuse" processes at household level. This strategy enables to households to mitigate against challenges of water supply and reducing the burden of sludge handling. Internationally and locally, standards (ISO 30500 and SANS 30500) have been developed for this purpose and to ensure safety, functionality, usability, reliability and maintainability of the system, and its compatibility with environmental protection goals.

To stimulate localized development of toilet technologies, the SMARTSAN (Smart Sanitation) initiative was established as dedicated funding Re-Engineered Toilet programme within Key Strategic Area 3.

As part of the SMARTSAN initiative, we seek innovative back-end (treatment facility) toilet processes that can match the following criteria:

- Utilize **carbonisation processes as the main treatment proces**s to safely treatment human excreta.
- The toilet design concept should take into consideration urban spatial requirements of office block toilet cubicles, apartment bathrooms or household bathroom.

Specific Aims:

The specific aims of the project are:

1. Proof-of-concept evaluation of the idea / process

Deliverables:

1. Reports on key aspects researched as per specific objectives
2. Draft Final Report
3. Final Report

Lighthouse:

- Water-Energy-Food Nexus
- The Green Economy

Knowledge Tree

- New Products and Services for Economic Development
- Sustainable Development Solutions

Budget: R600,000.00 (VAT inclusive). Year 1: R400,000, Year 2: R200,000.

Time Frame: 2-Years

Additional Notes:

- Conceptualized back-end processes can be designed to either be manufactured as one package, or manufactured as a set of prefabricated elements designed to be assembled in one location without further fabrication or modification that influences the system function
- While primarily applicable to the development of back-end treatment systems that are not connected to water and electricity networks, it can also be applied to systems that can utilize water mains and/or electricity (stable or unstable).

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA	**KSA 3**
THRUST	**4 - SANITI**
PROGRAMME	**1 – Re-Engineered Toilet**
TITLE	**Proof-of-Concept for urban, household re-engineered toilet that uses incineration as the main treatment process**

Objectives:

General:

Progress in sanitation is falling short of time-based targets. Part of the challenge lies in the technology paradigm that has seen little innovation is the last 150 years. The current sanitation paradigm is binary in nature – flush toilets connected to wastewater treatment works via sewered network and on-site alternatives that main serve as containment receptacles in which faecal sludges needs to emptied and transported to a treatment facility. Both approaches have their known technical shortcomings.

There is a strong need to innovate toilet technologies to address the technical limitations of current approaches. These solutions need to safely treat human excreta and match societal needs without relying on sewers and constant water and energy supply. Toilets that utilize "in-situ" treatment processes offer the potential to apply circular economy principles of "reduce, recycle and reuse" processes at household level. This strategy enables to households to mitigate against challenges of water supply and reducing the burden of sludge handling. Internationally and locally, standards (ISO 30500 and SANS 30500) have been developed for this purpose and to ensure safety, functionality, usability, reliability and maintainability of the system, and its compatibility with environmental protection goals.

To stimulate localized development of toilet technologies, the SMARTSAN (Smart Sanitation) initiative was established as dedicated funding Re-Engineered Toilet programme within Key Strategic Area 3.

As part of the SMARTSAN initiative, we seek innovative back-end (treatment facility) toilet processes that can match the following criteria:

- Utilize **incineration processes as the main treatment process** to safely treatment human excreta.
- The toilet design concept should take into consideration urban spatial requirements of office block toilet cubicles, apartment bathrooms or household bathroom.

Specific Aims:

The specific aims of the project are:

1. Proof-of-concept evaluation of the idea / process

Deliverables:

1. Reports on key aspects researched as per specific objectives
2. Draft Final Report
3. Final Report

Lighthouse:

- Water-Energy-Food Nexus
- The Green Economy

Knowledge Tree

- New Products and Services for Economic Development
- Sustainable Development Solutions

Budget: R600,000.00 (VAT inclusive). Year 1: R400,000, Year 2: R200,000.

Time Frame: 2-Years

Additional Notes:

- Conceptualized back-end processes can be designed to either be manufactured as one package, or manufactured as a set of prefabricated elements designed to be assembled in one location without further fabrication or modification that influences the system function
- While primarily applicable to the development of back-end treatment systems that are not connected to water and electricity networks, it can also be applied to systems that can utilize water mains and/or electricity (stable or unstable).

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:

1. Develop the framework and model for designing sanitation sensitive cities.
2. Undertake stakeholder engagement to define and benchmark Sanitation Sensitive Design, including Circular Economy aspects, for the South African sector.
3. Outline the vision, narrative, research and implementation support strategy that will be required in order to transition to sanitation sensitive ecocities.
4. 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:

1. Reports on key aspects researched as per specific aims.
2. Workshop/s with key stakeholders to define and benchmark Sanitation Sensitive Design.
3. Draft Final Report.
4. 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**
THRUST	**4 - SANITI**
PROGRAMME	**2 – Sanitation Sensitive Design**
TITLE	**Development of a Strategic Approach to include Re-Engineered Toilets into Institutional and Municipal Financial Planning**

Objectives:

General:

As cities grow and become under increasing water, energy, climatic and energy demand pressures, novel sanitation systems and processes are required. Accelerating the development of new technologies, processes and servicing and management models is required to catalyze a paradigm change in unsustainable practices. Many of these applications have been developed, tried and tested with success but have not reached the desired critical mass.

Contracting and procurement remains a major obstacle for new sanitation technologies and services. It is widely recognized that public procurement is an important demand-side instrument that governments can use to steer the sector in a more sustainable direction. It makes up a sizeable percentage of a country's GDP and therefore has influence over the market. Because it is traditionally considered an administrative function of government, however, a lot of the potential advantages and multiplier benefits have not yet been realized.

The contracting environment around implementing innovative solutions and services is fraught with challenges. There is a lot of resistance to considering a solution or process that appears costlier than the business-as-usual alternative even it may allow more sustainable spin-offs. Much public procurement remains very compliance-driven and not inclusive of innovative. Many public procurement agencies continue to buy yesterday's technologies and are, therefore, a barrier to deploying innovative solutions. There are also challenge of contracting where a new sanitation model may require different contracting and financing options across the sanitation value chain. For example, short servicing contracts may be required for the emptying of latrines or toilet servicing, but long-term financing is required for an innovative faecal sludge treatment process.

There are new sanitation technologies and services that offer more sustainability. Contracting decisions however are generally made on the price of acquisition, or the capital cost only, and do not take into consideration sustainability of the solution, including societal needs, availability of technical and natural resources, developing new revenues and / or economies, and skills development and local entrepreneurship. There is a need to bring innovative sanitation solutions to the market and make them

mainstream through public procurement. There are already examples out there of how business-as-usual has resulted in the lock-in and the failure of yesterday's solutions which do not take into account today's challenges of societal needs, servicing requirements, and water, energy and technical constraints. There is a need to look at ways of achieving the best value for money for a sanitation investment and where public procurement can become an immensely powerful tool to stimulate innovation and be a driver of more sustainable sanitation options.

Specific Aims:

The specific aims of the project are:

1. Frame the challenge of procuring new sanitation technologies and processes
2. Develop new procurement and contracting models across the sanitation value chain for new sanitation technologies and processes.
3. Produce a policy brief based on outputs

Deliverables:

1. Reports on key aspects researched as per specific objectives
2. Workshop(s)
3. Dissemination material (papers, briefs)
4. Final Report

Lighthouse:

- The Green Economy

Knowledge Tree

- Informing policy and decision-making
- Sustainable Development Solutions

Budget: R700,000.00 (VAT inclusive). Year 1: R350,000, Year 2: R350,000.

Time Frame: 2-Years

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA	**KSA 3**
THRUST	**4 – SANITI**
PROGRAMME	**2 – Municipal Sludge Valorisation**
TITLE	**Understanding the current trends and advances in municipal sludge technology and innovative options related to sludge management**

Objectives:

General:

Municipal wastewater sludges are produced in large quantities from wastewater treatment works. Generally, sludge treatment and disposal can account for half of the operating cost of sewage treatment plants. According to the State of Waste Report (SoWR, 2018), there are 824 large-scale municipal and private wastewater treatment works generating around 632,749 tonnes of wastewater sludge. Municipal wastewater sludge production will continue to increase as more people move to urbanized areas, new treatment works are implemented and environmental standards become more stringent. With some traditional disposal routes coming under pressure, the challenge is to find cost-effective and innovative solutions whilst responding to environmental, regulatory and public pressures. The continuous advancement of sludge treatment processes is therefore critical to municipal wastewater treatment operations and the healthy development of the sewage treatment industry.

Municipal wastewater sludges represents a major operational cost for wastewater treatment plants. With some traditional disposal routes coming under pressure, there is need to develop cost-effective and innovative solutions for municipal wastewater sludge whilst responding to increasing environmental, regulatory and public pressures.

Municipal wastewater sludges can contain a variety of pollutants, including non-toxic and toxic organic compounds, inorganic pollutants and microbial pathogens. The complexity of sludge quality determines the complexity for the requirements of the treatment and management processes. If not properly managed, it decreases the effect of treatment facilities and can bring about negative public health and environmental impact. Furthermore, there are potential technical challenges of odour, detritus and high water content.

The research and development of sustainable sludge treatment and management methods have always been key focus globally with numerous conferences and coordinated research and scientific committees focusing on sludge management.

This study scope is to undertake an analysis of the latest trends and development in wastewater sludge management research, development and innovation, and should cover shifts in technology, practice aligned to climate agenda and legislation, sludges as a resource, breakthrough innovations and management processes. This study will provide high-level strategic pathway for research investment in wastewater sludge treatment. The continuous advancement of sludge treatment processes is critical to municipal wastewater treatment operations and the healthy development of the sewage treatment industry.

Specific Aims:

The specific aims of the project are:

1. Comprehensive literature review of the latest trends in wastewater sludge management, research, development and innovation.
2. Identify key issues, strategic trends and priorities.
3. Develop a high-level research strategy responding to short, medium and long-terms issues identified.

Deliverables:

1. Reports on key aspects researched as per specific objectives
2. Workshop to disseminate findings
3. Journal article(s)
4. Final Report

Budget Limits

Total budget = R700,000 (VAT Inclusive); Year 1: R400,000; Year 2: R300,000

Time Frame: Two(2)-Years

Lighthouse:

- Water-Energy-Food
- The Green Village

Knowledge Tree

- Sustainable Development Solutions
- HCD in water and science sectors

Additional notes

The following information may be useful in developing an appropriate methodology:

- Emerging Technologies for Wastewater Treatment and In-Plant Wet Weather Management (epa.gov)
- Historical development of wastewater and sewage sludge treatment technologies in Japan – An analysis of patent data from the past 50 years - ScienceDirect
- Sludge management – future issues and trends | Water Science & Technology | IWA Publishing (iwaponline.com)

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 & Sludge Valorisation**

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:

1. Develop a curricula on Non-Sewered Sanitation that includes WRC Reports, Circular Economy principles and latest non-sewered engineering approaches.
2. Provide a support and implementation strategy for learning (including virtual platforms) based on the material developed.
3. The design of the learning material must be formatted to according to learning approaches.
4. 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:

1. Reports on key aspects researched as per specific aims.
2. Draft Final Report.
3. 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)

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

KEY STRATEGIC AREA	**KSA 3**
THRUST	**4 - SANITI**
PROGRAMME	**3 – Municipal Sludge Valorisation**
TITLE	**What are municipalities doing with their municipal sludge? Understanding the current practices and the cost associated with municipal sludge disposal with case studies**

Objectives:

General:

Municipal wastewater sludge generation is an inevitable operational by-product associated sanitation service provision. Municipal sludge consists of wastewater sludge generated as a by-product from wastewater treatment and faecal sludge generated from containment in on-site sanitation systems. The disposal strategies for municipal sludge management guided by the WRC Sludge Management Guidelines of 2006 and 2009, which are currently used in Authorisations by the Authorities responsible for water and environmental affairs to stipulate the regulatory requirements for sludge management. In addition to disposal, stockpiling of sludges may occur.

Wastewater treatment works can generate various volumes of wastewater sludge depending on the volumes of wastewater treatment and requires subsequent sludge handling. The State of Waste Report (SoWR, 2018) produced a status quo of current sludge management practices. According to the report, there are 824 large-scale municipal and private wastewater treatment works generating around 632,749 tonnes of sewage sludge. Land application (unstable) represents the largest percentage disposal option used (30%) followed by on-site stockpiling (19%), off-site landfill (19%) and stabilized land application (18%). There is a need to understand the financial implications of current sludge management practices, understand the proportion of funds used for this practice and adherence to compliance requirements.

At the same time, the country has around 30% of the population using latrine and other on-site sanitation systems. Faecal sludge generated in these on-site sanitation systems can be classified as a hazardous waste due to its pathogenic nature. Municipalities have developed certain practices to safely dispose of sludge which can vary depending on the number of on-site sanitation systems that need to be managed. The disposal of these faecal sludges also has an important cost implication.

With landfill space declining and a large percentage stockpiling, there is a need to consider alternative options, including valorisation of municipal sludges. This research project a better understanding of how municipal sludge, including faecal sludges, is managed in the country and understanding the challenges

associated with sludge handling and disposal practices across the country. It is anticipated that the outputs will stimulate thought into better usage of by-product, including sludge valorization.

This study will provide a status quo of the financial costs associated with the management of wastewater and faecal sludges in municipalities across the country and unpack the financial implication associated with municipal sludge interventions across the full sludge management chain. The study will cover the costs associated with collection, transport, treatment, disposal / recovery / reuse, monitoring, quality control etc. The end-product will guide sludge management selection and implementation towards more cost-effective strategies for sludge management including sludge valorization.

Specific Aims:

The specific aims of the project are:

1. Provide a status quo of the financial implications associated with municipal sludge management.
2. Determine the expenditure associated with for municipal sludge interventions for both wastewater and faecal sludges
3. Unpack financial implications of compliance matters related to current sludge management practices
4. Identify any policy and regulatory gaps.

Deliverables:

1. Reports on key aspects researched as per specific objectives
2. Workshops
3. Dissemination material (papers, briefs)
4. Final Report

Lighthouse:

- The Green Economy

Knowledge Tree

- Informing policy and decision-making
- Sustainable Development Solutions

Budget: R700,000.00 (VAT inclusive). Year 1: R350,000, Year 2: R350,000.

Time Frame: 2-Years

Additional Notes:

- Visual aid graphics / mapping is desirable
- Have representation of different types of municipalities

WATER RESEARCH COMMISSION

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	**Enabling the incorporation of administrative penalties into the National Water Act**
ToR NUMBER	

Objectives:

General:

To provide for the research and calculation methodology of the quantum of administrative penalties to be imposed for offences in terms of the National Water Act (No. 36 of 1998) and selected subordinate legislation, for inclusion and application in the National Environmental Management Amendment Bill, 2022, when passed

Specific:

To undertake the following research in alignment with the preliminary draft of the National Environmental Management Amendment Bill, 2022; Draft Policy on Introduction of an Administrative Penalty System into National Environmental Legislation[1] and the National Water and Sanitation Master Plan [Volume 1: Call to Action v 10.1 31 October 2018]:

1. Examine how administrative penalties can be applied, within the context of the National Water Act, to best support the strategic objectives of the Act, while complementing existing provisions for compliance, deterrence, polluter-pays, rehabilitation etc.
2. Develop criteria and guidelines for distinguishing between minor administrative offences (subject only to fixed administrative penalties) and more serious offences (subject to variable administrative penalties and/or criminal sanction) in terms of the National Water Act and selected subordinate legislation (see Appendix 2), and apply such criteria and guidelines by categorizing the identified offences as minor administrative or more serious offences.
3. Review the current criteria for determination of appropriate variable administrative penalties outlined in the draft National Environmental Management Amendment Bill (refer

[1] NEM Amendment Bill and the draft policy are not publicly available but will be shared with the project team appointed to undertake this project. Refer to Appendix 1 for a summary of aspects of the draft policy relevant to these ToR.

to summary of policy in Appendix 1) in order to determine their effectiveness in guiding the application of administrative penalties within the context of the National Water Act and selected subordinate legislation, and propose any necessary amendments.
4. Propose appropriate quanta for fixed administrative penalties for the minor administrative offences identified in objective 2.
5. Develop a user-friendly calculator template that can be used to calculate the quantum of variable administrative penalties in line with the proposed criteria referred to in objective 3.
6. Develop a mechanism to give effect to sections 152 and 153 of the National Water Act, within the context of an administrative penalty system, for the determination of damages for any harm or loss, or damage that has been caused to a water resource.
7. Undertake the activities in objective 1-5 above, where appropriate, in a manner that could be equally applied to national legislation regulating other environmental sectors (biodiversity, protected areas, waste, air quality, oceans and coast etc.) to which the envisaged administrative penalties system will be applied.

Rationale:

The Department of Forestry, Fisheries and Environment (DFFE) initiated a project to research the feasibility of applying administrative penalties to contraventions of national environmental legislation, develop national policy and prepare draft legislation on the introduction of administrative penalties into national environmental legislation.

The research project and engagement with 14 environmental compliance and enforcement authorities (including the Department of Water and Sanitation, DWS) examined the views and experiences of officials in relation to the efficacy of criminal enforcement in improving compliance with environmental legislation. This assessment made it apparent that there is definite scope for the current set of enforcement mechanisms provided for in environmental legislation in South Africa to be supplemented by a system of administrative penalties.

An administrative penalty is a regulatory response to a legal violation in which the violator is subject to a monetary fine after a fair administrative process. The goal of an administrative penalty is to punish violators. It should be contrasted from a remedial regulatory response to a legal violation, for example, the issuance of directives/notices, which aims to repair the harm caused by the legal violation. The envisaged administrative penalty system will fall outside the criminal justice system, and the imposition of an administrative penalty on a contravener does not necessarily require the launch of criminal proceedings. There does however need to be interplay between the implementation of the administrative penalty system and the criminal sanction system.

Having the mechanism of fixed administrative penalties that can be applied to certain violations without having to follow cumbersome and costly criminal and/or civil court processes has the potential to strengthen regulators' ability to reinforce the polluter pays principle and recoup costs of non-compliance. As a result, an additional device is added to the 'toolbox' approach to environmental enforcement, assuming that administrative sanctions should complement and be compatible with the existing enforcement framework. Very minor offences and offences that are unlikely to be effectively enforced through criminal law can be dealt with administratively. At the same time, those offences that are more serious may be subject to criminal prosecution and/or the issuance of a variable monetary penalty.

This administrative penalty method provides for more flexibility and variety in enforcement methods and ensures that appropriate sanctions are used for various types of non-compliance. The costs that flow from non-compliance are usually externalised onto (or borne by) broader society. The administrative penalty system attempts to prevent this burden from being passed

onto taxpayers unnecessarily. Sometimes the costs are direct and can be easily determined. In other instances, they are indirect and difficult to quantify, such as when companies gain an unfair competitive advantage because their market prices do not reflect the real cost of the environmental impact.

The pervasive use and application of an administrative penalty framework will enable environmental and water regulatory authorities to undertake a greater volume of enforcement in response to detected non-compliance. This motivates compliance by users desiring to rather comply with legislation to avoid further penalties and future liability. In so doing they "save money" by using more cost efficient and environmentally sound practices thereby avoiding the "Polluter Pays Principle" which is one of the guiding principles of the National Environmental Management Act, Act 106 of 1998 [which is an umbrella Act for all environmental related matters] and the National Water Act, 1998 respectively.

Against this background, DWS is an authority involved in the management of environment and mandated to enforce the National Water Act, which is a Specific Environmental Management Act (SEMA). Criteria, guidelines and tools are required that will enable the application of administrative penalties for offences in terms of the National Water Act. This development will supplement the amendment process of the National Environmental Management Act, 1998, which will provide for the imposition of administrative penalties for failure to comply with provisions of NEMA and the SEMAs.

This project should focus on the development of criteria and guidelines to determine penalty amounts for water related offences, bearing in mind that the development of the deliverables takes place in the context of non-compliances with NEMA and the SEMAs. While the focus of this project focuses on water related offences, the development of the deliverables should take the broader context of application into consideration. Wherever possible, tools that are developed through this project, such as the calculator, should ideally be sufficiently specific to guide application of administrative penalties under the National Water Act, while being sufficiently generic to be of use under other SEMAs. Implementation of the project will require close collaboration and alignment to the National Environmental Management Amendment Bill, 2022 and the Draft Policy: Introduction of an Administrative Penalty System into National Environmental Legislation.

Deliverables:

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

1. Project design that facilitates continuous engagement and knowledge co-generation between the project team and relevant units in DWS and DFFE, in support of the administrative penalty project, including an inception meeting.
2. At least one stakeholder workshop at appropriate stage/s of the research process
3. Draft final report for review by the reference group, including:
    - Criteria and guidelines for distinguishing between minor administrative offences and more serious offences under the National Water Act and selected subordinate legislation;
    - Proposed list of offences that will be subject to fixed administrative penalties, as well as the quanta of these penalties;
    - Proposed list of offences that will be subject to variable administrative penalties, as well as criteria, guidelines and a user-friendly calculator template for variable administrative penalties.
4. Final report, covering all aspects researched as per specific objectives, incorporating

comments received from the reference group.

Impact Areas (WRC Knowledge Tree):
Inform policy and decision-making
Sustainable development solutions
New products and services for economic development

Time Frame:
12 months (start date 1 April 2023)
Draft final report to be submitted no later than 31 January 2024

Total Funds Available:
R800,000

Appendix 1
Summary of relevant aspects of the Draft Policy on Introduction of an Administrative Penalty System into National Environmental Legislation

Appendix 2
List of subordinate legislation to be included in the scope of this project

Regulations

– Regulations requiring that a water use be registered (GN R1352, 12 November 1999)
– Regulation on use of water for mining and related activities aimed at the protection of water resources (GN R704, 4 June 1999)
– Regulations regarding the safety of dams (GN R139, 24 February 2012)
– Regulations requiring that the taking of water for irrigation purposes be measured, recorded and reported (GN R131,17 February 2017)
– Regulations regarding the procedural requirements for water use licence applications and appeals (GN R267, 24 March 2017)
– Regulations in terms of s26 and s12A of the Water Act, 1956 for the erection, enlargement, operation and registration of water care works (revised 2001 draft of R2834, 27 December 1985)
– Regulations for the establishment of a water resource classification system (GN R810, 17 September 2010)
– *Draft Regulations relating to access and use of government waterworks and surrounding state-owned land for recreational purposes (R1046, 30 October 2015)*
– *Draft Regulations for the use of water for exploration and production of onshore naturally occurring hydrocarbons that require stimulation, including hydraulic fracturing and underground gasification, to extract, and any activity incidental thereto that may impact detrimentally on the water resource (R406, 7 May 2021)*

General Authorisations

- Revised General Authorisation for the taking and storing of water (GN 538 in GG 40243 of 2 September 2016)
- General Authorisation for water uses as defined in terms of section 21(c) or section 21(i) of the National Water Act (GN 509 in GG40229 of 26 August 2016)
- General Authorisation in terms of section 21(c) and (i) of the Act for the purpose of rehabilitating a wetland for conservation purposes (GN 1198 in GG32805 of 18 December 2009)
- Revision of General Authorisations in terms of section 39 of the National Water Act (GN 665 in GG 36820 of 6 September 2013)