EVALUATING MEGA HUMAN SETTLEMENTS FROM A WATER SENSITIVE PLANNING PERSPECTIVE

Hildegard Edith Rohr

WATER RESEARCH COMMISSION

TT 923/1/23

Evaluating MEGA Human Settlements from a Water Sensitive Planning Perspective

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EXECUTIVE SUMMARY

Gauteng province suffers from major water challenges and is likely to face severe water challenges in the near future if business-as-usual water usage and infrastructure development trends continue. The Province is also faced with a major housing backlog of approximately 687,015 units which, according to the Gauteng City-Region Observatory, is estimated to increase by over 50,000 units each year (OECD, 2011).

In addressing the latter, the Gauteng Department of Human Settlements (GDHS) announced its 'MEGA City Incentive' as part of its new housing policy in 2015. GDHS defines MEGA City Projects as Clusters of New Cities'.

In recent years, built environment practitioners started using terms such as Smart Cities, Green Cities and Water Sensitive Cities/Settlements interchangeably to achieve sustainable, resilient, and efficient city-states. The latter, Water Sensitive Cities, focuses specifically on the way a city interacts with its hydrological cycle. Through Water Sensitive Design (WSD) Cities/Settlements can provide water security which is essential for economic prosperity by efficiently using a diversity of water resources available; enhancing and protecting the health of watercourses and wetlands; mitigating flood risk and damage; and creating public spaces that harvest, clean and recycle water (CRCWSC, 2019).

If not planned properly, MEGA Human Settlements are likely to result in satellite cities relying on costly overstretch infrastructure networks, high levels of unsustainable resource consumption, spatial fragmentation, and dislocation causing increased strain on the surrounding ecological infrastructure. Thus, there is a need to inform and facilitate the Gauteng Department of Human Settlements, private developers and professional practitioners in the planning and development of Water Sensitive MEGA Human Settlements.

This requires a critical evaluation of existing land development and design practice which informs decision-making and guides the project from feasibility to implementation.

This study opted to design a comprehensive Self-evaluation Water Sensitive Compliance/Criteria Toolkit which allows decision-makers to score the planning and

development processes of MEGA Human Settlements against water sensitive outcomes.

The study aimed to contribute to water conservation by:

- Minimising demand on the reticulated water supply system;
- Minimise impacts on existing natural features and ecological processes;
- Protect surface and groundwater quality;
- Improve the quality of and minimise polluted water discharges to the natural environment;
- Incorporate collection treatment and/or reuse of runoff;
- Reduce run-off and peak flows from urban development;
- Re-use treated effluent and minimise wastewater generation;
- Contribute to socio and economic sustainability.

Empower communities

MEGA Human Settlements and surrounding communities will benefit through increased social amenities in urban areas through multi-purpose green space by integrating water into the landscape to enhance visual, social, cultural and ecological values. Introducing Water Sensitive Design in the planning stage of the development will result in improved accessibility of clean water to previously disadvantaged individuals. It is anticipated that communities will develop a feeling of responsibility towards water resources and develop a new understanding of the value of water resources.

Informing policy and decision-making

This project proposed to harmonise water cycle practices across and within the institutions responsible for the planning and implementation of MEGA human settlements. It will be seen as a stepping stone towards water sensitive governance and policy support. Measures will be proposed to add value to MEGA Projects while minimizing development costs (e.g. drainage infrastructure costs). This study will also raise awareness between water use and wider social and resource issues.

Assist in Human Capital Development in the Water and Science sectors

The information gathered in the project will be made available to other provinces, municipalities and private developers to inform their own Human Settlements Policy directives. The multi-disciplinary team approach will result in cross-training between sector departments, built environment specialists and end-user stakeholders.

Mega Human Settlements

Mega Human Settlements represents a shift in housing policy away from the RDP housing model (which is considered inefficient) towards large-scale integrated human settlement development projects – ultimately to achieve Smart City developments. This will include, where possible, the integration of legacy, urban renewal, hostel upgrading, rapid land release and informal settlement upgrading projects/programmes into MEGA Human Settlements Projects ("MEGA Projects").

The MEGA Human Settlements strategy is a radical human settlements delivery mechanism that seeks to yield between 5,000 and 20,000 housing units per project, either as part of an existing development cluster or as a new nodal development project. To date, 39 sites have been identified spanning over 24,000 ha of provincial land. Information provided by the Gauteng Department of Human Settlements indicates that 14 of the 39 MEGA projects are already in the implementation phase while the remaining 25 are still in the planning phase.

It is anticipated that MEGA Human Settlements project will deliver over 300,000 new housing units together with a selection of complementary amenities, including but not limited to, primary schools and secondary schools, crèches, hospitals and clinics, municipal office centres, shopping centres, business facility sites, civic centres, higher-order community facilities, local community facility sites, multi-modal hubs, local parks, community gardens/allotment, industrial and manufacturing zones, theme parks, hotels and convention centre.

In 2018, a WRC-funded research project (K5/2587) entitled "Securing water sustainability through innovative spatial planning and land use management tools – a case study of two local municipalities" proved, through spatial analysis, that each land use change decision taken or approved by either Government officials, politicians or private developers carries both a water resource quality and quantity impact.

Thus, this study anticipated that the influx of land use and consumers generated by the MEGA Human Settlements will have both a water quality and water quantity impact on Gauteng's already stressed resource.

Research Rationale

Research Question: *How can Gauteng MEGA Human Settlements incorporate Water Sensitive Design and Planning solutions?*

- **Household Growth** – Gauteng Province is facing a housing backlog of around a million units caused by amongst others an influx of c. 300,000 people each year. This roughly translates to an increased demand for housing of more than 50,000 units each year (GDHS, 2020). The Gauteng Department of Human Settlements classified the housing crisis as both a historical and systematic challenge that could not be resolved timeously and had created issues such as the accumulation of accruals, illegal occupations, and housing projects which had been abandoned, mainly as a result of failed management.
- **Water Security** – Gauteng has limited natural water resources and therefore relies on a very large and highly engineered system called the Integrated Vaal River System (IVRS) which draws water from five different river basins across six provinces. The Gauteng Water Security Perspective (GCRO, 2019) calls for five interventions: (1) reduce water demand; (2) manage variability to prepare for drought and/or water scarcity; (3) invest in alternative water sources and tools for conservation; (4) manage water quality and limit pollution and achieve environmental goals, and (5) establish effective institutions for water security.
- **MEGA Human Settlements** – In 2015 GDHS announced its MEGA Human Settlement incentive, defining it as a radical human settlements delivery mechanism that seeks to yield between 5,000 and 20,000 housing units per project. Approximately 300,000 new housing units, together with a selection of land-use mixes, are planned to be developed as part of the MEGA Human Settlement Initiative. These planned settlements are mostly located in areas with limited to no bulk water and wastewater treatment works.
- **Water Sensitivity** – Land use change decisions taken by government officials, developers and other stakeholders carry both a water resource quality and quantity impact. South Africa's roadmap to water sensitivity is reaching its first

decade since its introduction. Research institutions such as the Water Research Commission (WRC) and the University of Cape Town (UCT), together with the private sector, have provided a sound foundation for practitioners to give effect to water sensitive practices. This study aims to put water sensitive theory into practice by adapting the business-as-usual approach of the land development process to incorporate water sensitive design and planning practices within each stage of the land development process.

This report puts forward a framework and guidelines together with a Water Sensitive Compliance/Criteria Assessment Toolkit that will assist developers, government officials and other professional practitioners to secure ecosystem sustainability and water resilience throughout the land development process of MEGA Human Settlements and any other developments.

Outlook and Opportunities for Water Sensitive MEGA Human Settlements

Critique

- Most of the planned Gauteng MEGA Human settlements are located within areas with limited to no bulk water and wastewater treatment work.
- To date, no evidence could be found that developers, professional practitioners, or government departments aim to develop these MEGA human settlements in a water sensitive manner. Or that the water crisis and sustained capacity of existing infrastructure is taken into consideration at all.

Gaps

- The reality is that South Africa's water crisis cannot be fixed by research only. There is a need to give effect to theory.
- The most evident gap in achieving water sensitivity in development is the fact that no one really knows whose responsibility it is to implement these practices. As a result, water sensitive design is brought in as an afterthought or reactive measure.

Opportunities

- Water Sensitive Design and Planning have been proven to improve water quality and water security. MEGA Human Settlements offer Gauteng a unique opportunity to put this to the test within the South African context.
- The opportunity to give effect to water sensitive design and planning lies within the land development processes. Professional practitioners can take proactive measures to include water sensitive design if they re-think the way in which the land development process is undertaken.

Research Project Outlook

A critical evaluation of existing criteria for the planning and design, and project approval processes set out for MEGA projects will lead to the identification of gaps and opportunities for water sensitive design solutions. While most MEGA projects are still in the planning phase, the research findings led to the development of a Framework and Guideline document (informed by existing WRC studies) specifically for the planning, design and implementation of Water Sensitive MEGA Human Settlements.

This framework and guideline document is supported by a Water Sensitive Compliance/Criteria Assessment Toolkit that will assist developers, government officials and other professional practitioners with how to plan, design and maintain water sensitive solutions within a MEGA human settlement. It is anticipated that this research project will facilitate cross-sectoral and inter-disciplinary collaboration of various sectors within the built and natural environment.

Framework & Guideline for Water Sensitive MEGA Human Settlements

Water Sensitive Land Development Process

Figure 1 illustrates a typical, almost generic, land development process through which a proposed development will transpire. The diagram forms the basis of the framework for Water Sensitive MEGA Human Settlements. The framework is also applicable to other proposed developments – however, not one land development application is likely to be the same and professional practitioners should use this framework at their own discretion and adapt where needed. Although the diagram might seem basic, opportunities for water sensitive design have been identified within each stage (where possible) to assist developers, professional practitioners and government officials in changing the business-as-usual approach of planning and development and reviewing applications to one which is water sensitive.

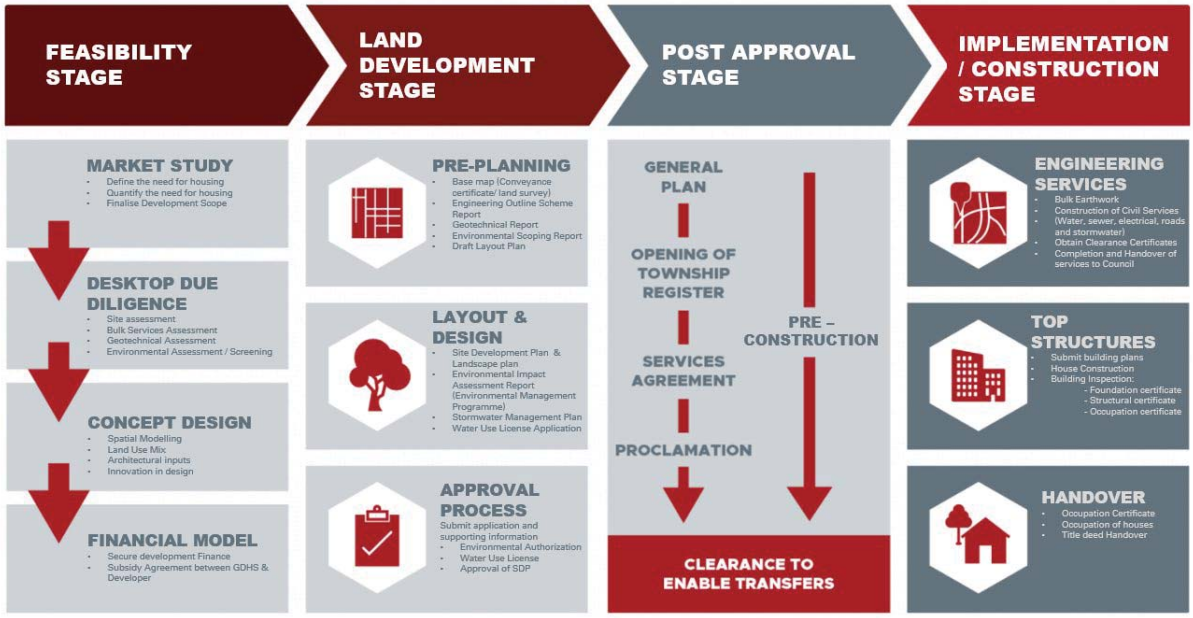

Figure 1: Typical Land Development Process

ACKNOWLEDGEMENTS

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LIST OF ACRONYMS

CMA	Catchment Management Agency
CoJ	City of Johannesburg
CoT	City of Tshwane
CRCWSC	Cooperative Research Centre for Water Sensitive Cities
EIAR	Environmental Impact Assessment Report
EISD	Environment and Infrastructure Services Department
GCRO	Gauteng City-Region Observatory
GCTWF	Greater Cape Town Water Fund
GDARD	Gauteng Department of Agriculture and Rural Development
GDP	Gross Domestic Product
GDS 2040	Growth and Development Strategy 2040
GIS	Geographical Information System
IUWM	Integrated Urban Water Management
IVRS	Integrated Vaal River System
IWA	International Water Association
IWRM	Integrated Water Resources Management
JRA	Johannesburg Roads Agency
JW	Johannesburg Water
LUS	Land Use Scheme
NRW	Non-Revenue Water
RSA	Republic of South Africa
SDF	Spatial Development Framework
SDP	Site Development Plan
SIUWM	Sustainability Index for Urban Water Management
SuDS	Sustainable Drainage Systems
SWMP	Stormwater Management Plan
UCT	University of Cape Town
UWCS	Urban Water Cycle Services
UWMTF	Urban Water Management Transitions Framework
UWTF	Urban Water Transitions Framework
WCWDM	Water Conservation & Water Demand Management
WRC	Water Research Commission

WSC	Water Sensitive City
WSCI	Water Sensitive Cities Index
WSUD	Water Sensitive Urban Design
WULA	Water Use License Application

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Chapter 1 – Study Overview

1.1. Introduction

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Thus, this study anticipates that the influx of land use and consumers generated by the MEGA Human Settlements will have both a water quality and water quantity impact on Gauteng’s already stressed resource.

1.2. Background

In recent years, built environment practitioners started using terms such as Smart Cities, Green Cities and Water Sensitive Cities/Settlements interchangeably to achieve sustainable, resilient, and efficient city-states. The latter, Water Sensitive Cities, focuses specifically on the way a city interacts with its hydrological cycle. Through Water Sensitive Design (WSD) Cities/Settlements can provide water security which is essential for economic prosperity by efficiently using a diversity of water resources available; enhancing and protecting the health of watercourses and wetlands; mitigating flood risk and damage; and creating public spaces that harvest, clean and recycle water (CRCWSC, 2019).

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As per the project proposal, the study aimed to contribute to **water conservation** by:

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The information gathered in the project will be made available to other provinces, municipalities and private developers to inform their own Human Settlements Policy directives. The multi-disciplinary team approach will result in cross-training between sector departments, built environment specialists and end-user stakeholders.

1.3. Aims and Methodology

In response to these challenges, this study scope was as follows:

1.3.1. Aims

- Establish a clear understanding of Gauteng's MEGA Projects and the opportunities and/or constraints for WSDP solutions within;
- Change the business-as-usual approach to land development projects from water-wasteful to water-sensitive;
- Develop a framework and guideline for Water Sensitive MEGA Human settlements against which all future MEGA projects can be benchmarked to ensure that MEGA projects will contribute to water security in South Africa;
- Develop training modules on how to plan, implement and maintain Water Sensitive solutions within a MEGA Human Settlements development process.

1.3.2. Research Methodology

The succeeding section describes the methodology employed in the literature review, followed by a section clarifying the empirical research design to be employed.

a) Literature review

The research team reviewed reports, analysed approved plans and assessed non-empirical data relating to the research question "How can Gauteng MEGA Human Settlements incorporate Water Sensitive Design and Planning solutions?". The literature review process was structured along three research themes which guided and informed the empirical research design:

- Theme 1: Understanding Gauteng MEGA Human Settlements (the motive, the concepts, the regulatory and strategic planning processes, the design criteria, identification of key role-players and their responsibilities, the processes involved from project feasibility to project initiation (design and planning) and project funding and implementation mechanisms).
- Theme 2: Understanding the projected impact of MEGA Human Settlements on Gauteng's already stressed water resources and infrastructure capacity.

- Theme 3: Understanding how Water Sensitive Design can be implemented to meet the design, cost, and performance objectives of sustainable MEGA Human Settlements.

b) Empirical investigation

This study drew primarily on qualitative and quantitative research in the form of case studies of Gauteng MEGA Human Settlement Projects. The case study research is comprised of three chief components.

- Thematic, self-evaluation: Water Sensitive Compliance/Criteria Assessment – The research was informed by a self-evaluation assessment of existing MEGA Human Settlements planning, design, and project approval processes/criteria to determine the extent to which existing MEGA Human Settlements can give effect to Water Sensitive Design and Planning solutions. The research team established the criteria for water sensitive design and planning solutions, informed by key research documents against which existing and planned MEGA Human Settlements will be assessed. These key documents include:
    - *The South African Guidelines for Sustainable Urban Drainage Systems (SUDS Guidelines) (WRC Project No. K5/1826 WRC report no. TT558/12) & Water Sensitive Urban Design for South Africa: Framework and Guideline (WRC Project No. K5/2071_WRC report no. TT 588/14).*
    - *Framework towards water sensitive spatial planning and land use management (WRC Project No. K5/2587_WRC report no. TT 809/1/19) & Guideline on compiling water-sensitive Spatial Plans (WRC Project No. K5/2587_WRC report no. TT 809/2/19).*
    - *Decision Support Tool for Sustainable Drainage Systems, Research on the use of Sustainable Drainage Systems in Gauteng Province (GT/GDARD/094/2018).*

The motive behind the self-evaluation assessment of Water Sensitive Compliance/Criteria is to build a comprehensive understanding of the concept of MEGA Human Settlements to identify gaps and opportunities for the implementation of water sensitive design and planning solutions from project feasibility to project initiation (design and planning) and project funding and implementation mechanisms.

Semi-structured stakeholder engagement meetings

Qualitative, the study was informed by semi-structured meetings held with officials from the Gauteng Provincial Department of Human Settlements, Local Municipalities, Private Developers and key role-players, Academics and WRC Reference Group Members assigned to this project. The semi-structure engagements were subject to pre-defined discussion topics or themes including, but not limited to:

- WSDP solutions and case studies – conceptual design criteria and standards
- Comparisons between conventional and WSDP with identified socio-economic benefits.
- Baseline investigations and key findings of qualitative and Quantitative research findings.
- Evaluation of existing challenges for WSDP solutions in MEGA Projects
- Opportunities for WSDP solutions in MEGA projects.

The focus of the semi-structured stakeholder engagement meetings was to build a platform of inter-disciplinary knowledge which integrates concepts and topics related to human settlements development, urban planning, Water Sensitive Urban Design and Planning; sustainable urban drainage systems; municipal engineering and services delivery; systematic biodiversity planning; green infrastructure; urban ecology; municipal finance; national law and regulations related to spatial planning, land use management and water resources planning and management.

The semi-structured meetings aim to gain expert input in developing a framework and guideline document on how to integrate or give effect to Water Sensitive Design and Planning Solutions within Gauteng MEGA Human Settlements. Comments and recommendations received during stakeholder engagement meetings were considered and included in the framework and guideline design.

Development of a framework and guideline document

The proof of evidence gained from the quantitative (case study) and qualitative research investigation was used to formulate the final project deliverable – drafting of a framework and guideline document that will assist the Gauteng Department of Human Settlements, Municipal officials, Private developers and other relevant stakeholders and decisionmakers in selecting and implementing the most suitable WSDP solution/technology for future MEGA Human Settlement developments.

Chapter 2 – Water Sensitive Design and Planning

2.1. Introduction

The combined effects of population growth and rapid urbanisation – contributing to the rapid transformation and occupation of land; increased levels of consumption and waste production, water loss and depleting water quality – have made the renewability factor of water resources increasingly questionable (Marsalek et al., 2006:3).

According to Wong & Brown (2008:2) conventional urban water management approach has become highly unsuited to addressing current and future sustainability issues due to the physical and institutional compartmentalization of municipal systems. In response, Brown et al. (2008) pioneered an aspirational concept of achieving a Water Sensitive City (WSC) state through an alternative and sustainable water resource planning and management approach called WSUD or WSD within the broader urban environment.

This section provides an in-depth review of key international and national publications regarding the subject matter and aims to highlight South Africa's progress towards achieving Water Sensitive City state.

2.2. From Vision to Mission

A Water Sensitive City is a vision of an aspirational future city-state for integrated water resource management. The Cooperative Research Centre for Water Sensitive Cities defines a Water Sensitive City as "a city that interacts with the urban hydrological cycle in ways that provide water security essential for economic prosperity by efficiently using a diversity of water resources available; enhances and protects the health of watercourses and wetlands; mitigate flood risk and damage; and create public spaces that harvest, clean and recycle water" (CRCWSC, 2019).

According to Rohr (2019:94), Rebekah Brown and fellow researchers spent approximately six years fulfilling a social research programme aimed at defining the hydrosocial contracts currently operating across cities. These hydrosocial contracts set the roadmap towards transitioning into a Water Sensitive City – See Figure 2.

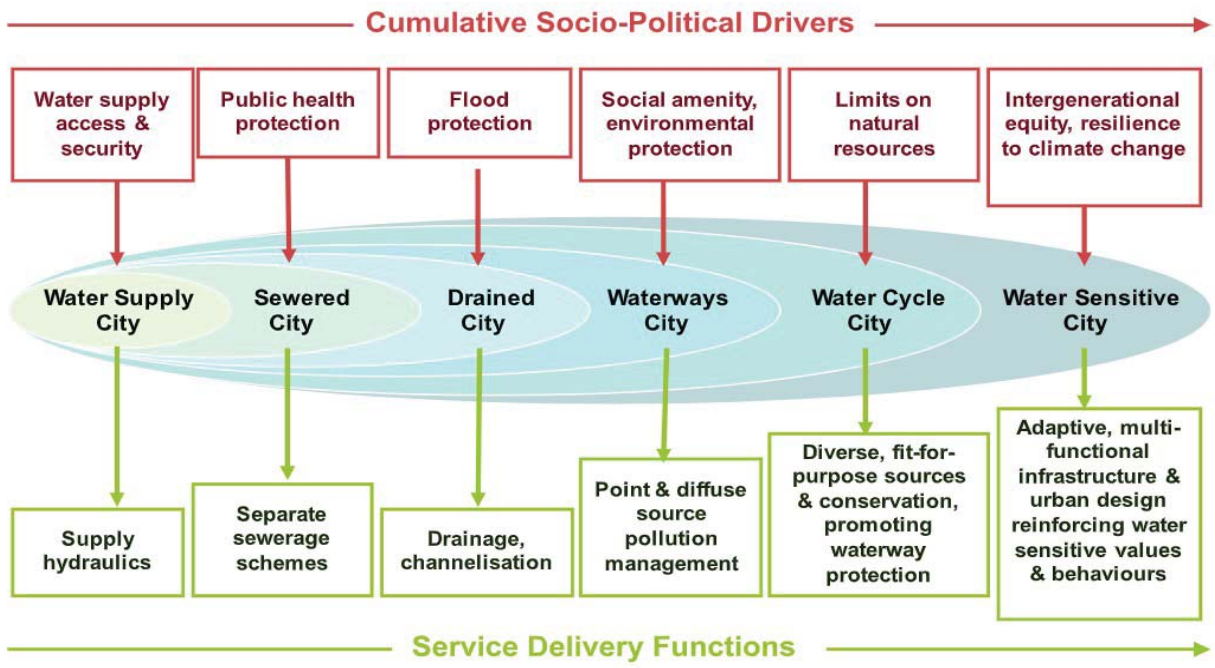

Figure 2: Urban Water Transition Framework

Source: Ferguson et al., 2013:32-45

The transitioning framework takes into consideration the "temporal, ideological and technological context that cities transition through when moving between different management paradigms and is sensitive to other influencing conceptual variables such as city-specific history, ecologies, geographies and socio-political dynamics" Brown et al. (2008:5)

It depicts a typology of six city-states, namely the 'water supply city', the 'sewered city' the 'drained city' the 'waterway city', the 'water cycle city', and ultimately the 'water sensitive city'" as envisioned at the far right (Ferguson et al., 2013:32-45). The Water Sensitive City calls for integrated development planning between all spheres of government and many diverse stakeholders to enable change that would result in a more sustainable system, notably by overcoming resistant cultures, structures, and practices that are 'locked in' to a current unsustainable path. Facilitating transitions is not easy. It requires dedicated attention to disrupt the dominant paradigm so that the emerging alternative of Water Sensitive Cities can become influential" (Brown et al., 2008:5).

- **Water supply city** – The most basic state of modern water management, whereby a centralised system provides water to a growing urban population

that expects cheap and equitable water for all. Large quantities of water are extracted from the environment using infrastructure such as pipes and dams. The public expects that water is cheap, harmless to the environment, and limitlessly available – see Figure 3.

- **Sewered City** – Building on the previous state, the Sewered City is driven by a desire for better public health and hygiene. Diseases caused by domestic and industrial waste effluent lead to the development of sewerage systems that divert effluent away from housing and into waterways outside of cities. As in the earlier state, it is assumed that the discarding of effluent does not harm the environment.
- **Drained City** – A need to protect homes and infrastructure from flooding is the driver behind the Drained City. The channelling of rivers enables the development of floodplains for housing and rapid urban growth. Like effluent, stormwater is directed away from urban areas and into waterways, generally thought of as dumping grounds for waste. The community expects water supply, sewerage and drainage services to be provided cheaply.
- **Waterways City** – The environmental impacts of both water extraction and waste processing are taken into account for the first time. As the social and aesthetic values of clean waterways are extolled, urban planning begins to integrate water as an important consideration. The unfettered extraction of fresh water is now being curbed, and receiving waterways are protected by filtering stormwater through bio-filtration systems such as rain gardens and artificial wetlands distributed throughout the city.
- **Water Sensitive City** – Based on holistic and integrated water cycle management that meets the city's water needs while also delivering a range of associated liveability benefits. A Water Sensitive City manages water in a way that protects the health of receiving waters, mitigates flood risk and creates green public spaces that also harvest and recycle water. Infrastructure, technology and urban design will be flexible, recognising the link between society and technology. The community is actively engaged with water, through recreational enjoyment of irrigated green spaces throughout the city and have opportunities for more active involvement in the water system.

2.2.1. Pillars of Practice

To operationalize this Water Sensitive City vision, Wong & Brown (2009) proposed three principles for practice, seamlessly integrated into the urban environment:

- Cities as Water Supply Catchments – access to a diversity of water sources, supplied by an integrated mix of centralized and decentralized infrastructure. The mix for alternative water sources include amongst others, managed aquifer (groundwater) recharge schemes, urban stormwater (catchment runoff), rainwater (roof runoff), recycled wastewater, and desalinated water.
- Cities Providing Ecosystem Services – espouses integrating urban landscape design with sustainable urban water management. This integration incorporates ecological functions and services into urban communities, to buffer the impacts of climate change while increasing natural capital in the urban and nearby natural environments.
- Cities Comprising Water-Sensitive Communities – asserts that community values and aspirations should govern urban design decisions and urban water management practices.

The transitioning framework towards Water Sensitive Cities and Water-sensitive practices is not one-size-fits-all. Since its first introduction nearly ten years ago, significant effort has gone into operationalizing the principles into cities with diverse social, institutional, and biophysical conditions around the world. While the principles provide important guidance, their application demands bespoke solutions that are tailored to the local context (Wong et al., 2020: 437-439).

South Africa's journey towards water sensitivity started in 2011 when the WRC solicited research proposals aimed at guiding urban water management decision-makers on the use of Water Sensitive Urban Design (WSUD) in a South African context.

2.2.2. Water Sensitive City

The modern urban water distribution network allowed developers of the early 1900s to identify land for development and economic activities far beyond previously limited built-up areas. In some way, it could be argued that this network of modern water

infrastructure facilitated rapid transformation and occupation of land inside and outside of densely populated urban areas. However, increased built-up areas and impermeable surfaces also caused increased runoff, which called for a more sophisticated method of treatment.

Figure 3 to the right is a simplified schematic illustration of a typical modern water distribution system, which starts by “extracting (1) raw water from dams, rivers and sometimes groundwater resources. Raw water is then (2) pumped through a (3) conveyance network to a (4) centralised water treatment plant. After treatment, water is distributed to (5) reservoirs through distribution pipelines.

Inspired by the Aqueduct rationale, reservoirs are usually located on higher ground, if topography permits it, as the system relies on pressure fed by kinetic energy. If the topography does not permit it, additional energy is used to (6) distribute water to customers through internal pipe networks” (Van Zyl, 2014:11). “Once consumed, greywater and sewerage are (7) collected and passed through an (8) network of sewer drains to

(9) pump stations which pump the raw sewerage to a (10) centralised wastewater treatment plant, where wastewater is treated. Treated effluent is then (11) discharged back into the (12) natural water body where it once again forms part of the natural hydrological cycle” (Ibid.).

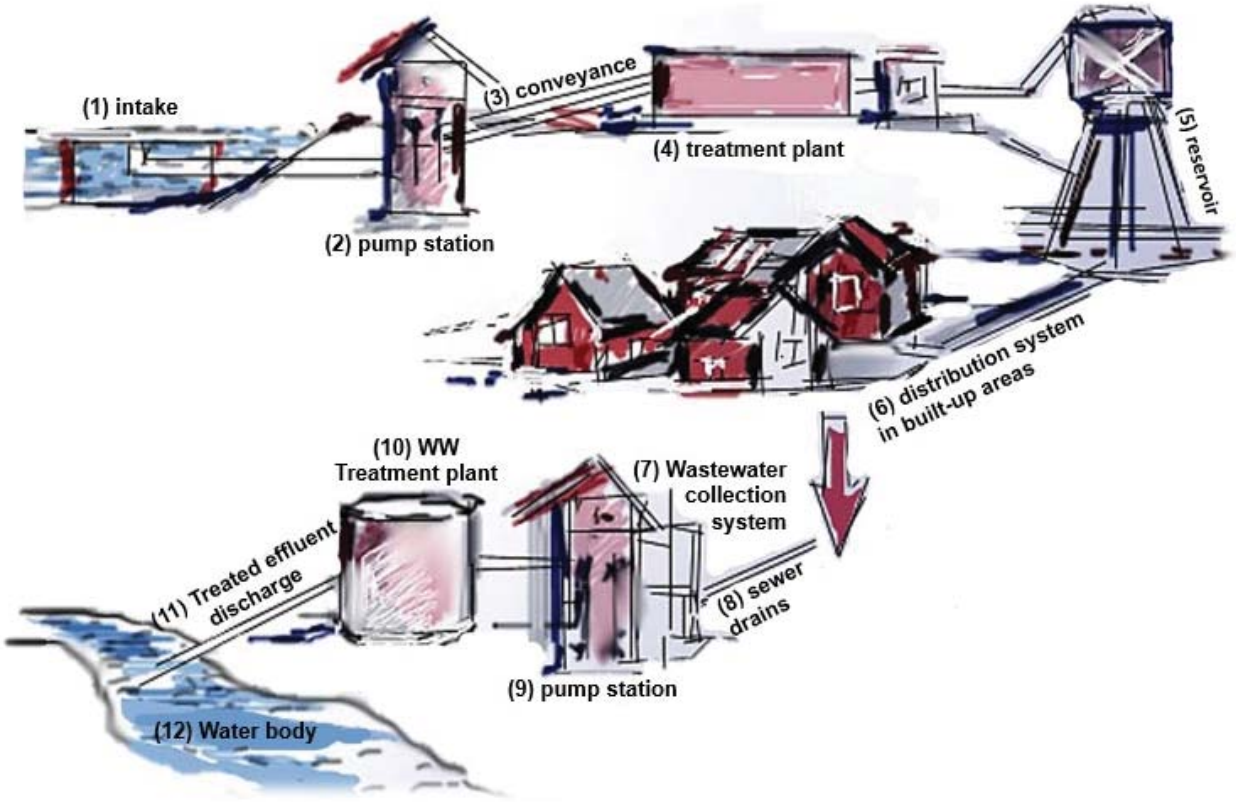

Figure 3: Schematic urban water distribution network

2.3. Towards SuDS South Africa

2.3.1. The South African Guidelines for Sustainable Drainage Systems

In 2013, South Africa's Water Research Commission published "The South African Guidelines for Sustainable Drainage Systems" which emanated from a project entitled "Alternative technologies for stormwater management" (WRC Project No. K5/1826) (Armitage et al., 2013:ii). The guideline focuses primarily on the Australian concept of SuDS as a stormwater management solution in South Africa's urban areas and the effect of urbanisation on both stormwater quality and quantity (Rohr, 2019:88).

The SuDS guideline provides detailed information on calculations and technical illustrations on twelve families of SuDS options designed to maintain pre-development conditions. These include Bio-retention areas; Detention ponds; Filter strips; Green roofs; Infiltration trenches; Multi-purpose detention ponds; Permeable paving; Rainwater harvesting; Retention ponds; Wetlands and Soakaways (Armitage et al.,

2013:22-57). The SuDS Guideline suggests that SuDS function best when implemented in a series of treatment trains starting with good housing keeping, followed by source controls, local controls, regional controls and finally discharging treated stormwater back to receiving

- **Source Controls** – SuDS selection for source control treatment includes green roofs; rainwater harvesting; soakaways, and permeable pavements. These SuDS source controls treat stormwater as close to its source as possible, decreasing both stormwater runoff rate and volume, gradually discharging stormwater to the surrounding soils, and facilitating relatively high rates of groundwater recharge (Armitage et al., (2014:5).
    - Rainwater harvesting systems can be installed on almost all roofs and impervious surfaces, including parking bays. It is most effective on corrugated iron, pitched roofs typically associated with modern buildings. Similar to rainwater harvesting, stormwater harvesting refers to the collection and storage of runoff from large impermeable surfaces in underground storage tanks. With limited treatment, harvested rainwater and stormwater can be used for non-potable purposes such as gardening and toilet flushing.
    - Green roofs and walls are typically associated with the goal to reduce the rate and volume of stormwater runoff as it interacts with a vegetated roof or wall. Green roofs are most effective on large roof surfaces, typically associated with industrial, commercial, and business buildings, and blocks of flats. Green roofs can be constructed on flat and gently sloped (between 0 and 20°) roofs and weigh more or less between 40 and 60 kg/m².
    - Soakaways operate on a small scale, typically within a space not bigger than 1000 m². Multiple soakaways can be linked to drain larger areas such as parking lots and motor highways as large as 100 000 m². Soakaways do not function well when constructed on steep slopes and in loose or unstable areas. Sub-drain piping systems must be utilised when soakaways are implemented in very fine silt and clay stratum because of the low infiltration rates. They should be constructed at least 1.5 m above the groundwater table to prevent groundwater contamination.

- Permeable pavements are most suitable for installation areas such as residential driveways, parking bays, private roads, public service roads, fire engine lanes, industrial storage and loading areas, bike pathways, walkways, terraces, and around swimming pools. However, the implementation of permeable pavements is generally limited to sites with slopes of less than 5% and is normally not suitable for high traffic volumes and speeds greater than about 50 km/hr, or for usage by heavy vehicles and/or high point loads.

- **Local Control** – If stormwater cannot be handled on-site, the next link in the management train is local SuDS controls that attempt to manage all the stormwater generated in a local area (Armitage et al., 2013:5). Where stormwater is to be conveyed from one place to another, natural channels should be used instead of pipes and concrete-lined canals, which speed up the flow and provide little water quality benefits. SuDS selection for local control treatment includes filtered strips, swales, infiltration trenches, bio-retention areas, and sand filters. In selecting SuDS local controls, the following should be considered as it applies to land characteristics and land use management (Ibid.: 22-34):

    - Infiltration trenches and bio-retention areas both decrease the frequency and extent of flooding due to their ability to increase stormwater infiltration and groundwater recharge (Ibid., 2013:40). They are also very effective in removing suspended particulates from stormwater. Infiltration trenches have relatively narrow cross-sections, which makes them suitable in urban areas or adjacent to impervious areas such as roads, footpaths and parking lots. (Ibid., 2013:42).

    - Filtered strips and swales are both vegetated or grass-lined areas of land. Swales, however, have a distinctive flat and sloped side and have a larger storage capacity than filtered strips (Ibid.:35-40). Nevertheless, both reduce high runoff volumes and peak stormwater flows. Filtered strips are commonly used along stream banks as vegetated buffer systems, and also downstream from agricultural land to intercept and infiltrate stormwater runoff. Filtered swales are generally suitable for road medians, road curbs in low-density residential areas, verges, car parking runoff areas, parks and

recreational environments (Ibid., 2013:37-38). They can also be effectively used in low-density development and in public open spaces, and normally serve areas smaller than 20 000 m² (Ibid.: 35-36). As a rule of thumb, the initial sizing of the specified filter strip should allow for an infiltration area approximately twice that of the contributing impervious stormwater runoff surface or be at least as long and wide (Ibid.). Sand filters are the most effective SuDS for water quality improvement and can be installed in conjunction with land uses with impervious areas of less than 8 000 m^2 (Armitage et al., 2013:45). Sand filters are most commonly used in arid regions with high evaporation rates, limited rainfall, and where there is a significant requirement to protect groundwater resources (Ibid.:46).

- **Regional Controls** – Regional SuDS controls represent the last line of defence for the management of stormwater before it is discharged to the receiving waters (Armitage et al., 2013:5). SuDS selection for regional control treatment includes detention ponds, retention ponds, and constructed wetlands. These SuDS require large areas of land and engineered structures that regulate the intake and discharge of stormwater. In selecting SuDS for regional controls, the following should be considered as it applies to land characteristics and land use management (Ibid.:22-34).
    - Detention ponds are temporary storage facilities that are ordinarily dry but are designed in such a manner that they can store stormwater runoff for short periods (Ibid.:49). Detention ponds can be integrated into sports facilities such as tennis courts and skate parks that can be flooded during a storm (Ibid.). A detention pond typically requires a surface area of at least 2% of its contribution impervious area (Ibid.:50).
    - Retention ponds have a permanent pool of water and provide a medium to high pollutant removal capacity, making water in a retention pond reusable for irrigation and secondary domestic purposes where the water quality is acceptable (Armitage et al., 2013:52).
    - Constructed wetlands are man-made systems designed to mimic the natural systems in areas where they would not usually be found (Armitage et al., 2013:54). They are most often to be found in flat areas, serving catchments

larger than 10 ha, and are particularly useful in attenuating stormwater flood peaks and 'polishing' the runoff from residential areas. Constructed wetlands can also be used to harvest rainwater, and to function as an alternative treatment solution for wastewater. If constructed to treat wastewater, the size of the constructed wetland should be approximately 3 to 6 m² per person. It can also take up to two years to reach maximum treatment efficiency.

Figure 4: Example of constructed wetlands

2.3.2. Water Sensitive Urban Design for South Africa: Framework and Guidelines

Following the 2013 SuSD Guideline publication, the WRC published another document entitled "Water Sensitive Urban Design for South Africa: Framework and Guidelines" in September 2014 (Armitage et al., 2014). The publication emanated from a project entitled Water Sensitive Urban Design (WSUD) for improving water resource protection/conservation and reuse in urban landscapes (WRC Project No. K5/2071).

The framework contextualises South Africa's water resource situation as follows:

- severely constrained by low rainfall…;
- limited underground aquifers…;

- relies significantly on water transfers from neighbouring countries..;
- wastewater is being generated at an alarming rate and often water treatment is compromised, leading to increased pollution of surface and groundwater…;
- deteriorating ecosystems are affecting the reliable production of food and energy, all of which are critically important for the country's social and economic development..;
- people have a general disregard for the value of water – both economic and socio-cultural..;
- fragmented "silo-management" of different aspects of the urban water cycle occurs, in part, because of the allocation of different responsibilities to different municipal departments..;
- it will be difficult for the government to implement "green" projects when basic services do not exist unless these are accomplished simultaneously" (Ibid.:2).

Given these realities, Armitage et al. (2014) proposed a new take on Brown et al. (2008) transition framework to a Water Sensitive City. Armitage et al. (2014:19) identified the need to change the internationally accepted term "Water Sensitive City" to "Water Sensitive Settlements" (WSS), as settlements are broadly understood as comprising a concentration of people within a specific area (non-urban but densely populated rural settlement areas) serviced by some form of public infrastructure (Ibid.). Considering South Africa's history and unique settlement types, the framework suggested that South Africa should adopt a context-specific roadmap towards WSS as illustrated in the figure below:

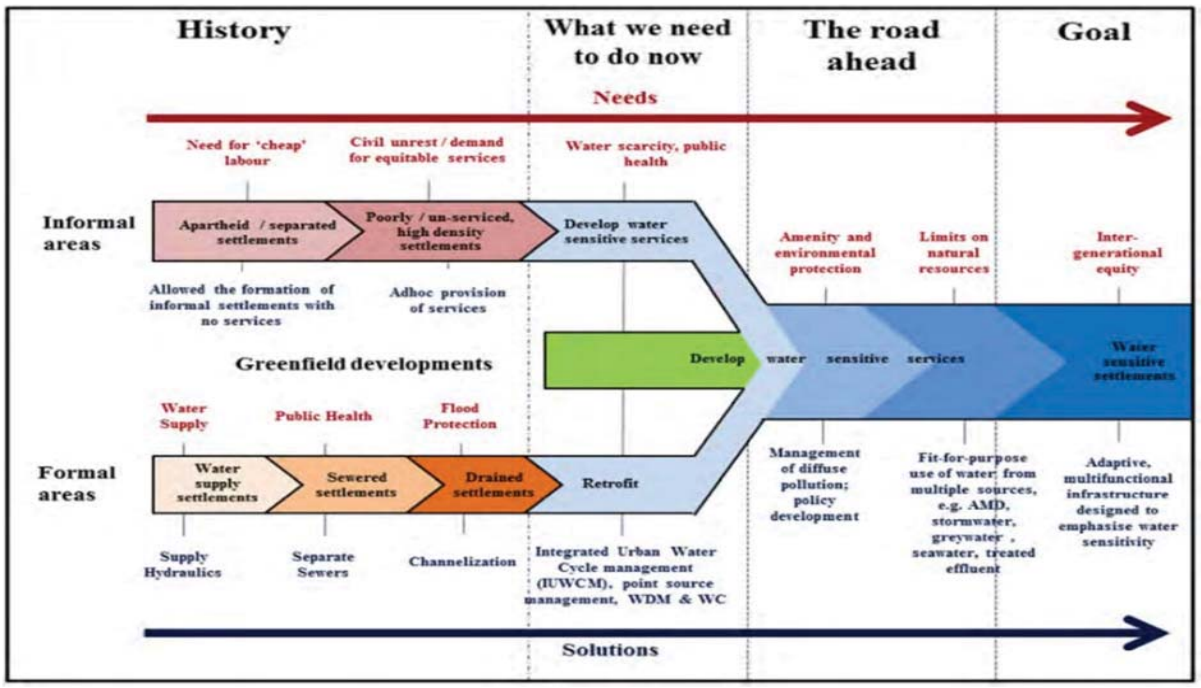

Figure 5: South Africa's roadmap towards WSS
Source: Armitage et al. (2014:25)

South Africa's roadmap towards WSS identified formal areas as drained settlements, and informal areas as poorly/un-serviced high-density settlements. In achieving the ultimate goal of WSS, the framework suggests that formal areas will have to retrofit existing infrastructure and focus on Integrated Urban Water Cycle Management, point source management, water demand management, and water conservation. A leapfrog approach towards water sensitive services (alternative solutions) is suggested in poorly/un-serviced informal settlements.

The framework highlights that in achieving WSS three components must be considered in an integrated manner, that is:

- Water Sensitive Urban Design (WSUD) – WSUD brings the concepts of 'water sensitivity' and 'urban design' together, ensuring that 'urban design' is undertaken in a 'water sensitive' manner.
- Water Sensitive Urban Planning (WSUP) – deals with urban planning and governance aspects. In the context of current water and environmental crises, water planning needs to be undertaken at the highest level. The term WSUP brings together two components: 'Water Sensitive' and 'Urban Planning', ensuring that

'Urban Planning' is undertaken in a manner that considers and treats water sensitively.

- Sensitive Urban Management (WSUM) – deals with the post-construction management of infrastructure. WSUM is the management of specific infrastructure supporting the three streams of the urban water cycle in a manner that is sensitive to the ecosystem and the needs of affected individuals (Ibid, 2014:19-20).

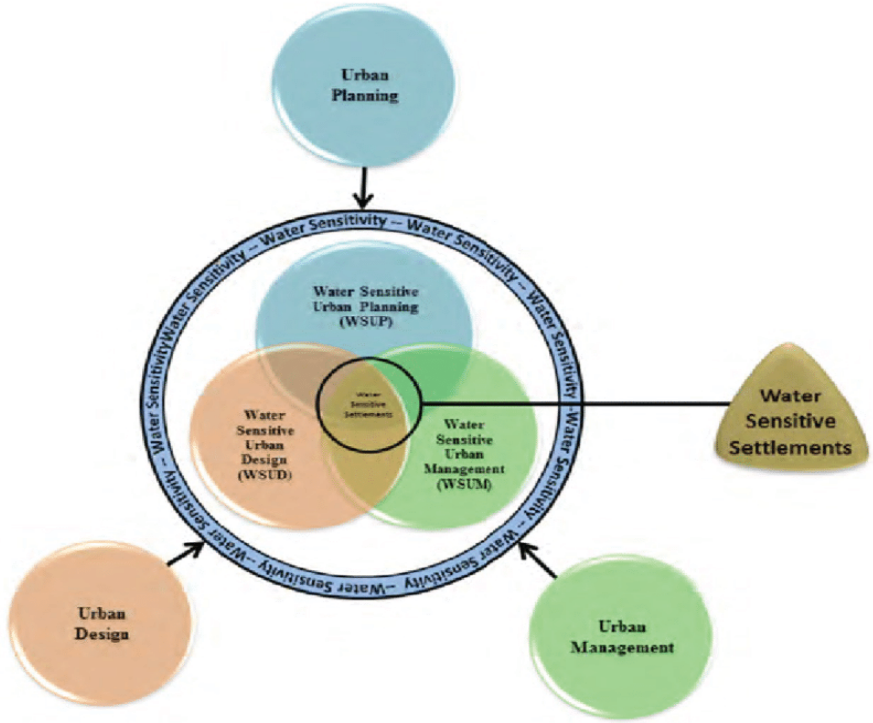

Figure 6: The integration of WSUD, WSUP and WSUM towards WSS
Source: Armitage et al. (2014:19)

In summary of the Water Sensitive Urban Design for South Africa: Framework and Guidelines, Armitage et al. (2014) make the following recommendations for achieving WSS through WSUD:

- From a stormwater management perspective, settlements should take a SuDS approach, which incorporates elements such as the enhancement of amenities and biodiversity, and flood mitigation;
- From a sanitation perspective, wastewater should be minimized, and settlements should improve effluent quality and more readily use treated wastewater/recycled water for non-potable reuses;

- From a groundwater management perspective, settlements should investigate the potential for artificial recharge and utilise groundwater if feasible, and lastly;
- From a water supply perspective, settlements should have strict water conservation and water demand management (WCWDM) policies in place, reduce their volume of NRW, and include alternative water sources, e.g. rainwater/stormwater harvesting as a water supply source.

Addressing WSUP and WSUM in the Water Sensitive Urban Design for South Africa: Framework and Guidelines was beyond the scope of work. However, according to Armitage et al. (2014:41) "there is unrealised potential for more extensive co-ordination – which could be facilitated by urban and strategic planning fora".

In addressing WSUP (the second component of achieving WSS), the WRC awarded funding in 2016 towards a three-year research project entitled "Securing water sustainability through innovative spatial planning and land use management tools: A case study of two local municipalities in South Africa" (WRC Project No. K5/2587). The study led to the publication of two key reports including:

- Framework towards water-sensitive spatial planning and land use management (WRC report no. TT 809/1/19).
- Guidelines for compiling water-sensitive spatial plans (WRC Report no. TT 809/2/19)

2.3.3. Framework Towards Water-sensitive Spatial Planning and Land Use Management

WRC Project No. K5/2587 empirical investigation was designed upon the hypothesis that every land use activity and land use decisions (where the activity takes place) have both a quantity (consumption) and quality (pollution and destruction of ecological resource) impact on water resources and its broader environment.

Fourie et al. (2019a) place emphasis on the disconnection between land use and water resource planning by stating that "despite this close relationship, urban and regional (people and land) and environmental resource management (water and the broader

environment) are typically governed by different sector departments, often to the detriment of sustainable development."

The research team conducted a comprehensive review of South Africa's extensive suite of legislations, policies and plans adopted between 1994 and 2019 which aim to give effect to land, water and environmental reform. Through this review, the Framework Towards Water-sensitive Spatial Planning and Land Use Management established a legal case for sustainable land, water and environmental resource planning and management amongst the various spheres of the local, provincial and national government.

Based on the review, the Framework identified opportunities within the Spatial Planning and Land Use Management Act No 16 of 2013 through which municipalities could and should give effect to Water Sensitive Spatial Planning.

SPLUMA is South Africa's only framework act that regulates and guides spatial planning and land use management for the entire country. The primary motivation for the enactment of this 'new' planning law was based on the need for a new planning regime – one that replaces the apartheid-era laws with a coherent legislative system designed to spatially transform the country in its democratic era. Such transformation should address spatial justice, spatial sustainability, efficiency, spatial resilience, and good administration, all of which should take place within the proposed Water Sensitive Settlements framework.

The Framework Towards Water Sensitive Spatial Planning attempts to address water sensitivity on a Municipal Planning scale using two key spatial planning and land use management instruments/tools – the Municipal Spatial Development Framework and the Municipal Land Use Scheme as mandated by Act No. 16 of Act 2013. These two planning tools were deliberately selected as the land use and spatial planning decisions and regulations implemented on this spatial scale will have a direct impact on both water quantity and quality.

The Municipal Land Use Scheme as a planning instrument for Water-Sensitive Planning

A land use scheme is a planning tool that allows or restricts certain types of land use to certain geographic areas. The SPLUMA declares that a municipal land use scheme

adopted in terms of Section 24 of Act 16 of 2013 has the force of law and all landowners and users of land, including a municipality, a state-owned enterprise and organs of state within the municipal area are bound by the provision of such land use scheme.

Section 24 of SPLUMA specifies that a municipality must adopt and approve a single LUS for its entire municipal area within five years from the commencement of the Act. The land use scheme must consist of regulations setting out the procedures and conditions relating to the use and development of land in any zone, a zoning map, and a register of all amendments to such a land use scheme.

Unlike other spatial plans, the LUS is a legal instrument that grants developmental rights on each registered land parcel or erf. It gives effect to an SDF by granting development controls associated with the SDF initiatives. An LUS records permissible use zones and provides other standards and procedures that can be employed in case of a land use under a permissible use zone is to be amended. Thus, any amendment to the use of a property or an erf must be consistent with an SDF and a land development application must be submitted to a municipality for approval so that land use changes and developmental rights granted are registered for accountability and to assess the performance and effectiveness of proposed SDF strategies (Fourie et al., 2019a:84).

The Municipal Spatial Development Framework as a planning instrument for Water-Sensitive Planning

An SDF is the principal strategic planning instrument that guides and informs all planning and development, and all decisions concerning planning, management and development within the municipality across all sectors of government. The SDF aims to provide an overview of the future spatial form of the municipality. It is the primary tool that is used to decide if a change in land use rights (through the amendment of the LUS) should be allowed.

The Municipal Spatial Development Framework is a strategic planning policy instrument which needs to guide future planning and development decisions spatially, across all sectors of government. The SDF addresses:

- **Who –** are we planning for: Population growth estimates; demand for housing units; estimates of economic activity and employment trends, and environmental pressures and opportunities.
- **When –** representation of a 5-year spatial development pattern; 10 to 20 years spatial growth pattern; and structuring and restructuring elements.
- **Where –** spatial form nodes, corridors, spines, etc. provide location requirements of engineering infrastructure capital expenditure framework, depicted spatially.

SPLUMA calls for spatial proposals that align with capital budgets and identify priority intervention areas and associated land development programmes. While an SDF indicates acceptable land uses or the intensity of land uses in some geographical regions, land use rights are managed through an LUS. Section 21 of SPLUMA provides an outline of what a municipal SDF should contain.

Fourie et al. (2018) established a framework for Water Sensitive Spatial Planning and Land Use Management at the municipal scale. To give effect to SPLUMA, and to achieve water sensitivity within the broader municipal planning environment, the Authors adopted a new term Water-sensitive Spatial Planning (WSSP), replacing water-sensitive urban planning (WSUP) as it relates to the entire municipal area (built-up and natural environments), instead of just the urban environment.

To make this framework feasible within South Africa's existing framework for spatial planning and land use management, and not to invent the wheel – the framework methodology adopted the Department of Rural Development and Land Reforms procedural steps required in the process of preparing a municipal SDF (RDLR, 2014:72) and LUS (RDLR, 2017:35)

The Framework makes approximately 30 recommendations on how to give effect to WSSP – simply by establishing a Water Sensitive Outcome in each phase. The Framework is supported by a technical guideline document called the "Guideline on compiling water sensitive spatial plans" Fourie et al. (2019b). The recommendations made by the framework and the technical guideline document should be used to inform land development applications within the Gauteng Province specifically the land development process associated with MEGA Human Settlement developments.

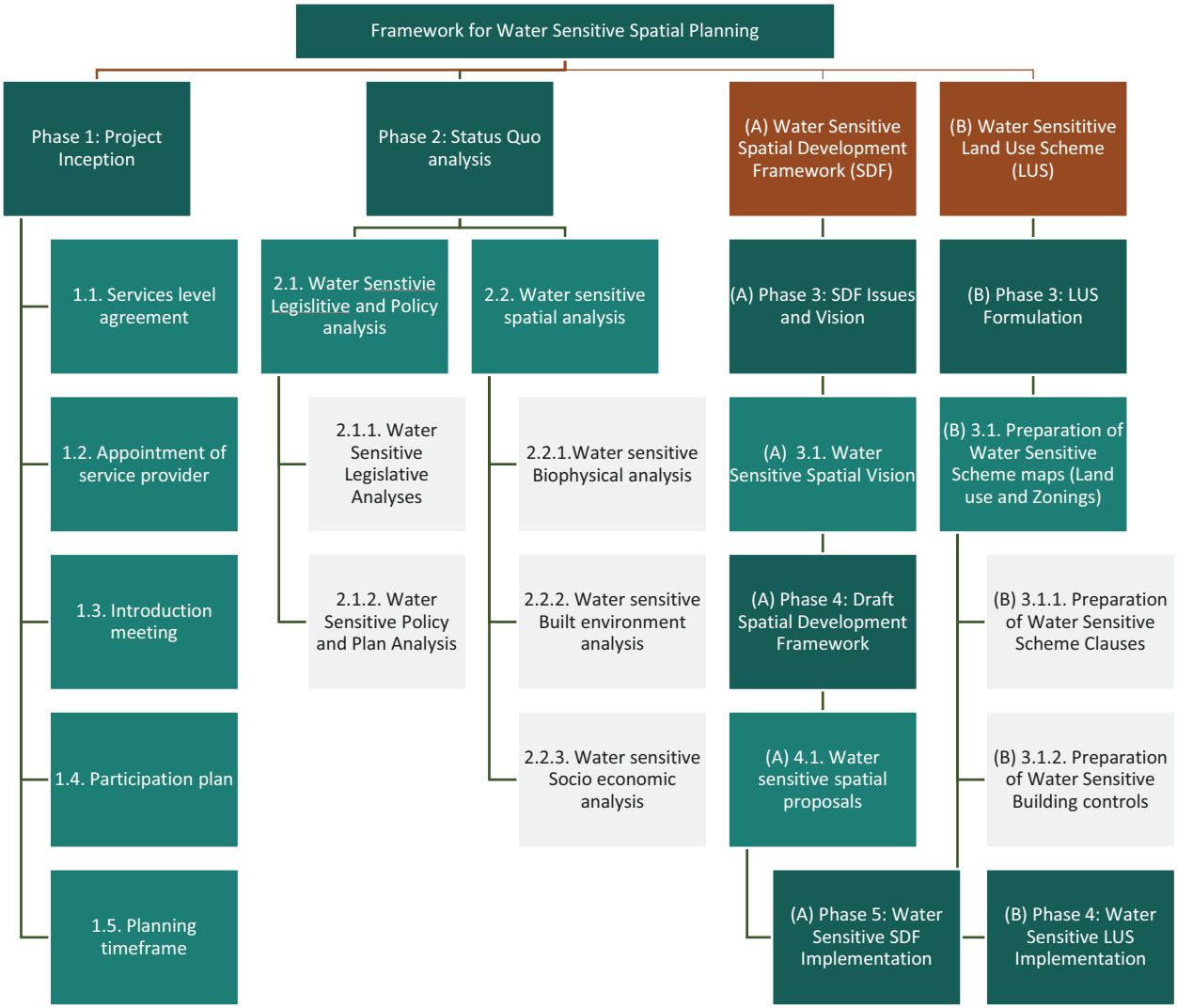

Figure 7: Framework towards Water Sensitive Spatial Planning
Source: Fourie et al. (2019)

2.3.4. Guideline on compiling water sensitive spatial plans

Phase 1 – Inception phase

The water sensitive objective set for the inception phase is for Municipalities to amend the requirements associated with the project team to include not only a Professionally Registered Town Planner but also amongst others a GIS specialist, Civil engineer/Stormwater engineer/Hydrologist, Urban Designer/Urban Ecologist or Environmentalist-Environmental sensitive inputs/Landscape architect and a Building Officer.

The introductory meeting serves as a platform for the Service Provider to request additional water-related information (e.g. WSDP; Infrastructure Master Plan; Infrastructure Asset Management Plan; Provincial Water and Sanitation Master Plan; CMS and WRS, by-laws related to stormwater management and water and sanitation; and any applicable Flood line or Geotech studies to ensure spatial alignment of various sector plans. The WSSP framework recommends that the steering committee includes a representative of the Water Services Providers and the Department of Water and Sanitation as well as other water sector professionals to ensure that other sectors are presented with the proposals as well as have time to provide input into the process.

Phase 2 – Status Quo

The Status Quo phase was informed by two key assessments including the Water Sensitive Legislative and Policy analysis and the Water Sensitive Spatial Analysis. Water Sensitive Legislative and Policy analysis objective is to establish a baseline legal and institutional framework for the planning and management of land, water and environmental resources. The water sensitive outcome of this phase would be that the service provider displays comprehensive knowledge of all relevant legislation. The service provider should also be able to address targets and key spatial development directives affecting land, water and environmental resource planning and management as contained in the respective regulatory and strategic planning documents.

The Guideline for Water sensitive spatial planning provides three templates, designed to guide planners in asking the right “water sensitive” questions. This includes a

Stakeholder Questionnaire Template, Water Sensitive Legislative Assessment Template, and A Water Sensitive Policy Analysis Template.

- The **Water Sensitive Spatial Analysis** consists of three main themes of investigation – typically known as the biophysical, built and socio-economic assessments. The guideline for Water Sensitive Planning provides step-by-step instructions on how to conduct each assessment:
- The **Water Sensitive Biophysical Analysis** main objective is to limit the expansion of the built footprint onto areas of ecological importance (freshwater and groundwater resources) expand ecological infrastructure and restore ecological functionality. The analysis investigates three sub-themes including: Physical and underlining structuring elements; Macro scale water quality and quantity assessment; and, Protected areas and areas with management requirements.
- The **Water Sensitive Built Environment Analysis's** main objective is to build an understanding of historical and current development trends and to determine the urban scale land use water quantity and quality interaction. The analysis investigates three sub-themes including: Land use water quantity impact; Land use water quality impact; and the form and density of settlements.
- The **Socio-economic Analysis's** main objective is to determine the current and future socio-economic demand for water in order to identify opportunities for change. The analysis investigates three sub-themes including: services assessment of potable water and Sanitation services and Future Water Demand.

Phase 3(a) – Water Sensitive Spatial Development Framework

This phase incorporates the finding of the various assessments/analyses into the SDF Spatial Vision Statement, Spatial Development Principles and Spatial Proposals. The spatial proposals for the municipality's next 5, 10 and 20 years are therefore based on water sensitivity development objectives that will, in future, mitigate water scarcity and improve water quality. The following strategies are typically found in SDF and should be utilized to improve both water quality and secure water quantity:

- ***Growth Management Strategy*** – by limiting the extent of development beyond settlement boundaries, reducing the need for extensive distribution pipelines,

ultimately reducing the volume of UARL, and the demand for water resources; by limiting the extent of development beyond settlement boundaries, protecting the broader environment and its ecological infrastructure necessary for the replenishment of polluted water resources; directing development away from areas of ecological importance including rivers, wetlands, high groundwater recharge zones, etc.

- ***Densification Strategy*** – by directing all future development towards more sustainable locations (existing node with potential to increase its carrying capacity/density) where infrastructure investment will focus on upgrades and maintenance rather than expansion of infrastructure;
- ***Spatial Targeting –*** re-evaluating the level of services provided in certain areas and settlements based on the availability of water resources and affordability of services. Through spatial targeting, a Water Sensitive SDF should make recommendations for the use of alternative infrastructure (off-grid) in areas where the service's backlog is high and in other areas where such solutions are feasible.

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- **Growth Management Strategy** – by limiting the extent of development beyond settlement boundaries, reducing the need for extensive distribution pipelines, ultimately reducing the volume of UARL, and the demand for water resources; by limiting the extent of development beyond settlement boundaries, protecting the broader environment and its ecological infrastructure necessary for the replenishment of polluted water resources; directing development away from areas of ecological importance including rivers, wetlands, high groundwater recharge zones, etc.
- **Densification Strategy –** by directing all future development towards more sustainable locations (existing node with potential to increase its carrying

capacity/density) where infrastructure investment will focus on upgrades and maintenance rather than expansion of infrastructure;

- **Spatial Targeting** – re-evaluating the level of services provided in certain areas and settlements based on the availability of water resources and affordability of services. Through spatial targeting, a Water Sensitive SDF should make recommendations for the use of alternative infrastructure (off-grid) in areas where the service's backlog is high and in other areas where such solutions are feasible;
- **Localised Spatial plans/precinct plans** – on a larger municipal scale, local water systems should be protected and rehabilitated to create blue-green corridors or integrated open space systems designed to create localised water catchments. These water resources could be utilised for local uses and re-used which reduces the demand for municipal treated water; implement spatial strategies to reduce water demand in certain zones; by developing detailed spatial proposals for SuDS in areas where runoff is highly polluted by land uses. The layout and design of neighbourhoods must incorporate existing water systems and provide sufficient space for green infrastructure such as constructed wetlands and retention ponds which could be utilised for non-potable water uses and enhance water quality.

In addition to the strategies and spatial proposals the SDF must also be informed by an implementation plan which identifies projects for the next 5-year cycle which could include:

- Launch water audits in areas where irregular high-water demand is a concern and where billing data is lacking;
- Implement a stormwater modelling study in areas identified to have high levels of land use water quality threat ratings; Implement feasibility studies for the potential for alternative services in settlements experiencing a high backlog in services;
- Development of a Water Sensitive Urban Design Plan for areas with high economic investment potential Implement a strategy to update the status of all Pas, CBAs, ESAs, and FEPAs affected by the development and priorities for rehabilitation of such areas.

Phase 3(b) – Water Sensitive Land Use Scheme

This phase incorporates the finding of the various assessments/analyses into the Land Use scheme Clauses and establishes building controls. From a water sensitivity perspective, additional areas may require additional protection, overlay zones can be established for areas requiring immediate intervention or for areas of future concern where development should be prohibited or limited. Overlay zones can also contribute to reducing water quantity demand and improving water quality outcomes in certain areas.

Environmental Management overlay zones:

- Immediate Intervention Zone
- Modified CBA's, ESA's, and FEPA's
- Priority FEPA Rehabilitation Zone
- Areas of future concern
- Expansion of protected areas management overlay zone
- Surface water protection and conservation management overlay zone
- High Groundwater Quality Impact Zone or Groundwater Quality
- Improvement Zone
- Groundwater protections and conservation management overlay zone
- Borehole Protection Zone

Settlement intervention overlay zones

- WCWDM zone
- Water Quality Intervention Zone
- Blue-green corridor zone
- High Density Development Zone

Services interventions overlay zones

- Household Services Intervention Zone
- Off-grid development zone

The Framework for Water Sensitive Spatial Planning noted that "at the time of writing no national standard for water efficiency in buildings could be found". The Land Use Scheme should therefore be used to bridge this gap until such a time as water efficiency is similarly dealt with. This would imply that a specific chapter (or clause) be added to the land use scheme, specifically to deal with water efficiency in buildings.

Proposals for water sensitive building controls and/or development controls are as follow:

Building Controls can be used to reduce the land use water quantity impact:

- Water-efficient domestic plumbing
- Domestic and commercial irrigation
- Private and public swimming pools
- Rainwater/stormwater harvesting tanks
- Onsite water re-use technologies

Development Controls to reduce the land use water quality impact:

- Increased or reduced coverage
- Increasing permeability

While the Guidelines for Water Sensitive Spatial Planning is comprehensive given the scope – it lacks information on how land development and planning practices can give effect to water sensitivity. This happens at a much more detailed spatial scale. To address this gap, the Gauteng Department of Rural Development and Land Reform set out to publish an Implementation Manual for SuDS. This manual is intended to target decision-makers in municipalities, especially those involved in guiding and regulating development, particularly stormwater planning and implementation in the Province. It is also considered a useful guide for Environmental Assessment Practitioners (EAPs) and other specialties as well as developers and their project teams.

2.4. Towards SuDS Gauteng

2.4.1. Gauteng Sustainable Drainage Systems Implementation Manual

The Gauteng Department of Rural Development and Land Reform (GDARD) is mandated to develop strategies for environmental management, including responding to the challenges and potential impact of climate change within the Gauteng City Region (GCR).

In 2018, GDARD identified the need to conduct research on the use of Sustainable Urban Drainage Systems in Gauteng to combat the increasing effects of urbanization (i.e. increased runoff, decreased infiltration and waste management challenges of the

province's water resources). The research resulted in seven research reports, three of which add significant value and insight to this study, including:

- Report 1: A literature review on SUDS
- Report 6: Best Management Practices
- Report 7: Implementation Manual

Significance of study "Research on the use of Sustainable Drainage Systems in Gauteng Province (GT/GDARD/094/2018)" to this study:

The first report "Literature Review on SUDS" sets the scene for SUDS in Gauteng by evaluating insights that are impacting SUDS-Design. The authors acknowledge the research publications of Armitage et al. (2013) and Armitage et al. (2014) referring to it as the 'baseline' against which their literature review measures progress in research. The literature review reiterates some of the aspects covered by Armitage et al. (2013) and (2014) but narrows implementation challenges down to Gauteng specifics challenges.

The Literature Review presents an insightful review of South Africa's legal framework in as far as relevant planning legislation and policy frameworks and guidelines, on a national and provincial level promote the concept of SUDS implementation. The Literature Review also provides a comprehensive review of Gauteng's policies, strategies, plans and outlooks on SuDS implementation – in conclusion, to which it states that "the most powerful tool for SuDS implementation currently available in Gauteng at the Provincial level seems to be the Gauteng Province Environment Management Framework, promoting SuDS through its EIA processes (GPG, 2020a:47).

The Literature Review provides insight into Gauteng's Local Government perspective of SuDS and identifies within each municipality existing Municipal policies, by-laws and guidelines that seek to give effect to SuDS implementation. It comes as no surprise that where stormwater by-law exists, they predate the SuDS approach and remain unhelpful in the drive to adopt a more sustainable approach to handling stormwater as a resource (GPG, 2020a:57).

Report 6, Best Management Practices carries significant importance to this study as it defines the roles and responsibilities of the various disciplines including Urban

Planners, Urban Designers, Stormwater Design Engineers/hydrologists and Ecological advisors within the land development process, in particular, WULA and EIA processes.

The Best Management Practices report focuses specifically on the integration of SUDS within the Project Development Process. It also reiterates the importance of Water Sensitive Design and Planning at Municipal level by means of two municipal planning instruments the Municipal Spatial Development and the Municipal land use scheme as suggested by Fourie et al. (2019a & 2019b).

The report defines urban planners as forward thinkers and land use decision makers "advising and acting on land use and development rights and other land designations and cadastral issues to support the long-term management of SuDS" (GPG, 2020b:8). The report reiterates one of Fourie et al. (2019a) key findings that is "town and regional planners generally do not have the skill set to address matters relating to water sensitivity… point to the need for a multidisciplinary team to support the preparation of the municipal WSSDF and WSLUS".

The Best Management Practices recommend that the Stormwater Designer engineer/hydrologist "should already be part of the **development processes when the land use plan is determined,** so that sufficient space, at strategic locations, can be reserved for SuDS and the stormwater designer co-designs with the other experts the development" (GPG, 2020b:15). The Best Management Practices report concludes with high-level recommendations that will allow for interconnectivity between specialists (GPG, 2020b:31-33).

- ***Urban Planner* –** should provide inputs into Catchment Scale Planning and Catchment Management Plans; Opportunities for SUDS should be considered early on in any development process, especially for larger greenfield development (i.e. Gauteng MEGA Human Settlements).
- ***Urban Designers* –** must consider the opportunities for SUDS early in the development process. Urban designers can add value to the initial design processes by analyzing the local area and identifying the existing spatial conditions, its challenges and the opportunities related to water sensitive design. This analysis should then feed into an integrated design process with the engineers (and environmental specialists).

- ***Stormwater Design Engineer/Hydrologist*** – will essentially determine the hydrological, hydraulic and water quality performance of the treatment train. His/her design inputs should be included early in the Land Use Plan/Layout Design or Site Development Plan.
- ***Ecologist –*** should advise the design team on how to rethink the use of open spaces, actively encouraging reasonable levels of use and seeking to integrate human use and environmental conservation by creating open spaces that are multifunctional and satisfy a range of objectives.
- ***Stakeholder Engagement Specialist –*** facilitate the adoption of the SuDS scheme by the community and developing a sense of "ownership".

Report 7, Implementation Manual is a non-technical guideline for designing SuDS. Yet, it should be seen as a baseline reference for action to implement SuDS across the province. It provides an interesting discussion on "the sticks" and "the carrots", related to the implementation of SuDS in the Gauteng Province:

- ***The "sticks"*** – Municipal legislation that sets requirements for SuDS in all stormwater permits is identified as the primary vehicle for enforcement. Environmental Impact Assessment (EIA) and Water Use License Application (WULA) processes can also help in enforcing SuDS. It is however critical that water sensitive spatial planning becomes embedded in the broader municipal planning regime – so that developers will have a clearer framework for stormwater management before they start planning their site. The Implementation Manual recommends that permitting processes (i.e. stormwater management plan, EIA and WULA) are adapted to make provision for the issue of an "Agreement Principle" at the concept design stage for SuDS drainage systems where system performance targets are set but the details will continue to be refined through iterative interaction with the multi-disciplinary team as the detailed design develops (GPG, 2020c:9-10). SuDS should form part of municipal asset registers. Town planning instruments such as conditions of establishment and stormwater servitudes are examples that may assist, but this needs to be taken up at the municipal level.

- ***The "Carrots"*** – Typically referred to as incentives, a way to stimulate the attractiveness of SuDS for developers. However, municipalities will need to

implement incentive policies equally across their entire geographic areas – which is in most municipalities not likely to happen due to spatial inequality.

The Implementation Manual confirms that the current oversight role of government focuses on the establishment stages of land development (e.g. spatial planning and development approvals). Chapter 9 of the implementation manual for SuDS in Gauteng provides a detailed discussion on “Implementing SuDS through the planning and land development Processes. This chapter forms an integral part of this study and will form part of the key takeaway discussions to follow. Chapter 9, of the Implementation Manual provides insights into how and when SuDS should be integrated into the planning and land development processes. The figure to the right outlines the planning and land development stages typically found in Gauteng and other provinces.

It is evident that the Catchment Management Plan should first be considered, although it has no legal status, it is the ideal planning instrument to set the objectives of SuDS at a regional scale. The SuDS objectives as set out by the CMP should then be municipal spatial plans – this planning phase requires forward thinking and should provide a baseline for land use that should include space for stormwater management. Two planning instruments are proposed at this stage which includes the Municipal SDF and Land Use Scheme – see Fourie et al. (2019a and b) for more detail.

Moving towards the land development process, the focus shifts to site scale. The CMP, WSSDF and WSLUS should impose water sensitive development directives at an early site concept design stage allowing for enough time to set detailed SuDS performance objectives. Overall stormwater performance (particularly stormwater quantity and quality) would be set at a concept design stage and presented for authority approval – ideally, this would lead to an ‘Agreement in Principle’. The details of the treatment trains, network layout and integration with ecological and amenity functions would then be refined in the detailed design stages. This is often an iterative process with input from a range of specialists.

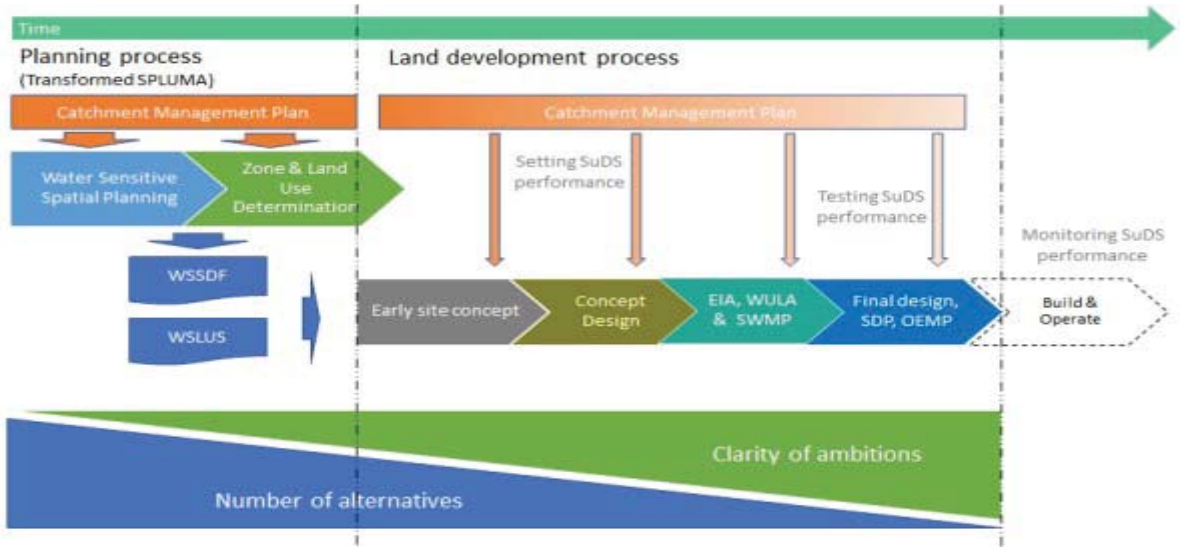


Figure 8: Planning and land development process in case of water sensitive planning
Source: GPG (2020C:48)

2.5. Conclusion

It is evident that South Africa has invested in Research and Development of Water Sensitive Urban Design Practices. Yet, implementation still seems to be lacking from private developers. The GDARD also noted that Government officials and or decision-makers are often unaware of the benefits of WSUD. It should be made clear that water sensitive design and planning do not aim to reinvent the wheel, but rather adjust to address specific challenges within the built environment. It comes down to asking the right water-related questions as early as possible in the development stage of a project.

Chapter 3 – Gauteng Ongoing Challenges

3.1. Introduction

This section presents an introduction to the Gauteng Province and places emphasis on specific issues and challenges regarding housing need and Provincial water security. This chapter sets the scene for the research question “How can Gauteng MEGA Human Settlements incorporate Water Sensitive Design and Planning solutions?”. Although the research is narrowed down to one specific province, the issues and challenges raised throughout this chapter are common amongst many, if not all, provinces. South Africa’s water availability is spatially skewed (in terms of areal distribution), with Gauteng province drawing the shortest straw.

3.2. Gauteng Province

Situated in the northeastern interior of the country, Gauteng is South Africa’s smallest province covering 18 178 km² of land, equivalent to only 1.5% of the country’s total land area (Stats SA, 2011). Gauteng is divided into three metropolitan municipalities (Ekurhuleni, Johannesburg and Tshwane), and two district municipalities, each divided into three local municipalities: Sedibeng District Municipality (Emfuleni, Lesedi and Midvaal) and West Rand District Municipality (Merafong, Mogale and Rand West City).

These are well-known administrative boundaries within which provincial and local government and sector departments operate. Yet, the province does not function in isolation but has strong economic, movement and functional linkages with towns and cities that fall outside the provincial boundaries, resulting in a much larger functional economic space (GSDF, 2019:48). In recent years, the Province adopted a new term – Gauteng City Regions (GCR) which expands beyond the provincial and municipal boundaries. The Gauteng City-Region Observatory defines the GCR delineation as a 175 km radius drawn from the centre of Gauteng – see Figure 7. Defining the GCR is important to this study due to the fact that almost all land uses (residential, business, industrial and mining, etc.) within the Province and the greater GCR depend primarily on the same water supply network – the Integrated Vaal River System (IVRS).

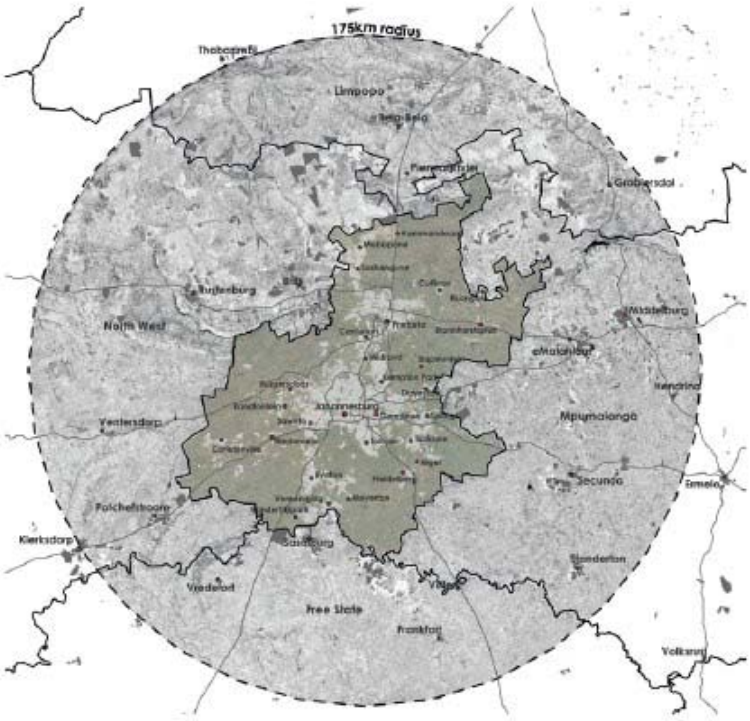


Figure 9: Gauteng City Region (GCR)
Source: GSDF 2019:51

3.2.1. Natural water resource availability within Gauteng Province

Not many people living within the Gauteng Province know that the Province is situated on top of the watershed that divides the Limpopo and Orange Rivers. This region is notably water-stressed as it has very limited natural streams and rivers and relatively low rainfall levels. The annual average rainfall in Gauteng varies between just over 700 mm on the Witwatersrand (approximately 1 700 m a. m. s. l.) and just over 600 mm north of the Magaliesberg (approximately 1 100 m a. m. s. l.) (GPEMF, 2014:18).

The rivers and streams in Gauteng represent a relatively fine maize of small seasonal fast, flowing channels that are deceptively dangerous during summer storms (Ibid, 2014:22). The Vaal River is the province's largest river. It also forms the southern boundary of the province. Other major rivers include the Klip, Blesbokspruit, Suikerbosrant, Magalies, Apies, Pienaars, Elands, Bronkhorstspruit and Wilge Rivers (GSDF, 2019:106).

Major water bodies (man-made dams) within the province (and in close proximity to Gauteng) include the Vaal Dam, Hartbeespoort Dam (North-West Province), Rietvlei

Dam, Bon Accord Dam, Roodeplaat Dam and the Bronkhorstspruit Dam (Ibid). According to the Department of Water and Sanitation (2021), Gauteng is only able to store 0.40% of the country's actual volume of water within its provincial boundaries.

The geology of Gauteng is characterised by hard rock, which means that there are some reserves of groundwater available (GCRO, 2020:10). Under natural conditions, depth to the groundwater level is estimated to occur between 1 m and 30 m below the surface. Giving the fact that mining and heavy-industrial land uses ruled the province's economy for almost a century, many artificial aquifers exist within Gauteng. However, these artificial aquifers contain significant amounts of water polluted by mining operations. It is generally agreed by experts that pollution from old mines will decline over time.

Given the limited availability of natural water resources found within Gauteng, the Province depends on supplies from a large, highly engineered system called the Integrated Vaal River System (IVRS). The IVRS is the country's largest system and in many ways the lifeblood of Gauteng's economy. The IVRS is operated by the national Department of Water and Sanitation.

3.2.2. Integrated Vaal River System

According to the DWS (2018), the average annual flow in the Vaal River at Vaal Dam is just 1900 Mm^3/annum, which is barely enough to meet Gauteng's annual needs, let alone those of the many other upstream and downstream users in the river's catchment.

Therefore, the IVRS draws water from five different river basins, linked by rivers, canals and pipelines, including the Vaal river and other linked systems (Tugela, Orange (Sequ-Lesotho), Komati, Usuthu, Crocodile West, Olifants, Mokolo) across six provinces. According to the DWS (2018) The amount of water stored in the IVRS dams is over 9300 Mm^3/a, equivalent to nearly 5 years of the average flow in the river and six times the volume used annually within Gauteng.

Many experts believe that the IVRS is somewhat resilient in nature because it covers a very large area – over 40 000 square kilometres. It is considered highly unlikely that all parts of the IVRS could be equally affected during a dry period (GCR, 2019:11).

3.2.3. Bulk water supply

Rand Water is Gauteng's largest bulk water supplier. Rand Water transports water from the Vaal Dam through a network of 3 500 km of pipes to 58 reservoirs around Gauteng to local municipalities. Municipalities then use it to provide water supply and sanitation services to residents and other land uses.

Of Rand Water's potable water supply taken from the IVRS, 36% is supplied to Johannesburg, 23% to Ekurhuleni, 17% to Tshwane and 6% to Emfuleni municipalities; 4% is supplied directly to large users and the remaining 20% to twelve smaller municipalities. Tshwane's water demand is augmented supply from Magalies Water and other smaller sources including municipal dams such as Rietvlei and groundwater in Tshwane, for example, which supplies about 30% of its water from its own sources (GCRO, 2019:12).

3.2.4. Wastewater treatment

Wastewater from municipalities and industries is treated and discharged back into the river system. This is referred to as return flows – an important source of water for downstream users. Since many of Gauteng's metropolitan municipalities' large wastewater treatment works are situated north of the watershed (including the City of Joburg's major Northern Works), the treated wastewater is discharged into the Limpopo Basin (mostly the Crocodile West-Marico catchment). This is a substantial water transfer from the Vaal to the Limpopo and ensures that flows in the Upper Crocodile, below Hartbeespoort Dam, are amongst the most reliable in the country although they are also very polluted by sewage, stormwater runoff and mining effluents.

The Gauteng Province Environmental Outlook Report (2017), reported that "large volumes of wastewater produced in the region do not always meet the statutory standards… 81% of surface water samples showing unacceptable levels of *E. Coli* pollution while dams in the northern part of the Province which are used for water supply and recreation frequently become eutrophic and suffer from algae blooms, restricting their use".

Informed decisions need to be taken about how much water is discharged into each river system. This is becoming increasingly important since wastewater reuse also has significant potential as a future source of additional water for Gauteng. Furthermore, protecting the environment and ensuring that the quality of water resources remains fit for purpose plays a significant role in securing future water resources.

According to GCRO (2019:23) “Overloading of municipal wastewater treatment works (WWTWs) is sometimes aggravated inadequate alignment between provincial housing and municipal water services planning and development, which result in large new (mostly low-cost housing) settlements being required to be serviced by municipal bulk sewers and wastewater treatment when its augmentation is not implemented yet, causing some WWTWs overflows of raw sewage”.

3.2.5. Gauteng Economy

In 2017, Gauteng generated just over a third (c 1.5 trillion) of South Africa's Gross Domestic Product. The sectors that contribute the most to the Gauteng economy are finance, real estate and business services (23.2%), general government services (17.8%) and manufacturing (13.8%). It is evident that the province’s economy is moving away from traditional heavy industry markets and low value-added production towards sophisticated high value-added production, particularly in information technology, telecoms and other high-tech industries (GDHS, 2014: 20). These tertiary sectors are less reliant on water resources and therefore use less water per R1 generated in GDP compared to primary sectors such as agriculture that utilises more water for every R1 generated in GDP. The figure below illustrates this by comparing water usage vs GDP contribution at a sectoral level.

Considering that the Gauteng Economy is expanding in the tertiary sectors such as finance, governance, transportation and IT, it is expected that an increase in water demand will be low as these sectors are not water intensive.

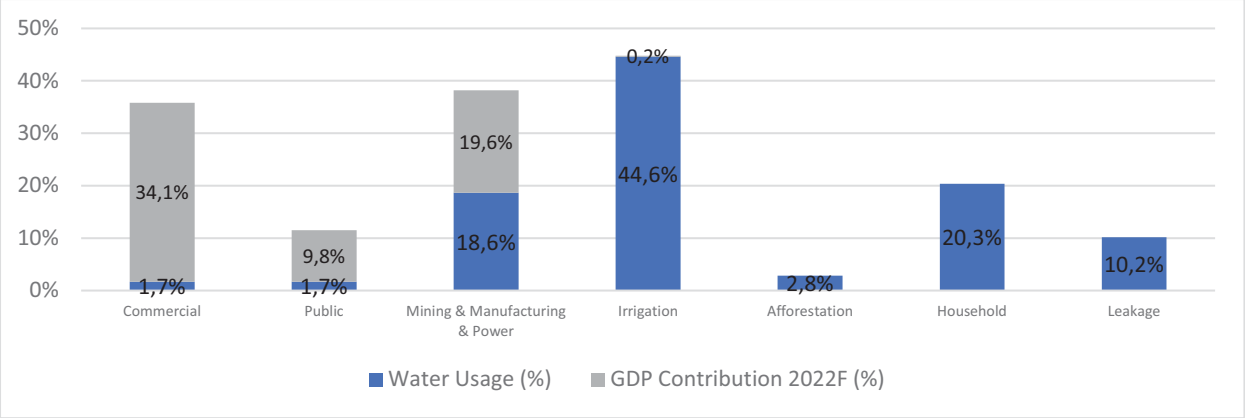


Figure 10: Water usage vs GDP contribution at a sectoral level
Source: Oxford Economics, Mckinsey.com, JLL

3.2.6. Population Growth

Due to the province's strong economy, amongst others, the province experienced extremely high levels of migration in the past years. According to STATS SA (2020), between 2016 and 2021, the province experienced the highest net migration across all provinces. An influx of approximately 460 253 new residents was recorded in 2021. The majority of them migrated from Limpopo (104 385 people), Kwa-Zulu Natal (68,001 people) and Eastern Cape (43,299 people) to Gauteng.

In addition to the net migration, the GCRO (2019:18) reports that Gauteng's population is currently growing at over 3% per year. This means that every year, water needs to be supplied to over 400 000 additional people. The infrastructure challenge that this poses is substantial. 60% of this increase is due to the growth of the Province’s own population and only 40% is due to in-migration.

Gauteng’s population currently stands at 16 million people. Copenhagen Consensus Center predicts that the province’s population will reach 65 million people in 2050 – four times as many people living in the province as there are today.

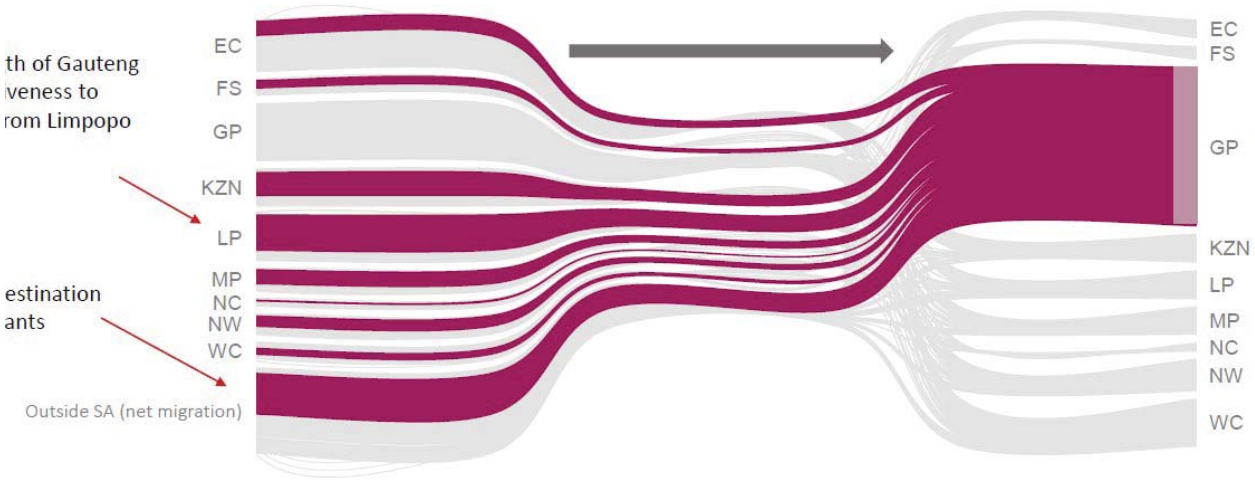


Figure 11: Gauteng as a destination province
Source: StatsSA,2021

The GCRO (2019:18) presents interesting findings on the province's per-capita water usage. According to their records, the per capita water use has been declining slightly over the past decade. This is likely due to a combination of three main factors:

- An influx of poorer residents (who use less water or do not have access to water);
- a process of densification in established suburbs (which reduces the use of water for gardens); and
- increased efficiencies in both municipal distribution and actual water use.

However, in the absence of new supplies, the rate at which consumption is reduced will have to increase if Rand Water's abstractions are to be maintained at their licence limits. Without new supplies, this means that consumption per person will have to be reduced from 300 litres per person per day in 2018 to 220 l/c/d by 2028 to stay at a level that can safely be supplied.

3.3. Gauteng's settlement patterns

Gauteng's settlement patterns took shape in early 1900 when groupings of towns were established around gold mines along the east-west gold reef. This east-west development axis remains a key structuring element of the existing urban form. According to the GSDF (2019) "Fragmented land use dominated – with agricultural land, mine workings, mine tailings facilities (sand dumps and slimes dams) and scattered urban development – created a racially, economically and functionally

separated settlement pattern that is environmentally wasteful and sprawling, stretching from Pretoria in the north, via the early Johannesburg, to Vereeniging in the south. Most of the black population were relegated to a survivalist existence in marginal, often unsafe and generally miserable living conditions in townships, which were secluded or far away from the enclaves of enormous economic prosperity."

Following the first democratic elections in 1994, the State embarked on a massive drive to address the legacy of Apartheid spatial planning. Notably, Government succeeded in providing access to basic services and housing to millions of previously deprived South Africans through its low-income housing programme or RDP housing.

Unfortunately, an unintended consequence of the State's low-income housing programme entrenched further the existing Apartheid spatial separation resulting in even further sprawling settlement pattern, often with low population densities, making infrastructure provision extremely costly and inefficient.

Today, these settlements (or townships) face spatial structural challenges, amongst others, spatial isolation and separation, concentration of poverty, limited access to social facilities and infrastructure services, the lack of a local economy and poor environmental quality.

Quantitative spatial data indicates that 14,7% of the province's land area is already urbanized and is home to 97% of the province's population (Own source, 2022). Yet, the province is faced with a relatively low population density of 4 760 people/km² within its urban areas (GSDF, 2019:49). It is evident that Gauteng residents are biased towards single residential development – resulting in significant cases of urban sprawl.

More than half (59%) of households in Gauteng live in houses on separate stands, while 19% live in informal dwellings and only 13% in multi-residential dwellings, such as apartments, clusters and townhouses (Stats SA, 2011).

Areas of highest density are found in townships and informal settlements on the periphery of the urban footprint, away from areas of economic concentration and public transport networks. As a result, the Province's spatial pattern has become highly fragmented, with dispersed development in some areas, and poor linkages and

integration between townships and the rest of the urban conurbation (GSDF, 2019, 108).

The province's rapidly growing population has led to increased demand for housing, more specifically subsidized housing. In 2014, the GDHS reported a housing backlog figure of 687 015 units, which according to the GCRO (2011) increased annually by 50 000 units each year.

The highest demand for housing is found in the CoJ Metropolitan Municipality, closely followed by Ekurhuleni Metropolitan Municipality. Of the three metros, the CoT Metropolitan Municipality has the lowest number of people residing in informal settlements and informal dwellings. It becomes apparent that housing delivery in the Province has been slow. It is anticipated that the province is likely to face a total housing demand backlog of 837 015 by 2024 (5-year interval).

South Africa has a strong regulatory framework for the provision of housing. However, the issues around water services provision within the Gauteng province suggest that there is a disconnect between the planning for human settlements and the planning for service provision. The section to follow provides an overview of South Africa and the Gauteng province legislative framework for developing housing and human settlements. The aim of the section is to identify opportunities for intergovernmental alignment between the planning process for human settlements and the planning for water-related services (including ecological services).

3.4. Housing Provision

Housing is an area of concurrent competence for national and provincial governments. The **Housing Act** sets out the roles and responsibilities of each of the three spheres of government in South Africa concerning housing.

- ***National government*** is responsible for developing a national housing policy; establishing a funding framework for housing development; allocating funds from the budget to provincial governments, and monitoring the performance of provincial governments and local municipalities.

- ***Provincial government*** is responsible for developing a provincial housing policy, supporting and strengthening the capacity of municipalities in respect of housing development; and assessing applications received from municipalities to administer national housing programs and monitor the performance of accredited municipalities.
- ***Local government's*** primary role of municipalities is to facilitate the development and management of housing stock within their jurisdictional areas, as part of the process of integrated development planning. To achieve these functions, municipalities must among other things:
    - Initiate, plan, coordinate and facilitate appropriate housing development on a progressive basis within its boundaries;
    - Prepare a local housing strategy and set housing delivery goals;
    - Set aside, plan and manage land for housing development; and
    - Create a financial and socially viable environment conducive to housing development.
    - Implementation of Bulk and Link Services Infrastructure to support Human Settlements projects.

The **Gauteng Department of Human Settlements (GDHS)** is tasked with the provision of Integrated Sustainable Human Settlements within the GCR. The GDHS mandate derives from the Constitution and the bill of rights which states the right of all people in terms of section 24, to an environment that is not harmful to their health and well-being; Section 26, to housing; and Section 27(b) to sufficient food and water.

The Housing Act 107 of 1997 upholds section 26 of the Constitution by outlining the following general principles applicable to housing development which national, provincial and local government must adhere to:

- The needs of the poor must be prioritised;
- The housing process should provide a wide choice of housing and tenure options, be economically and financially affordable and sustainable and be administered transparently and equitably;
- Housing development should occur in an integrated manner that creates socially and economically viable communities;

- Government should encourage and support all individuals and community-based bodies in fulfilling their own housing needs, in a way that ensures skills transfer and community empowerment;
- The active participation of all relevant stakeholders in housing development should be facilitated;
- Individuals and communities affected by housing development should be meaningfully consulted;
- The gearing of government investment in housing by additional finance, and other investment by the private sector and individuals should be facilitated; and
- The sustained protection of the environment should be promoted.

3.4.1. Other Role Players

Since housing delivery is such a complex and timeous process, several institutions or partners have been established to assist the GDHS in housing delivery, these include:

- **Housing Development Agency (HDA)** – Primary focus on land acquisition for the Rapid Land Release Programme; Coordination of the implementation of the Mining Towns Revitalization Programme.
- **Gauteng Partnership Fund (GPF)** – Implementing Agent for the execution of MEGA Human Settlements Projects; Monitoring of the realization and actualization of the Sector Economic Development (SED) objectives.
- **Social Housing Regulatory Authority** – Implementation of Rental and Social Housing Projects.
- **National Housing Finance Corporation** – Implementation of Affordable Housing for the "missing middle" or GAP Housing Market through the Finance Linked Individual Subsidy Programme (FLISP).
- **Municipalities** – Implementation of Bulk and Link Services Infrastructure to support Human Settlements projects.

3.4.2. South Africa Housing Market

The South African housing market can broadly be defined as:

- The **Affordable Housing Market** in South Africa is defined as households earning between R3,500 and R25,000. This market accounts for about 32% of the entire home loan market, requiring cost-effective, good-quality housing up to R600,000.
- **Open Market**, refers to the homes available for sale which can purchase and own, often financed by a mortgage and/or with a lump sum. This is considered to be housing for income levels from R18,000 and above.

National Government has several initiatives dating back from the post-apartheid era for different income levels in the hopes to solve the shortage of housing. The rising unemployment rate from 31.4% in Q1 of 2020 to 34.4% in Q1 of 2021 by the narrow definition in the country further increases the burden on government to make provisions for housing grants. The separate initiatives that the government has for different income levels are as follows:

The first bracket of housing provides for the R0.00-R3,500,00/month income level is the RDP/BNG housing. The Department of Human Settlements no longer refers to RDP houses but has updated the RDP housing plan, and now calls it “Breaking New Ground” or BNG. The BNG housing model is intended towards providing quality housing as well as community properties and business parks to create areas where the residents can sustain themselves.

Finance Linked Individual Subsidy Program (FLISP) was developed by Government to help affordable first-time home-ownership opportunities to South Africans with an income level of R3,501-R22,000 per month. This housing programme is also aimed at households who earn more than R801 per month and less than R3,500 per month. Community Rental Unit housing units are for rent and not for sale. This project is aimed at refurbishing inner-city buildings and hostels. The municipality will charge you rent to cover the municipal rates of the house.

Social Housing refers to housing where Municipalities and provincial governments can subsidise companies to develop new housing projects if some of the houses are rented as affordable housing. This makes the building and planning of the projects cheaper, which makes rent lower. SHPs are mainly (but not only) for households earning between R3,501 and R15,000 per month. You can qualify even if you have benefited

from other housing projects in the past, but you may not currently own property. Couples (married or living together) qualify, or single people with dependents.

3.3.3. Government Grants and Funds to be utilized for WSUD

National Government (Treasury) provides funding mechanisms/schemes/grants for both public and private sector developments to tap into, to achieve rapid transformations in housing delivery. National Government provides funding through the Division of Revenue Act (DORA) under the two conditional grants for Metropolitan municipalities. For the nonmetropolitan municipalities, additional funding is provided through other DORA conditional grants. The following section summarises key aspects that could be utilized for WSUD solutions:

- **Human Settlements Development Grant's** purpose is to provide funding for the creation of sustainable and integrated human settlements. Provinces may utilise a maximum of 2% of the HSDG for the provision of bulk infrastructure projects for basic services in non-metropolitan municipalities. Furthermore, Schedule 5 Part A states that at least 2% of the HSDG should be allocated to programmes and projects for the implementation of innovative building technologies in the human settlement's implementation delivery chain.
- **Urban Settlements Development Grant (USDG)** is an integrated source of funding for infrastructure for municipal services and upgrades to urban informal settlements in the eight metropolitan municipalities. Municipalities are expected to use a combination of grant funds and their revenue to develop urban infrastructure and integrated human settlements. At least 50% of the grant must be used to fund the upgrading of informal settlements.
- **Regional Bulk Infrastructure Grants** propose to develop new, refurbish, upgrade and replace ageing water and wastewater infrastructure of regional significance that connects water resources to infrastructure. To pilot regional Water Conservation and Demand Management (WC/WDM) projects or facilities and contribute to the implementation of local WC/WDM projects that will directly impact bulk infrastructure requirements.
- **Water Services Infrastructure Grant's** purpose is to facilitate the planning and implementation of various water and sanitation projects to accelerate backlog reduction and improve the sustainability of services in prioritised district

municipalities, especially in rural municipalities. The Grant provides interim, intermediate water and sanitation supply that ensures the provision of services to identified and prioritized communities including through spring protection, drilling, testing and equipping of boreholes; provides on-site sanitation solutions; supports the existing bucket eradication programme intervention in formal residential solutions, and support drought relief projects in affected municipalities.

- **Municipal Infrastructure Grant (MIG)** provides specific capital finance for eradicating basic municipal infrastructure backlog for poor households, microenterprises and social institutions servicing poor communities. The outputs of MIG are defined by the number of poor households impacted through the construction of new infrastructure and upgrading and renewal of existing infrastructure for basic water and sanitation services; central collection points for refuse, transfer stations, recycling facilities and solid waste disposal sites; sport and recreation facilities; street and community lighting; and, public facilities.
- **Public Transport Network Grant** – Stormwater provides funding for accelerated construction and improvement of public and non-motorised transport infrastructure that forms part of a municipal integrated public transport network and to support the planning, regulation, control, management and operations of fiscally and financially sustainable municipal public transport network services.
- **Infrastructure Skills Development Grant's** purpose is to improve infrastructure delivery management capacity within municipalities by developing a long-term and sustainable pool of registered professionals within the built environment and related technical skills in engineering, town planning, architecture, quality surveying, geographic information systems and project management.
- **Extended Public Works Programme Grant** provides incentive funding to municipalities to expand work creation efforts through the use of the labour-intensive delivery method in the following identified focus areas, in compliance with the EPWP guidelines.

3.4.3. Gauteng's Housing System and programs

The revised National Housing Code of 2009 sets out the national housing policy for South Africa and most significantly the rules and regulations about the national subsidy programs. The National Housing Code stipulates several programs, funding

mechanisms, and subsidies that can be used to assist and undertake housing projects. The following section provides an overview of Gauteng's housing systems. Focus is placed on two key elements including existing housing programs and Housing Funds/Grants.

The GDHS has various housing programs geared towards assisting the province and local municipalities in addressing and rectifying unsustainable human settlements developments including:

- The **Integrated Residential Development Programme (IRDP)** provides for the acquisition of land, the servicing of stands for a variety of land uses, including commercial, recreational, schools and clinics, as well as residential stands for low-, middle- and high-income groups. The land-use and income group mix is based on local planning and needs assessments. The IRDP may only be used for developing unoccupied vacant land into an integrated human settlement; or for developing an integrated human settlement project (e.g. building of a school) on a vacant stand within an existing township.
- The **Upgrading of Informal Settlements Programme (UISP)** aims at dealing with the results of rapid, unstructured and unplanned development. It is the main instrument for achieving the objectives of the Legacy, Informal Settlements Upgrading, Hostels Redevelopment, Opening of Township Register and Title Deeds programs. The UISP favours in-situ upgrading over relocation and resettlement. *It also provides funding for basic engineering services and infrastructure upgrades that is sustainable and affordable to informal settlements.*
- The ***Emergency Housing Programme (EHP)*** is a programme to respond to emergencies and includes a grant to municipalities to enable them to respond rapidly to housing-related emergencies by providing land, municipal engineering services and shelter. The grant may be used to re-house households both temporarily and permanently as a result of amongst others a declared state of disaster, for example *after extreme weather events; dangerous or life-threatening conditions such as flooding or for relocating households that are living in the way of engineering services or proposed engineering services.*
- The ***Provision of Social and Economic Facilities*** is a funding mechanism to assist municipalities to provide primary municipal community facilities (social and

economic) until other dedicated funding for such facilities becomes available. The funding mechanism is only available to those municipalities that do not have sufficient financial resources to provide such facilities. The grant is available for existing and new housing areas, as well as within informal settlement upgrading projects.

- ***Social Housing*** means a rental or co-operative housing option for low to medium-income households at a level of scale and built form which requires institutionalized management, and which is provided by social housing institutions (SHI's) or other delivery agents (ODA's) in approved projects at designated restructuring zones with the benefit of public grant funding. The ***Community Residential Units Programme (CRUP)*** aims to facilitate the provision of secure, stable rental tenure for lower-income persons/households.
- The National Housing Code provides for the prioritization of the ***Rapid Land Release Programme*** in the Serviced Stand (subsidised) cost breakdown for Municipal Engineering Services. The RLRP prioritises the identification and release of land currently not in use which could be made available for people who want to build houses for themselves, but do not qualify for government-subsidized housing.
- ***MEGA Human Settlements Projects ("MEGA Projects")*** will be implemented in terms of the National Housing Code and will include, where possible, the integration of legacy, urban renewal, hostel upgrading, rapid land release and informal settlement upgrading projects/programmes. The MEGA Human Settlements strategy is a radical human settlements delivery mechanism that seeks to yield between 5 000 (five thousand) and 20 000 (twenty thousand) housing units per project, either as part of an existing development cluster or as a new nodal development project along the five development corridors. *MEGA Human Settlement Projects will include the planning, design and construction of state-funded housing units; bulk and link infrastructure; social facilities such as schools and hospitals; commercial areas or economic hubs within the context of the developing Smart Cities*. MEGA Projects will apply a life-cycle approach which includes interventions that operationalise the constructed MEGA Projects and provide post-construction urban management.

3.5. Conclusion

Gauteng province is under severe strain to provide housing and infrastructure services to its growing population. The province is already facing water shortages, both in terms of services and natural resource availability. It is evidence that on a National level and Provincial, Government has funding structures available for municipalities to tap into, in order to provide housing and associated water and wastewater services. The question that remains unanswered is “how can these funds be utilized towards the implementation of water sensitive design approaches and solutions?”.

Chapter 4 – Gauteng Housing & MEGA Human Settlements

4.1. Introduction

This section presents an introduction to Gauteng MEGA Human Settlements (the motive, the concepts, the regulatory and strategic planning processes, the design criteria, identification of key role-players and their responsibilities, the processes involved from project feasibility to project initiation (design and planning) and project funding and implementation mechanisms). The location, design and planning process through which the development of MEGA Human settlements will transpire will have either a water-wasteful or water sensitive impact on the province and the country. It is therefore important to identify the opportunity for water sensitive design and planning as early as possible within the land development process.

4.2. Background to Gauteng MEGA Human Settlements

The development and implementation of MEGA Projects ("MPs") date back to 2014, at the beginning of the previous fifth term of governance. The adoption of MEGA Projects as a means of human settlements emerged as a corrective measure on two levels, namely to (i) redefine post-apartheid cities, and (ii) to address post-1994 housing programme policy and implementation deficiencies that inadvertently reinforced and perpetuated separate human settlements as defined under apartheid rule.

MEGA Projects were described by the then National Minister of Human Settlements as "National Priority Catalytic Projects using different tenure options to deliver MEGA, high impact integrated and sustainable human settlements that clearly demonstrate spatial, social and economic integration".

According to Gauteng Premier (2015) "MEGA Human settlements represent a decisive departure from uncoordinated, small scale, low impact, and sporadic as well as unsustainable housing developments. The goal must be to achieve diversity in human settlements by emphasizing mixed-income, high-density human settlements that place emphasis on social and economic inclusion, as well as promoting spatial justice.

This is what we consider spatial transformation, wherein we transform and develop new cities" (speech made at the Gordon Business Institute of Business Science. 2015). Today, the Province's "MEGA Cities Initiative" aims to ensure "unprecedented radical transformation of human settlements and spatial planning in Gauteng for the next 10 years". It forms part of the GDHS's four strategic outcome-oriented goals. Goal 3 aims to "Accelerated implementation of MEGA Human Settlements projects through the Urban Regeneration Programme, Rapid Land Release, and other programmes through the Contractor Incubation Initiative."

The establishment of the MEGA Cities or MEGA Human Settlement projects in Gauteng brings forth a new housing project delivery model, based on the infrastructure Development Management System (IDMS). Within IDMS, MEGA projects are looking to move away from sporadic township and housing development trends towards developments that are organized around large-scale residential developments that are supported by infrastructure as well as economic activities. The implementation of the IDMS also places much emphasis on other programmes that are running through the Department of Human Settlements such as the Rapid Land Releases as well as the Contractor Incubator Initiative that supports local contractors.

4.2.1. Defining MEGA City/MEGA Human Settlements

MEGA Cities or MEGA human settlements are inclusive in nature, as it offers housing for different income levels, ranging from lower-income housing to high-level income earners. The seamless development of these different types of housing is achieved through building partnerships with property developers, financial institutions and governments to assist in achieving project goals.

MEGA Human Settlements each consist of more than 15,000 residential units. It is also the intention to divert funding towards investment into Bulk Infrastructure through the Mining Towns Program in the non-metro District Municipalities of Gauteng. The Gauteng MEGA Human Settlements Initiative proposes to develop some 680,000 new affordable housing opportunities in new mass housing developments across the province. The table below extrapolates the key characteristics/aspects of MPs.

Table 1: Characteristics for MEGA Human Settlements

Characteristic/Aspect	Explanation
Mixed Use Development	Development that is inclusive of housing, social amenities, open spaces, economic, commercial and industrial opportunities.
Mixed-Income Housing	Housing that is inclusive of BNG, rental, social, gap market and bonded units, and serviced sites for employer assisted housing.
Mixed Tenure Housing	Housing that is inclusive of ownership, rental stock and social housing tenure options.
Mixed Typology Housing	Housing that is inclusive of free-standing and multi-story walk-ups.
Smart City/ies	Incudes but is not limited to gas reticulation systems, renewable energy, broad band internet, solid waste and waste-water recycling, ecological integration and innovations in terms of energy, water and alternative building materials.

4.2.2. Anticipated Benefits of MEGA-Cities

The large features of MEGA projects offer attractive prospects for economic growth and consequently bring about organized traffic flow that is not flocking towards the CBD. It is also important to note that MEGA human Settlement projects bring about a huge advantage politically for the government as such projects can be widely recognized under the umbrella of service delivery and infrastructure development. The appeal of large-scale projects allows private investors to get involved in the projects.

Firstly, large projects are seen as an effective way of meeting the demand for housing through economies of scale and through the sheer quantity of units constructed. Second, in the context of a flagging economy, promoters of this direction regard state-led city-building as a mechanism for catalysing the economy and development.

4.2.3. Constraints of MEGA Human Settlements

Some critiques of MEGA City Projects are less concerned about the scale of the projects than the fact that they could be poorly located. This is especially true in Gauteng as large tracts of land are no longer available in well-located areas near economic nodes such as Johannesburg or Pretoria, but instead, many planned MEGA-city projects are located on the periphery of cities and urban areas. This means that many of these MEGA-city projects will be removed from existing economic activities. From a municipal services perspective, the peripheral locations of MEGA Cities may put additional strain on municipal infrastructure and maintenance. Many municipalities are already struggling to keep up with existing maintenance activities and adding such large-scale developments at the periphery where municipalities are

already weaker with regard to maintenance may result in poor service delivery over the project lifetime.

Historically it has been difficult to create new urban centres with enough jobs for the people who live there. Concerns have been raised that some MEGA-city projects will follow this trend which means that residents will have to commute to urban centres for work which is counter to the objective of MEGA-city projects. Coupled with the peripheral location of many MEGA-cities, some critics point out that this can also further fragment cities which are counter to the objectives of the South African Government to curb urban sprawl and create more inclusive and less segregated cities from an economic and demographic perspective.

MEGA Human Settlements also have a variety of risks associated with them. The huge scale of such projects means that a significant amount of time can pass before project implementation and completion, introducing a variety of risks such as costs/budgetary, political, and economic risks. Over an extended period of time, a variety of risks can materialise which could severely impact the project if not carefully planned for and monitored.

4.2.4. Key Role Players

As the Department rolls out the MEGA Human Settlements programme which focuses on building new cities of the future which will radically transform how human settlements are delivered across all the corridors of Gauteng, there is a need to form key partnerships to ensure proper planning and provision of all required infrastructure services such as water, sanitation, electricity, energy, roads and social amenities. The table below list the key roles-players and their responsibilities.

Table 2: Role Players and Responsibilities

Role Player	Responsibilities
NDHS	• Policy Directives • Funding • Performance Oversight
GDHS	• Approves MPs • Signs Subsidy Agreement with developers • Signs Turnkey Development Agreement with developers • Signs Tripartite Implementation Agreement with Municipalities and developers • Develops and updates the Gauteng HS Spatial Master Plan • Implements and maintains the IDMS • Provides subsidies for applicable housing typologies in MPs • Provides 10% of HSDG grant for bulk infrastructure in mining towns, particularly the West Rand District • Provides 2% of HSDG grant for bulk infrastructure in the Sedibeng District • Beneficiary administration and issuing of title deeds in respect of government subsidised housing units
GDID (infrastructure development)	• Government Precincts – including magistrate courts and regional offices of Home Affairs, SARS and SASSA
HDA	• Implements national catalytic priority projects
GPF	• Revenue generation for MPs
SHRA	• Manages and implements social housing projects, including in MPs
Municipalities	• Township establishment and approvals • USDG and other Grant Funding • Signs SLAs with developers • Signs SLAs with developers
GDRT (roads and transport)	• Regional Roads and Public Transport facilities
GSACR (sports, arts, culture and recreation)	• Parks, Open Spaces and other social amenities
GDED (economic development)	• Township and Rural Economic Revitalization and Food Production, including Telecommunication facilities
GDBE (basic education)	• Schools and other education infrastructure
GDCS (community safety)	• Community Policing and By-Law Enforcement
GDoH (health)	• Community Health Centres and Hospitals
GDSD (social development)	• Community Support and Early Childhood Development
Provincial Treasury	• Special Funding, Governance and Compliance

4.3. Strategic Location of MEGA City

MEGA Human Settlements will be rolled out in phased stages in five (5) MEGA city corridors – see maps to follow.

- ***The Central Development Corridor*** – anchored on the city of Johannesburg as the hub of finance, services, information and communication technology, and pharmaceutical industries – Collectively, the delivery of **140,000 housing units** are planned in Olievenhoutbosch ; Malibongwe Ridge; Clayville; Alexandra; Goudrand; Fleurenhof and Savannah City.

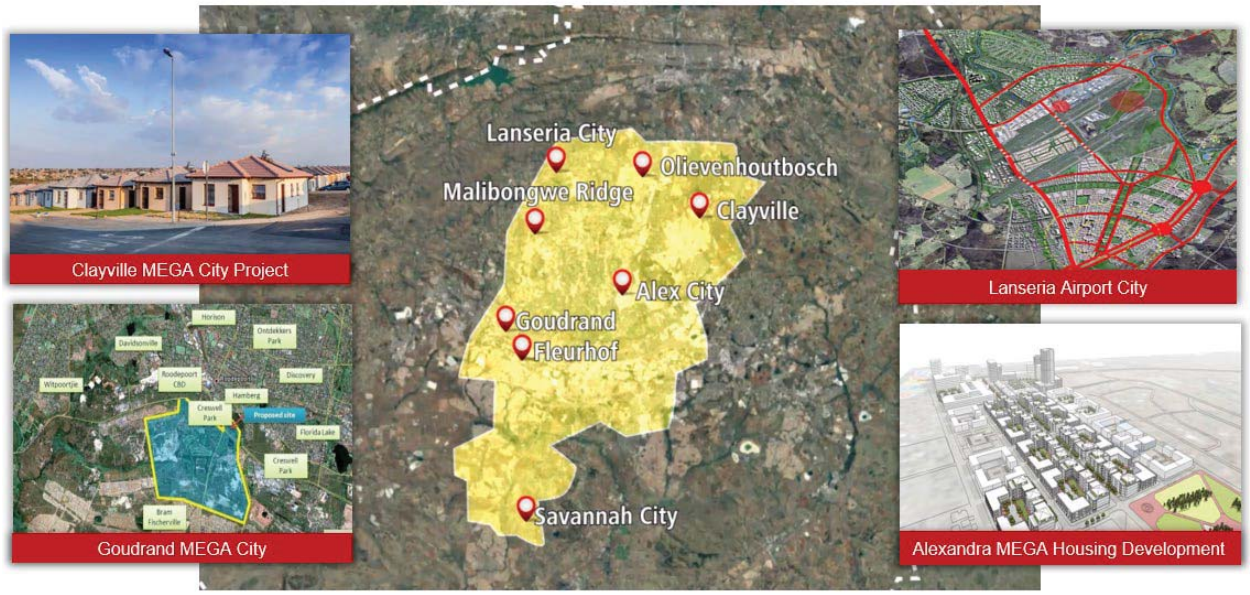


Figure 12: The Central Development Corridor

- ***The Eastern Development Corridor*** – built around the economy of the Ekurhuleni metro as the hub of manufacturing, logistics and transport industries – collectively, the delivery of **100,000 housing units** are planned in Chief Albert Luthuli Park; Helderwyk Integrated MEGA; Daggafontein and John Dube Ext 2.

Figure 13: The Eastern Development Corridor

- ***The Northern Development Corridor*** – anchored on Tshwane as the administrative capital city and the hub of the automotive sector, research, development, innovation and the knowledge-based economy – collectively, the delivery of **160,000 housing units** are planned in Tswaiing New Eersterus; Cullinan; Nellmapius; Pienaarspoort and Park City

Figure 14: The Northern Development Corridor

- ***The Western Corridor –*** encompassing the economy of the West Rand district and the creation of new industries, new economic nodes and new cities – Collectively, the delivery of **160,000 housing units** are planned in Leratong;

Western MEGA; Montrose; Lufhereng; Westonaria Borwa; Syferfontein; Varkenslaagte & Kokozi Ext 6 & 7.

Figure 15: The Western Corridor

- ***The Southern Corridor*** – encompassing the economy of the Sedibeng district and the creation of new industries, new economic nodes and new cities. Collectively, the delivery of **120,000 housing units** are planned in Vaal River City; Golden Highway MEGA; Bioketlong Sebokeng Ext 32 and Kwazanzele Phase 2.

Figure 16: The Southern Corridor

4.4. Empirical Investigation

4.4.1. Case study design

As per the study proposal, this study was designed to draw primarily on qualitative and quantitative research methods design with three chief components in mind:

- Systematic Data Analysis: Screening and Feasibility of Water Sensitive Design and Planning Solutions within MEGA Human Settlements Development (Quantitative)
- Thematic Self-evaluation: Water Sensitive Compliance/Criteria Assessment (Qualitative)
- Semi-structured stakeholder engagement meetings (Qualitative)

4.4.2. Methodology

The approach has been to start by compiling a list of all known MEGA City Development in Gauteng. This was done through desktop research as well as multiple engagements with the Gauteng Department of Human Settlements, municipal official and Developers. 36 MEGA City projects were recorded across Gauteng. For each MEGA City Project, the research team aimed to collect information on:

- **Base information:** Project Name; Project Number; Project Type; District/Region; Municipality; Longitude & Latitude; Implementing Agent: Region/Municipality/HDA/GPF; Intervention; Land Acquisition Complete; Original Approved Project Scope Project Size; Approved Project Budget; Expenditure To Date; Available Budget and PRM Project Number.

- **Land use information:** Layout plan/Land Use plan depicting the number and locality of planned uses including but not limited to Creches; Primary School Secondary School; Clinic; Community Facilities; Church; Shops; Shopping Centres; Office Park; Filling Station; Taxi Rank; Parks and Public Open Spaces

- **Water-related information:** Water demand calculation/projections, Bulk Services Assessment (existing capacity and future capacity), stormwater quality objectives, catchment management plans, Water Services Development plans, etc.

- **Planning information:** Market study (explain housing typologies) and Due Diligence report including Site Assessments, Environmental assessment, and

Geotechnical Assessment; any information pertaining to the concept design, Architectural design and innovation; Engineering outline scheme report, Environmental scoping report; Site Development Plan, Layout Plans; Stormwater management plan; Water use License, Environmental authorization; approved general plan, conditional of establishment and any information pertaining to Contracts; Proclamations; Township approval; Conditions of Establishment; Services level agreements and any other development correspondence applicable.

However, it was found that most of this information was not well documented or freely available on the internet thus the research team opted to engage with stakeholders through semi-structured meetings. Numerous emails were sent, and phone calls were made – but it soon became evident that Private Developers felt that the information we requested was of confidential/sensitive nature and was not willing to share information even for research purposes. As a result, the inventory consists predominantly of information provided by the local municipalities and the Gauteng Department of Human Settlements.

See **Annexure 2** for proof of evidence.

4.4.3. Addressing the Quantitative research approach

The Research Proposal (2021/2022-00589) set out to conduct a systematic data analysis that will allow for the screening and feasibility of water sensitive design and planning solutions within MEGA Human. To do this, the research would need to apply integrated systematic analysis of spatial dimensions using GIS Software, spatial data and other numeric source data. It was anticipated that the screening and feasibility of water sensitive design and planning solutions could be addressed on the grounds of scenario planning.

- Scenario 1 being business-as-usual that would model or calculate the anticipated impact of the selected case study on both water resource quality and quantity.
- Compared to Scenario 2 which set out to model the feasibility of water sensitive design and planning solutions within the selected MEGA Human Settlement. The intent of this model was to quantify the anticipated positive outcomes of

implementing water sensitive design and planning solutions within MEGA Human Settlements.

However, after weeks of sending out data requests, and trying to set up meetings with developers and municipal officials – and not being successful at all, the team called for a data inventory review. It was soon realized that given the lack of spatial data and the complexity of the proposed modeling exercise that the scenarios would end up with skewered results and not a realistic interpretation of the two scenarios. Therefore, this study failed to comply with the initial or intended scope of research giving reference to the quantitative research approach.

4.4.4. Addressing the Qualitative research approach

The Research Proposal (2021/2022-00589) set out to design a Water Sensitive Compliance Criteria/Assessment toolkit to establish a benchmark for planning and designing Water Sensitive MEGA Human Settlements. The following key documents were used to design and inform the Toolkit –

- The South African Guidelines for Sustainable Urban Drainage Systems;
- Water Sensitive Urban Design for South Africa: Framework and Guideline;
- Framework towards water sensitive spatial planning and land use management;
- Guideline on compiling water-sensitive Spatial Plans; and,
- GDARD Decision Support Tool for Sustainable Drainage Systems

The motive behind the self-evaluation assessment of water sensitive compliance criteria is to build a comprehensive understanding of MEGA Human Settlements land development process to identify gaps and opportunities for the implementation of water sensitive design and planning solutions from the project initiation and feasibility phase up to construction and handover phase. Even though the Water Sensitive Compliance Criteria/Assessment toolkit is intended for MEGA Human Settlements, it is designed to be applicable to all land development scenarios.

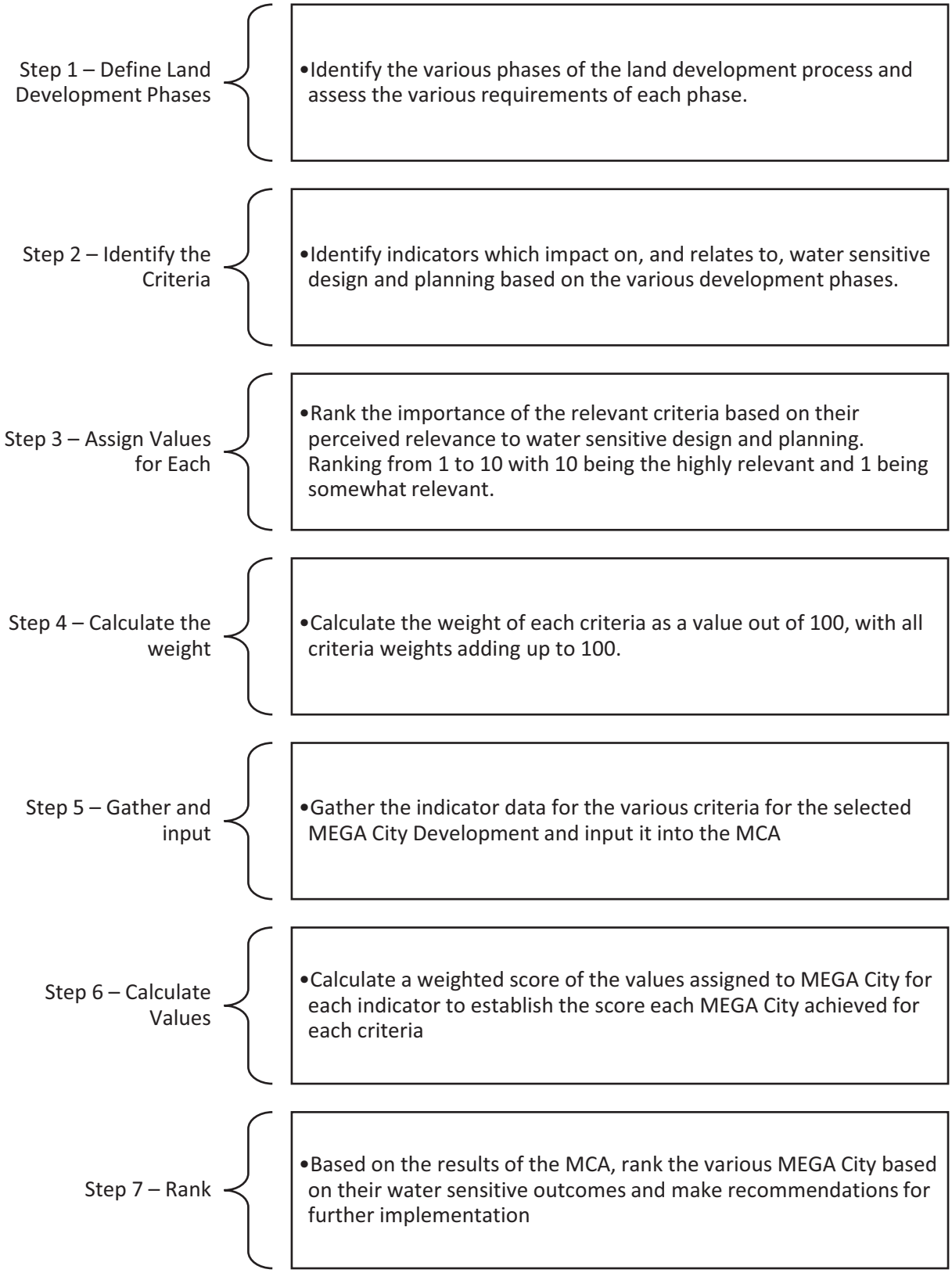
The following methodology was adopted to design the Water Sensitive Compliance Criteria/Assessment toolkit for MEGA Human Settlements:

- Based on the literature review and the availability of data pertaining to the planning and development of MEGA Human Settlements, the research team

developed a Multi-Criteria Analysis (MCA) Matrix which scores and ranks each planning phase and actions in relation to water sensitive outcomes.

- Indicators pertaining to the opportunities for water sensitive outcomes were identified for each of the following land development stages:
    - Feasibility stage
    - Land Development Stage
    - Post Approval Stage
    - Construction Stage
- The intention is that each MEGA Human Settlements is scored and ranked using these indicators to establish gaps and opportunities to give effect to water sensitive planning practices within the various land development stages.
- Using multiple indicators allows for choosing and prioritizing between the interests of different groups by comparing options with slightly different outputs. These differences (in this instance indicators), are typically weighted based on the desired analyses and outcome of the assessment.
- The weight for each indicator was based on its perceived relative importance/impact on possible water sensitive outcomes in a specific MEGA Human Settlement. The weighting of indicators is done on a range of 1 to 10, with 10 indicating an indicator that holds a very high relevance to water sensitivity and a score of 1 for an indicator with little relevance.
- The research team compiled a Multi-Criteria Analysis (MCA) Matrix in which all relevant MEGA City Developments can be scored and compared cohesively. Subsequently, MEGA Human Settlements can be ranked accordingly to provide a hierarchical list of potential interventions and or opportunities for water sensitive outcomes.
- The ranking can be done on development stages considerations to provide a holistic, although high-level, assessment of the potential for water sensitive practices roll-out.

The illustration below provides a flow chart illustrating the various steps in compiling the MCA and ranking of various MEGA City Developments.


Step 1 – Define Land Development Phases
•Identify the various phases of the land development process and assess the various requirements of each phase.
Step 2 – Identify the Criteria
•Identify indicators which impact on, and relates to, water sensitive design and planning based on the various development phases.
Step 3 – Assign Values for Each
•Rank the importance of the relevant criteria based on their perceived relevance to water sensitive design and planning. Ranking from 1 to 10 with 10 being the highly relevant and 1 being somewhat relevant.
Step 4 – Calculate the weight
•Calculate the weight of each criteria as a value out of 100, with all criteria weights adding up to 100.
Step 5 – Gather and input
•Gather the indicator data for the various criteria for the selected MEGA City Development and input it into the MCA
Step 6 – Calculate Values
•Calculate a weighted score of the values assigned to MEGA City for each indicator to establish the score each MEGA City achieved for each criteria
Step 7 – Rank
•Based on the results of the MCA, rank the various MEGA City based on their water sensitive outcomes and make recommendations for further implementation

Chapter 5 – Conclusion & Recommendations

The study concluded with the following key finding:

Outlook and Opportunities for Water Sensitive MEGA Human Settlements

- Most of the planned Gauteng MEGA Human settlements are located within areas with limited to no bulk water and wastewater treatment work.
- To date, no evidence could be found that developers, professional practitioners, or government departments aim to develop these MEGA human settlements in a water sensitive manner. Or that the water crisis and sustained capacity of existing infrastructure is taken into consideration at all.

- The reality is that South Africa's water crisis cannot be fixed by research only. There is a need to give effect to theory.
- The most evident gap in achieving water sensitivity in development is the fact that no one really knows whose responsibility it is to implement these practices. As a result, water sensitive design is brought in as an afterthought or reactive measure.

- Water Sensitive Design and Planning have been proven to improve water quality and water security. MEGA Human Settlements offer Gauteng a unique opportunity to put this to the test within the South African context.
- The opportunity to give effect to water sensitive design and planning lies within the land development processes. Professional practitioners can take proactive measures to include water sensitive design if they re-think the way in which the land development process is undertaken.

This study recommends that all stakeholders involved in the land development proses uses the "Evaluation Toolkit – Water Sensitive Compliance Criteria" to better plan and

execute on water sensitive developments in South Africa and more specifically the Gauteng Province.

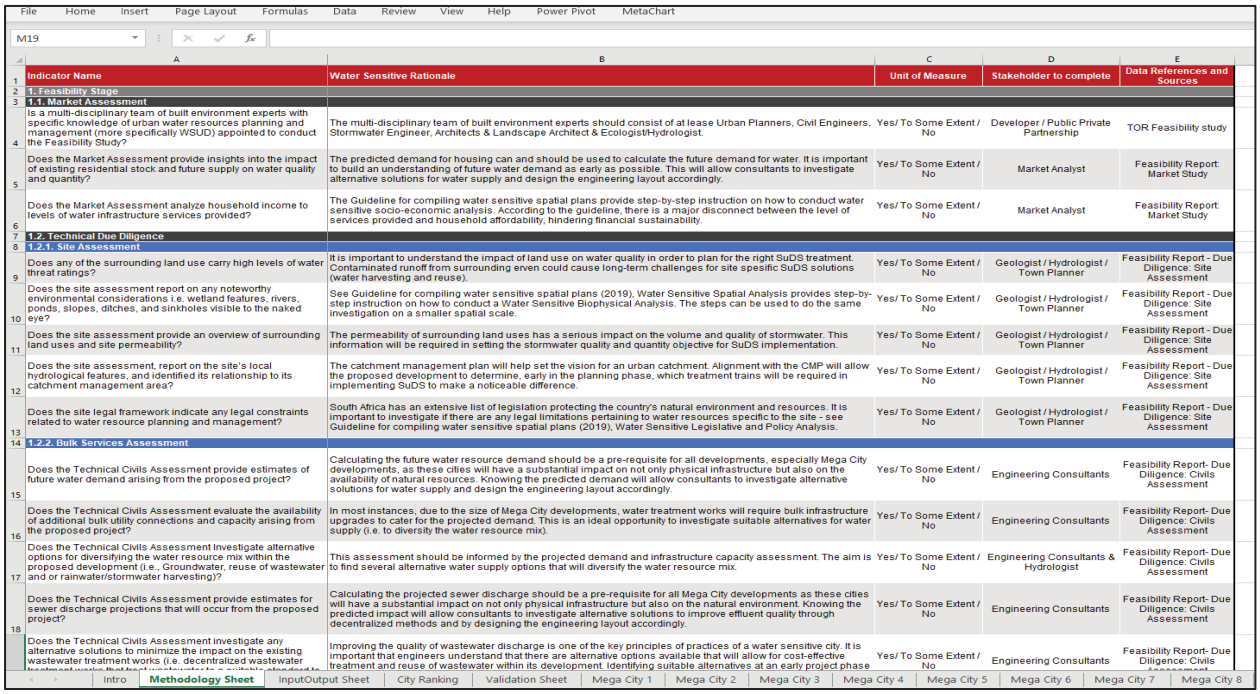
Information on the “Evaluation Toolkit – Water Sensitive Compliance Criteria” is a supporting document and toolkit to this research report and is downloadable on the WRC website _____

The section below provides a snapshot of the Evaluation Toolkit:

Evaluation Toolkit – Water Sensitive Compliance Criteria

Figure 17 showcases the Methodology Sheet which sets out the Indicator (Colum A) in the form of a water/development-related question, followed by the Water Sensitive rationale (Colum B), the unit of measurements (Colum C) in this case Yes/To Some Extent/No.

Colum D indicates which stakeholder is the recommended custodian of the section followed by a Data Reference Source in Colum E.



	A	B	C	D	E
1	Indicator Name	Water Sensitive Rationale	Unit of Measure	Stakeholder to complete	Data References and Sources
2	1. Feasibility Stage				
3	1.1. Market Assessment				
4	Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management (more specifically WSUD) appointed to conduct the Feasibility Study?	The multi-disciplinary team of built environment experts should consist of at lease Urban Planners, Civil Engineers, Stormwater Engineer, Architects & Landscape Architect & Ecologist/Hydrologist.	Yes/ To Some Extent / No	Developer / Public Private Partnership	TOR Feasibility study
5	Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	The predicted demand for housing can and should be used to calculate the future demand for water. It is important to build an understanding of future water demand as early as possible. This will allow consultants to investigate alternative solutions for water supply and design the engineering layout accordingly.	Yes/ To Some Extent / No	Market Analyst	Feasibility Report: Market Study
6	Does the Market Assessment analyze household income to levels of water infrastructure services provided?	The Guideline for compiling water sensitive spatial plans provide step-by-step instruction on how to conduct water sensitive socio-economic analysis. According to the guideline, there is a major disconnect between the level of services provided and household affordability, hindering financial sustainability.	Yes/ To Some Extent / No	Market Analyst	Feasibility Report: Market Study
7	1.2. Technical Due Diligence				
8	1.2.1. Site Assessment				
9	Does any of the surrounding land use carry high levels of water threat ratings?	It is important to understand the impact of land use on water quality in order to plan for the right SuDS treatment. Contaminated runoff from surrounding erven could cause long-term challenges for site spesific SuDS solutions (water harvesting and reuse).	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
10	Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches, and sinkholes visible to the naked eye?	See Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Spatial Analysis provides step-by-step instruction on how to conduct a Water Sensitive Biophysical Analysis. The steps can be used to do the same investigation on a smaller spatial scale.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
11	Does the site assessment provide an overview of surrounding land uses and site permeability?	The permeability of surrounding land uses has a serious impact on the volume and quality of stormwater. This information will be required in setting the stormwater quality and quantity objective for SuDS implementation.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
12	Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management area?	The catchment management plan will help set the vision for an urban catchment. Alignment with the CMP will allow the proposed development to determine, early in the planning phase, which treatment trains will be required in implementing SuDS to make a noticeable difference.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
13	Does the site legal framework indicate any legal constraints related to water resource planning and management?	South Africa has an extensive list of legislation protecting the country's natural environment and resources. It is important to investigate if there are any legal limitations pertaining to water resources specific to the site - see Guideline for compiling water sensitive spatial plans (2019), Water Sensitive Legislative and Policy Analysis.	Yes/ To Some Extent / No	Geologist / Hydrologist / Town Planner	Feasibility Report - Due Diligence: Site Assessment
14	1.2.2. Bulk Services Assessment				
15	Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	Calculating the future water resource demand should be a pre-requisite for all developments, especially Mega City developments, as these cities will have a substantial impact on not only physical infrastructure but also on the availability of natural resources. Knowing the predicted demand will allow consultants to investigate alternative solutions for water supply and design the engineering layout accordingly.	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils Assessment
16	Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed project?	In most instances, due to the size of Mega City developments, water treatment works will require bulk infrastructure upgrades to cater for the projected demand. This is an ideal opportunity to investigate suitable alternatives for water supply (i.e. to diversify the water resource mix).	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils Assessment
17	Does the Technical Civils Assessment investigate alternative options for diversifying the water resource mix within the proposed development (i.e., Groundwater, reuse of wastewater and or rainwater/stormwater harvesting)?	This assessment should be informed by the projected demand and infrastructure capacity assessment. The aim is to find several alternative water supply options that will diversify the water resource mix.	Yes/ To Some Extent / No	Engineering Consultants & Hydrologist	Feasibility Report- Due Diligence: Civils Assessment
18	Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	Calculating the projected sewer discharge should be a pre-requisite for all Mega City developments as these cities will have a substantial impact on not only physical infrastructure but also on the natural environment. Knowing the predicted impact will allow consultants to investigate alternative solutions to improve effluent quality through decentralized methods and by designing the engineering layout accordingly.	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils Assessment
	Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment works (i.e. decentralized wastewater	Improving the quality of wastewater discharge is one of the key principles of practices of a water sensitive city. It is important that engineers understand that there are alternative options available that will allow for cost-effective treatment and reuse of wastewater within its development. Identifying suitable alternatives at an early project phase	Yes/ To Some Extent / No	Engineering Consultants	Feasibility Report- Due Diligence: Civils

Figure 17: Methodology Sheet

Figure 18 illustrates the layout of the Input/output sheet which is also the main toolkit sheet where stakeholders are required to select one of the Data Input options (Colum B-G) to answer the Water Sensitive Indicator (Colum A). Each of the Data Input options has a numeric value/score as per the Data Validation Sheet:

- Yes = 5
- To some extent = 3
- No = 1

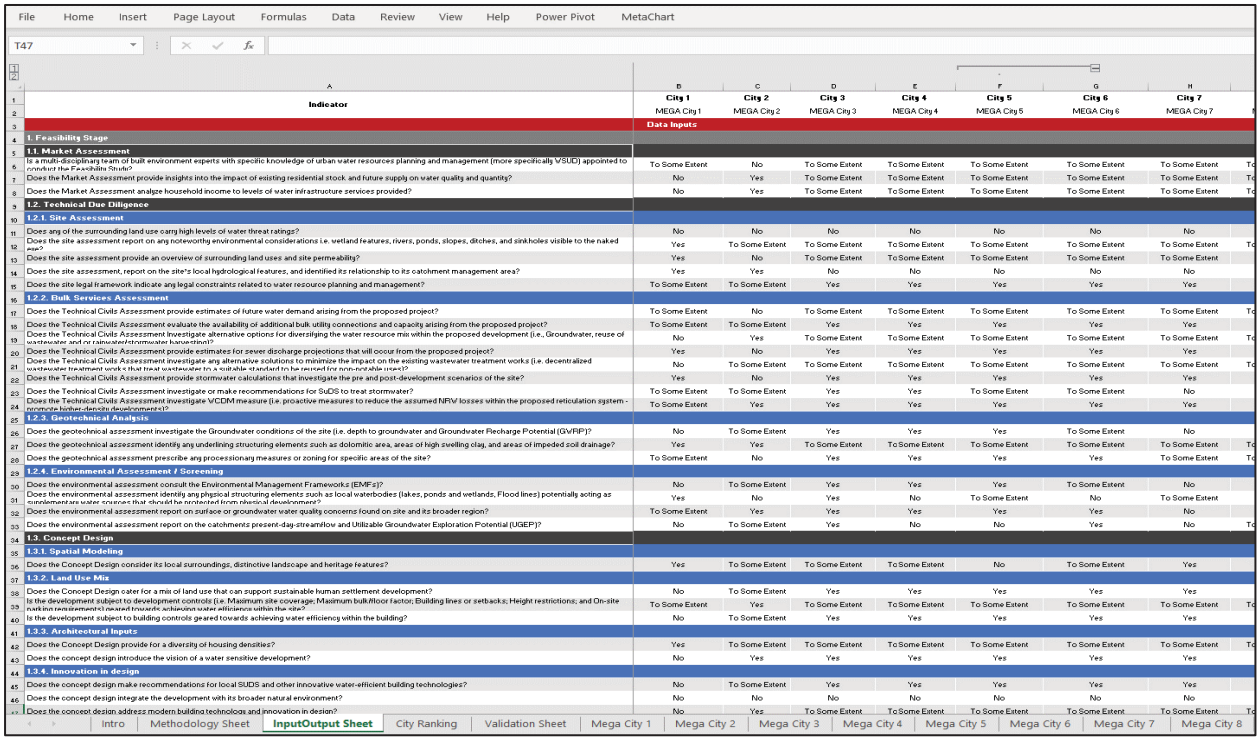


Figure 18: Input/output sheet

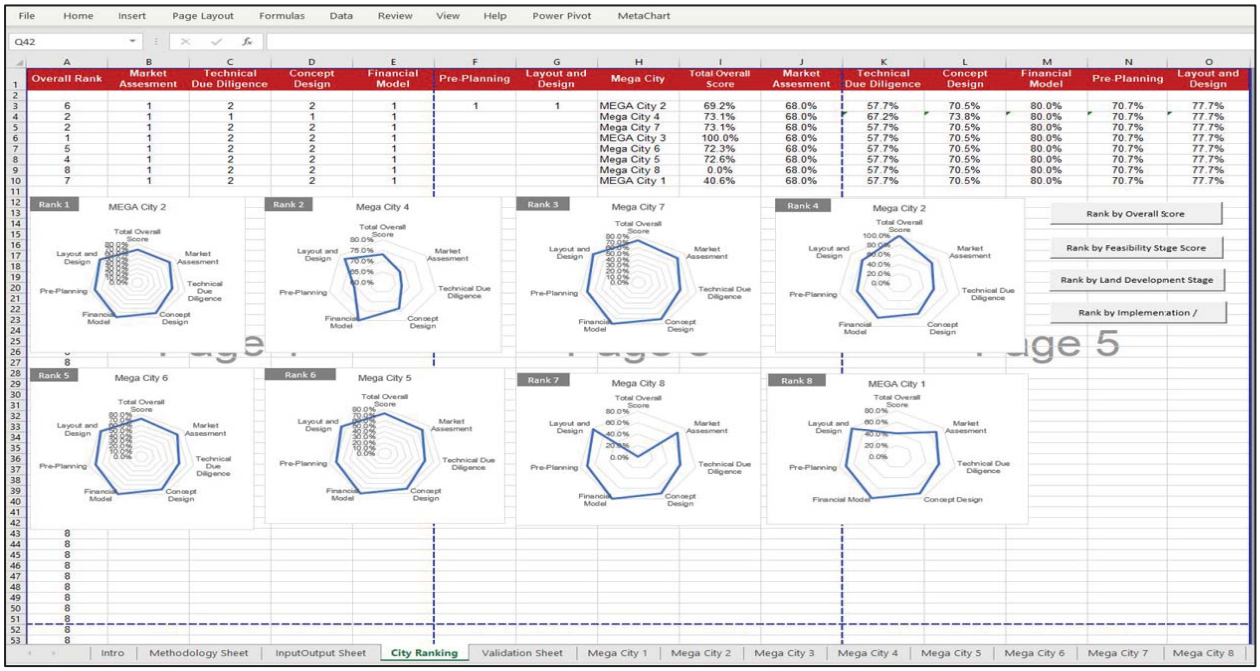
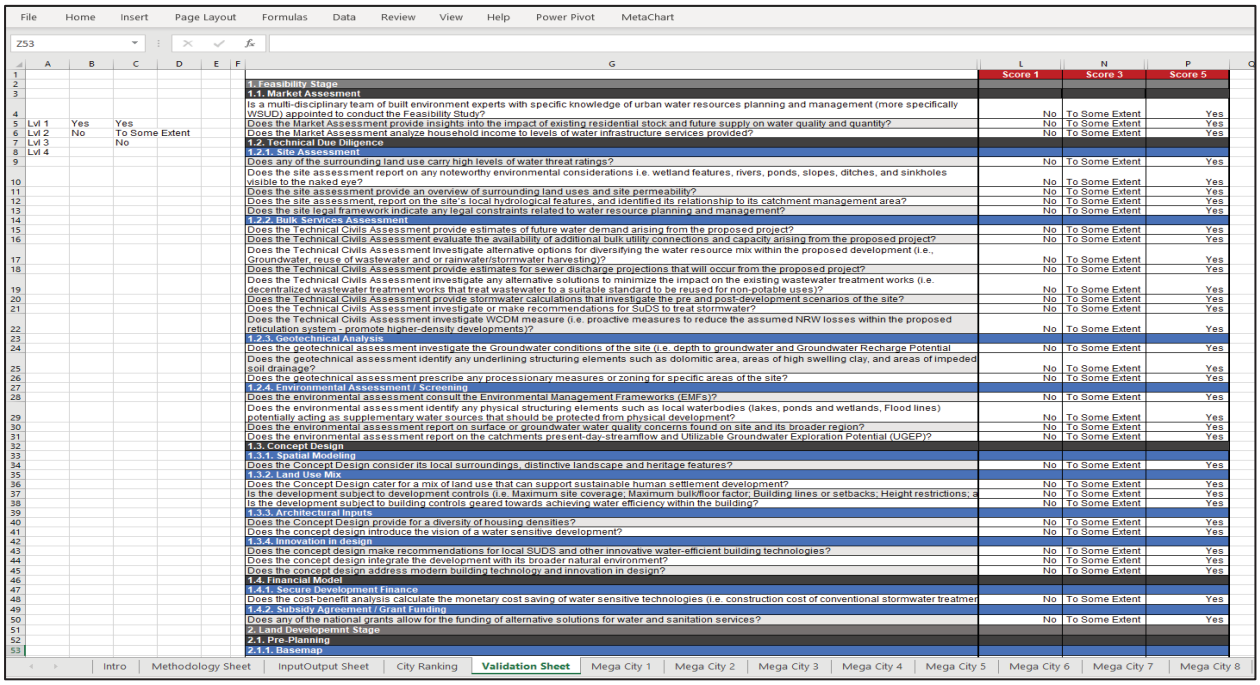


Figure 19: City Ranking

Figure 19 ranks the various Mega City development according to their level of water sensitivity given the various indicators. The sheet offers the user the option to rank the

developments according to Overall Score, Feasibility Stage, Land Development State and Implementation.



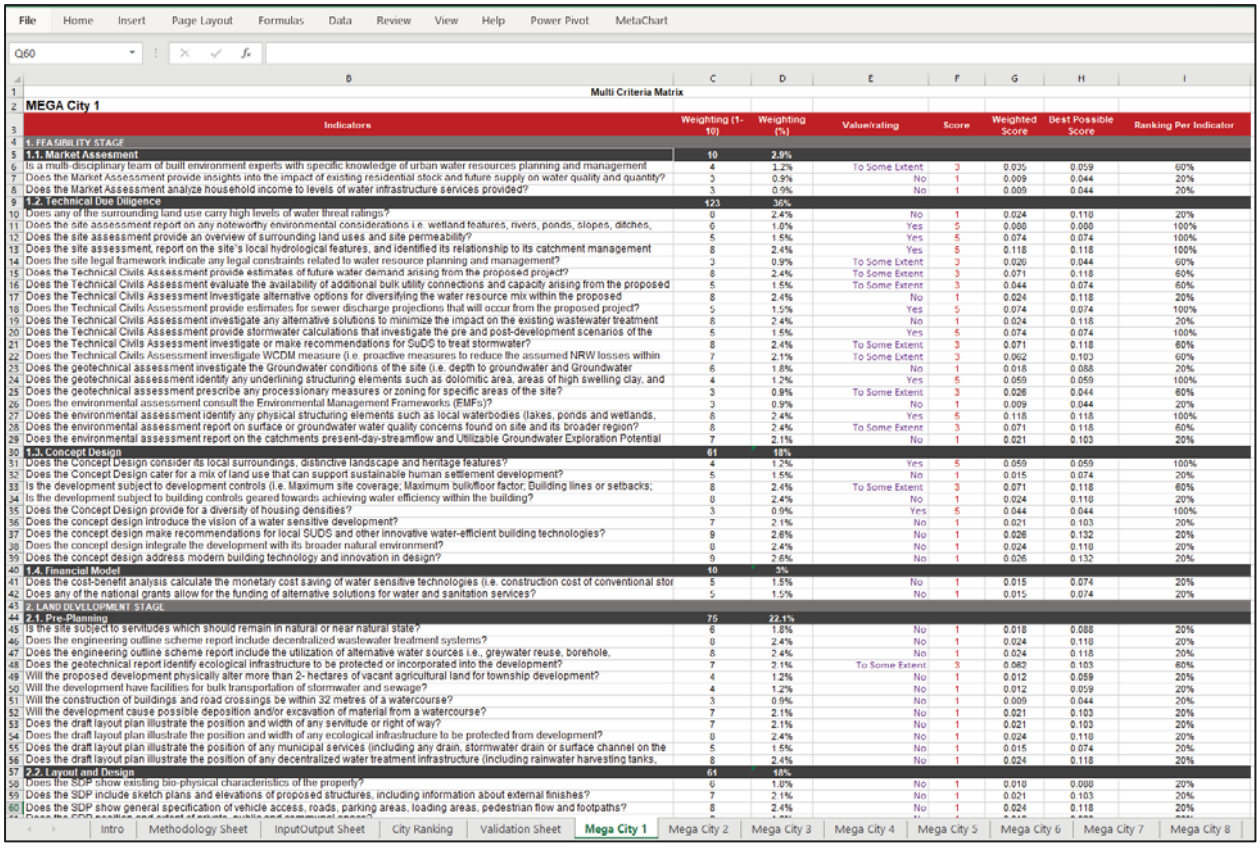
	A	B	C	D	E	F	G	L	N	P
1								Score 1	Score 3	Score 5
2							1. Feasibility Stage			
3							1.1. Market Assesment			
4							Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management (more specifically WSUD) appointed to conduct the Feasibility Study?	No	To Some Extent	Yes
5	Lvl 1	Yes	Yes				Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	No	To Some Extent	Yes
6	Lvl 2	No	To Some Extent				Does the Market Assessment analyze household income to levels of water infrastructure services provided?	No	To Some Extent	Yes
7	Lvl 3		No				1.2. Technical Due Diligence			
8	Lvl 4						1.2.1. Site Assessment			
9							Does any of the surrounding land use carry high levels of water threat ratings?	No	To Some Extent	Yes
10							Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches, and sinkholes visible to the naked eye?	No	To Some Extent	Yes
11							Does the site assessment provide an overview of surrounding land uses and site permeability?	No	To Some Extent	Yes
12							Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management area?	No	To Some Extent	Yes
13							Does the site legal framework indicate any legal constraints related to water resource planning and management?	No	To Some Extent	Yes
14							1.2.2. Bulk Services Assessment			
15							Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	No	To Some Extent	Yes
16							Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed project?	No	To Some Extent	Yes
17							Does the Technical Civils Assessment investigate alternative options for diversifying the water resource mix within the proposed development (i.e., Groundwater, reuse of wastewater and or rainwater/stormwater harvesting)?	No	To Some Extent	Yes
18							Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	No	To Some Extent	Yes
19							Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment works (i.e. decentralized wastewater treatment works that treat wastewater to a suitable standard to be reused for non-potable uses)?	No	To Some Extent	Yes
20							Does the Technical Civils Assessment provide stormwater calculations that investigate the pre and post-development scenarios of the site?	No	To Some Extent	Yes
21							Does the Technical Civils Assessment investigate or make recommendations for SuDS to treat stormwater?	No	To Some Extent	Yes
22							Does the Technical Civils Assessment investigate WCDM measure (i.e. proactive measures to reduce the assumed NRW losses within the proposed reticulation system - promote higher-density developments)?	No	To Some Extent	Yes
23							1.2.3. Geotechnical Analysis			
24							Does the geotechnical assessment investigate the Groundwater conditions of the site (i.e. depth to groundwater and Groundwater Recharge Potential	No	To Some Extent	Yes
25							Does the geotechnical assessment identify any underlining structuring elements such as dolomitic area, areas of high swelling clay, and areas of impeded soil drainage?	No	To Some Extent	Yes
26							Does the geotechnical assessment prescribe any processionary measures or zoning for specific areas of the site?	No	To Some Extent	Yes
27							1.2.4. Environmental Assessment / Screening			
28							Does the environmental assessment consult the Environmental Management Frameworks (EMFs)?	No	To Some Extent	Yes
29							Does the environmental assessment identify any physical structuring elements such as local waterbodies (lakes, ponds and wetlands, Flood lines) potentially acting as supplementary water sources that should be protected from physical development?	No	To Some Extent	Yes
30							Does the environmental assessment report on surface or groundwater water quality concerns found on site and its broader region?	No	To Some Extent	Yes
31							Does the environmental assessment report on the catchments present-day-streamflow and Utilizable Groundwater Exploration Potential (UGEP)?	No	To Some Extent	Yes
32							1.3. Concept Design			
33							1.3.1. Spatial Modeling			
34							Does the Concept Design consider its local surroundings, distinctive landscape and heritage features?	No	To Some Extent	Yes
35							1.3.2. Land Use Mix			
36							Does the Concept Design cater for a mix of land use that can support sustainable human settlement development?	No	To Some Extent	Yes
37							Is the development subject to development controls (i.e. Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks; Height restrictions; a	No	To Some Extent	Yes
38							Is the development subject to building controls geared towards achieving water efficiency within the building?	No	To Some Extent	Yes
39							1.3.3. Architectural Inputs			
40							Does the Concept Design provide for a diversity of housing densities?	No	To Some Extent	Yes
41							Does the concept design introduce the vision of a water sensitive development?	No	To Some Extent	Yes
42							1.3.4. Innovation in design			
43							Does the concept design make recommendations for local SUDS and other innovative water-efficient building technologies?	No	To Some Extent	Yes
44							Does the concept design integrate the development with its broader natural environment?	No	To Some Extent	Yes
45							Does the concept design address modern building technology and innovation in design?	No	To Some Extent	Yes
46							1.4. Financial Model			
47							1.4.1. Secure Development Finance			
48							Does the cost-benefit analysis calculate the monetary cost saving of water sensitive technologies (i.e. construction cost of conventional stormwater treatmer	No	To Some Extent	Yes
49							1.4.2. Subsidy Agreement / Grant Funding			
50							Does any of the national grants allow for the funding of alternative solutions for water and sanitation services?	No	To Some Extent	Yes
51							2. Land Development Stage			
52							2.1. Pre-Planning			
53							2.1.1. Basemap			

Intro | Methodology Sheet | InputOutput Sheet | City Ranking | Validation Sheet | Mega City 1 | Mega City 2 | Mega City 3 | Mega City 4 | Mega City 5 | Mega City 6 | Mega City 7 | Mega City 8

Figure 20: Validation Sheet

Figure 20 represents the Validation Sheet. The Validation Sheet is functioning background information linked to the Input/output sheet of the toolkit.

Figure 21, Mega City 1 contains functioning background information which links to both the Methodology Sheet, Input Output sheet and city ranking sheet. This sheet contains the Indicator Weightings (Colom C) which can be adjusted or customized to suit the development needs.



Multi Criteria Matrix

MEGA City 1

Indicators	Weighting (1-10)	Weighting (%)	Value/rating	Score	Weighted Score	Best Possible Score	Ranking Per Indicator
1. FEASIBILITY STAGE							
1.1. Market Assesment	**10**	**2.9%**					
Is a multi-disciplinary team of built environment experts with specific knowledge of urban water resources planning and management	4	1.2%	To Some Extent	3	0.035	0.059	60%
Does the Market Assessment provide insights into the impact of existing residential stock and future supply on water quality and quantity?	3	0.9%	No	1	0.009	0.044	20%
Does the Market Assessment analyze household income to levels of water infrastructure services provided?	3	0.9%	No	1	0.009	0.044	20%
1.2. Technical Due Diligence	**123**	**36%**					
Does any of the surrounding land use carry high levels of water threat ratings?	8	2.4%	No	1	0.024	0.118	20%
Does the site assessment report on any noteworthy environmental considerations i.e. wetland features, rivers, ponds, slopes, ditches,	6	1.8%	Yes	5	0.088	0.088	100%
Does the site assessment provide an overview of surrounding land uses and site permeability?	5	1.5%	Yes	5	0.074	0.074	100%
Does the site assessment, report on the site's local hydrological features, and identified its relationship to its catchment management	8	2.4%	Yes	5	0.118	0.118	100%
Does the site legal framework indicate any legal constraints related to water resource planning and management?	3	0.9%	To Some Extent	3	0.026	0.044	60%
Does the Technical Civils Assessment provide estimates of future water demand arising from the proposed project?	8	2.4%	To Some Extent	3	0.071	0.118	60%
Does the Technical Civils Assessment evaluate the availability of additional bulk utility connections and capacity arising from the proposed	5	1.5%	To Some Extent	3	0.044	0.074	60%
Does the Technical Civils Assessment investigate alternative options for diversifying the water resource mix within the proposed	8	2.4%	No	1	0.024	0.118	20%
Does the Technical Civils Assessment provide estimates for sewer discharge projections that will occur from the proposed project?	5	1.5%	Yes	5	0.074	0.074	100%
Does the Technical Civils Assessment investigate any alternative solutions to minimize the impact on the existing wastewater treatment	8	2.4%	No	1	0.024	0.118	20%
Does the Technical Civils Assessment provide stormwater calculations that investigate the pre and post-development scenarios of the	5	1.5%	Yes	5	0.074	0.074	100%
Does the Technical Civils Assessment investigate or make recommendations for SuDS to treat stormwater?	8	2.4%	To Some Extent	3	0.071	0.118	60%
Does the Technical Civils Assessment investigate WCDM measure (i.e. proactive measures to reduce the assumed NRW losses within	7	2.1%	To Some Extent	3	0.062	0.103	60%
Does the geotechnical assessment investigate the Groundwater conditions of the site (i.e. depth to groundwater and Groundwater	6	1.8%	No	1	0.018	0.088	20%
Does the geotechnical assessment identify any underlining structuring elements such as dolomitic area, areas of high swelling clay, and	4	1.2%	Yes	5	0.059	0.059	100%
Does the geotechnical assessment prescribe any processionary measures or zoning for specific areas of the site?	3	0.9%	To Some Extent	3	0.026	0.044	60%
Does the environmental assessment consult the Environmental Management Frameworks (EMFs)?	3	0.9%	No	1	0.009	0.044	20%
Does the environmental assessment identify any physical structuring elements such as local waterbodies (lakes, ponds and wetlands,	8	2.4%	Yes	5	0.118	0.118	100%
Does the environmental assessment report on surface or groundwater water quality concerns found on site and its broader region?	8	2.4%	To Some Extent	3	0.071	0.118	60%
Does the environmental assessment report on the catchments present-day-streamflow and Utilizable Groundwater Exploration Potential	7	2.1%	No	1	0.021	0.103	20%
1.3. Concept Design	**61**	**18%**					
Does the Concept Design consider its local surroundings, distinctive landscape and heritage features?	4	1.2%	Yes	5	0.059	0.059	100%
Does the Concept Design cater for a mix of land use that can support sustainable human settlement development?	5	1.5%	No	1	0.015	0.074	20%
Is the development subject to development controls (i.e. Maximum site coverage; Maximum bulk/floor factor; Building lines or setbacks;	8	2.4%	To Some Extent	3	0.071	0.118	60%
Is the development subject to building controls geared towards achieving water efficiency within the building?	8	2.4%	No	1	0.024	0.118	20%
Does the Concept Design provide for a diversity of housing densities?	3	0.9%	Yes	5	0.044	0.044	100%
Does the concept design introduce the vision of a water sensitive development?	7	2.1%	No	1	0.021	0.103	20%
Does the concept design make recommendations for local SUDS and other innovative water-efficient building technologies?	9	2.6%	No	1	0.026	0.132	20%
Does the concept design integrate the development with its broader natural environment?	8	2.4%	No	1	0.024	0.118	20%
Does the concept design address modern building technology and innovation in design?	9	2.6%	No	1	0.026	0.132	20%
1.4. Financial Model	**10**	**3%**					
Does the cost-benefit analysis calculate the monetary cost saving of water sensitive technologies (i.e. construction cost of conventional stor	5	1.5%	No	1	0.015	0.074	20%
Does any of the national grants allow for the funding of alternative solutions for water and sanitation services?	5	1.5%	No	1	0.015	0.074	20%
2. LAND DEVELOPMENT STAGE							
2.1. Pre-Planning	**75**	**22.1%**					
Is the site subject to servitudes which should remain in natural or near natural state?	6	1.8%	No	1	0.018	0.088	20%
Does the engineering outline scheme report include decentralized wastewater treatment systems?	8	2.4%	No	1	0.024	0.118	20%
Does the engineering outline scheme report include the utilization of alternative water sources i.e., greywater reuse, borehole,	8	2.4%	No	1	0.024	0.118	20%
Does the geotechnical report identify ecological infrastructure to be protected or incorporated into the development?	7	2.1%	To Some Extent	3	0.062	0.103	60%
Will the proposed development physically alter more than 2- hectares of vacant agricultural land for township development?	4	1.2%	No	1	0.012	0.059	20%
Will the development have facilities for bulk transportation of stormwater and sewage?	4	1.2%	No	1	0.012	0.059	20%
Will the construction of buildings and road crossings be within 32 metres of a watercourse?	3	0.9%	No	1	0.009	0.044	20%
Will the development cause possible deposition and/or excavation of material from a watercourse?	7	2.1%	No	1	0.021	0.103	20%
Does the draft layout plan illustrate the position and width of any servitude or right of way?	7	2.1%	No	1	0.021	0.103	20%
Does the draft layout plan illustrate the position and width of any ecological infrastructure to be protected from development?	8	2.4%	No	1	0.024	0.118	20%
Does the draft layout plan illustrate the position of any municipal services (including any drain, stormwater drain or surface channel on the	5	1.5%	No	1	0.015	0.074	20%
Does the draft layout plan illustrate the position of any decentralized water treatment infrastructure (including rainwater harvesting tanks,	8	2.4%	No	1	0.024	0.118	20%
2.2. Layout and Design	**61**	**18%**					
Does the SDP show existing bio-physical characteristics of the property?	6	1.8%	No	1	0.018	0.088	20%
Does the SDP include sketch plans and elevations of proposed structures, including information about external finishes?	7	2.1%	No	1	0.021	0.103	20%
Does the SDP show general specification of vehicle access, roads, parking areas, loading areas, pedestrian flow and footpaths?	8	2.4%	No	1	0.024	0.118	20%

Figure 21: Mega City 1/Development

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Annexure 1

Key characteristics/aspects of MEGA Project

The table below extrapolates the key characteristics/aspects of MPs.

Old	New: applicable to each MP
Projects that offer scale of delivery of, preferably, a minimum of 10 houses and 5,000 serviced stands per FY for next 5 to 15 years. Projects that include a variety of housing typologies and cover a variety of housing programmes, such as inter-alia rental…..assisted housing. In this regard projects contribution to MTSF of the NDHS shall serve as a guide for the mix of typologies and housing project combinations	2,500 serviced stands per FY, linked to the Rapid Land Release Programme: • Serviced stands for employer assisted housing – 10% • For owner-built housing – 10% 10,000 housing units of mixed typology as follows: • High Density Multi-Storey BNG – 50% • Gap housing – 10% • Social housing – 5% • Bonded housing – 5% • Affordable Rental housing – 5% • Hostel redevelopment – 10% • Urban Renewal Projects (repurposed buildings) – 5% • Accessible housing for Persons with Disabilities – 5% • Military Veterans housing – 5% OR • Percentages to be determined by demographics of municipality
Projects that will maximise job creation opportunities in line with the Expanded Public Works Programme (“EPWP”) requirements and assist with mobilising and utilising youth brigades and women empowerment.	• EPWP Job Creation per MP per FY: Total 600 [300 youth, 300 women] • 100 youth and 100 women (sub-total 200) – opportunities for sustainable decent jobs [full time-equivalent (as defined by the Department of Public Works)] • 100 youth and 100 women (sub-total 200) – practical work experience opportunities • 100 youth and 100 women (sub-total 200) – access to accredited training while earning an income
Projects that can demonstrate a maximum gearing of overall government investment	50% co-investment of each MP’s total budget: • Water and Sanitation – 10% • Electricity and Energy – 10% • Houses – 5% • Social Amenities – (5%) [education, health, sport and recreation, arts and culture] • Economic Amenities – 15% • Public Transport and Roads – 5% OR • As defined by the municipal Infrastructure Services Agreement
Projects that can demonstrate sustainability over the long term and post project completion and promote and impact on the creation of sustainable integrated human settlements	Time and budget based whole life-cycle plan from concept and design to maintenance; and an urban management plan for common spaces in multi-storey high density developments
Projects that promote joint collaboration between the private sector and government in order to facilitate efficiency, effectiveness and fast-tracking of project development and delivery	• Government – • integrated, centralised construction and development approval process and system • integrated and aligned grant allocation and disbursements • Gauteng Human Settlement Spatial Master Plan updated each quarter of each FY against deliverables

Old	New: applicable to each MP
	• Implementation of IDMS
Projects that demonstrate and promote innovation in respect of environmental and ecological innovations, alternative building technologies, etc.	• Broadband/5G internet connectivity • Utilisation of alternative building technologies • Gas reticulation systems • Renewable energy, e.g. solar • Recycling of solid waste and waste-water
Projects that promote government's transformation agenda through, amongst others, procurement from local suppliers and SMMES	• 50% of construction materials to be procured from SMME's of formerly disadvantaged individuals • Staff profile of developer meets or exceeds Employment Equity targets i.r.o. youth, women and persons with disabilities. • 70% of general company procurement, e.g. stationery, from local suppliers • 40% women, youth and persons with disabilities ownership of entity (5% pwd, 20% women and 15% youth)
	Connection to bulk services infrastructure: • 100% provision of external and link infrastructure • 100% provision of civil and engineering services • 100% upgrading of existing and civil engineering services • Storm water drainage • Water reticulation up to and including water connection to each unit • Electricity reticulation as agreed with the municipality
	Project must be reflected in the Gauteng Human Settlements Spatial Master Plan and in the IDP of the respective municipality. Acquisition of 100% of land required: • 50% for housing delivery • 20% for services stands/RLRP • 10% for social amenities • 20% for economic amenities All Required Approvals attained: • EIA • Water Use • Contour Mapping and Servitudes • Conveyancing and Land Ownership verification • Town Planning, Land Use, Zoning and Site Development Plans • Market and Feasibility Studies • Civil Engineering Scheme • Electrical Engineering Scheme • Traffic Studies • • Transport, Roads and Public Transport Plans Detailed financial Plan/budget for entire project and presented per FY: • Income (subsidies) from government • Income (investment acquired) from developer • Capex (including bulk, link, internal services) • Operations and Maintenance • Post development urban management and maintenance • Cash flow management and expenditure patterns • Revenue optimisation measures High level implementation Plan: • Key drivers, risks and mitigation measures • Key Performance Indicators

Annexure 2

Information and Resource Demand

The table below extrapolates the planned land use of each of each MPs.

MEGA City	Land Size(h.a)	Planned Land Use																				
	-	RDP and RNG	FLISP/Bonded Houses	Section Title	Community Rental	Military Veterans	Social Housing	Creches	Primary School	Secondary School	Clinic	Community Facilities	Church	Shops	Shopping Centers	Office Park	Filling Station	Taxi Rank	Parks	Public Open Spaces
Alexandra	-	18,480	3,080	3,080	3,080	3,080														
Boikelong MEGA Housing Development	519																			
Cullinan MEGA City	180	1,246	239		1,595	275	1,415	2	1	1	1	2	1	1	1	1	1	1	7	3
Daggafontein MEGA City	750	4,730	1,796		4,259		4,725				1									
Goudrand MEGA City		10,668	2,529					7	5				8		3					
Helderwyk Integrated MEGA	300	3,250	5,579				1,750													
John Dube MEGA City	497.22	7,205	2,030		1,030															
Kwazenzele MEGA Development		994	177				178													
Lanseria Airport City																				
Leratong City	400																			
Mapleton																				
Montrose City MEGA Development	519	4,954	2,325		980	839	4,695													
Nelmapius MEGA Development		2,079	446				234													
Park City		2,200	1,000				3,200													
Stinkwater MEGA city	415	4,093	1,488		1,233		822	4	3				4			5				6
Tswaing Urban Development	415	8,634	2,469		1,231				5	4		19	21			27				
Varkenslaagte MEGA Project		5,000	3,991		1,500		2,000													
Western MEGA Project																				
Witpoortjie MEGA Project	148																			
Total	3,646	73,533	27,149	3,080	14,908	4,194	19,019	13	14	5	2	21	34	1	4	33	1	1	7	9