

TERMS OF REFERENCE FOR A DIRECTED WRC PROJECT

THEME: Water Availability

TITLE: Impacts of rapid urbanisation on water resources (groundwater, surface water, and recharge systems), water quality, and long-term water security in South Africa

ToR:

1. Rationale

Rapid urbanisation in South Africa is placing increasing pressure on both surface water and groundwater systems, often without adequate planning, monitoring, or integration of water resource considerations. The expansion of urban areas, including both formal development and informal settlements, is transforming natural landscapes into impervious surfaces and disrupting key hydrological processes. This transformation reduces infiltration, alters runoff dynamics, and diminishes groundwater recharge, while increasing pollutant loading to both surface water and shallow aquifers. Critical recharge zones and hydrologically sensitive areas are increasingly being degraded or lost, resulting in declining water quality, reduced baseflow contributions to rivers, and growing uncertainty around long-term water availability and water security.

In many urban and peri-urban areas, water services infrastructure is unable to keep pace with development, leading to additional pressures from poorly managed wastewater, stormwater runoff, and sanitation systems. These pressures introduce complex contaminant loads into water systems, increasing risks to human health and raising treatment costs.

Despite the scale of the challenge, there remains a limited integrated understanding of how urbanisation affects groundwater, surface water, recharge systems, and water quality across different hydrogeological and climatic settings in South Africa. This lack of evidence constrains effective planning, the protection of critical water resource areas, and the development of long-term water security strategies.

This project aims to assess the extent and nature of urbanisation impacts on water resources, with a focus on groundwater recharge, water quality, and catchment hydrological functioning. By developing an integrated evidence base and spatial understanding of these impacts, the project will support improved planning, protection, and management of water resources in rapidly urbanising environments.

2. Main Objective

To assess and quantify the impacts of rapid urbanisation on groundwater recharge, water quality, and catchment hydrological functioning, including linkages to surface water systems, in order to support evidence-based planning and long-term water security in South Africa.

Specific Objectives

1. To assess the vulnerability of groundwater systems to contamination under different urbanisation pressures and land-use conditions.
2. To evaluate the impacts of urban expansion on surface water systems, including changes in runoff dynamics and baseflow contributions.
3. To quantify changes in groundwater recharge potential associated with urban land-use transformation using spatial and temporal analysis.
4. To analyse pollutant pathways and contaminant loading affecting both surface water and shallow groundwater systems in urban and peri-urban environments.
5. To compare different urbanisation typologies (e.g. formal vs informal expansion) and their impacts on water quantity and quality.
6. To develop spatial tools and conceptual models that describe the interactions between urban development and water resource systems.

7. To generate scenarios illustrating potential future impacts of urban growth on water resources under different development pathways, including implications for long-term water security.
8. To engage stakeholders in validating findings and supporting uptake in planning and management processes.

3. Expected Deliverables

1. Inception report: detailing the study approach, selected case study areas, and methodology.
2. Urbanisation impact assessment report: analysis of impacts on groundwater, surface water, recharge systems, and water quality.
3. Spatial analysis and mapping outputs: maps illustrating changes in recharge potential, vulnerability zones, and the impacts of urban expansion.
4. Conceptual models of urban–water system interactions: integrated representation of how urbanisation affects hydrological processes.
5. Scenario analysis report: future projections of urbanisation impacts on water quantity and quality under different development scenarios, including implications for long-term water security.
6. Stakeholder engagement report: summary of consultations and validation of findings.
7. Final report and management guideline: practical guidance for integrating water resource considerations into urban planning and management.

Total Budget: R 2 200 000

Year 1: R 300 000

Duration: 3 years