REFINEMENT OF STRATEGIC GROUNDWATER SOURCE AREAS OF SOUTH AFRICA

WP11446

STATUS QUO OF STRATEGIC GROUNDWATER SOURCE AREAS OF SOUTH AFRICA REPORT

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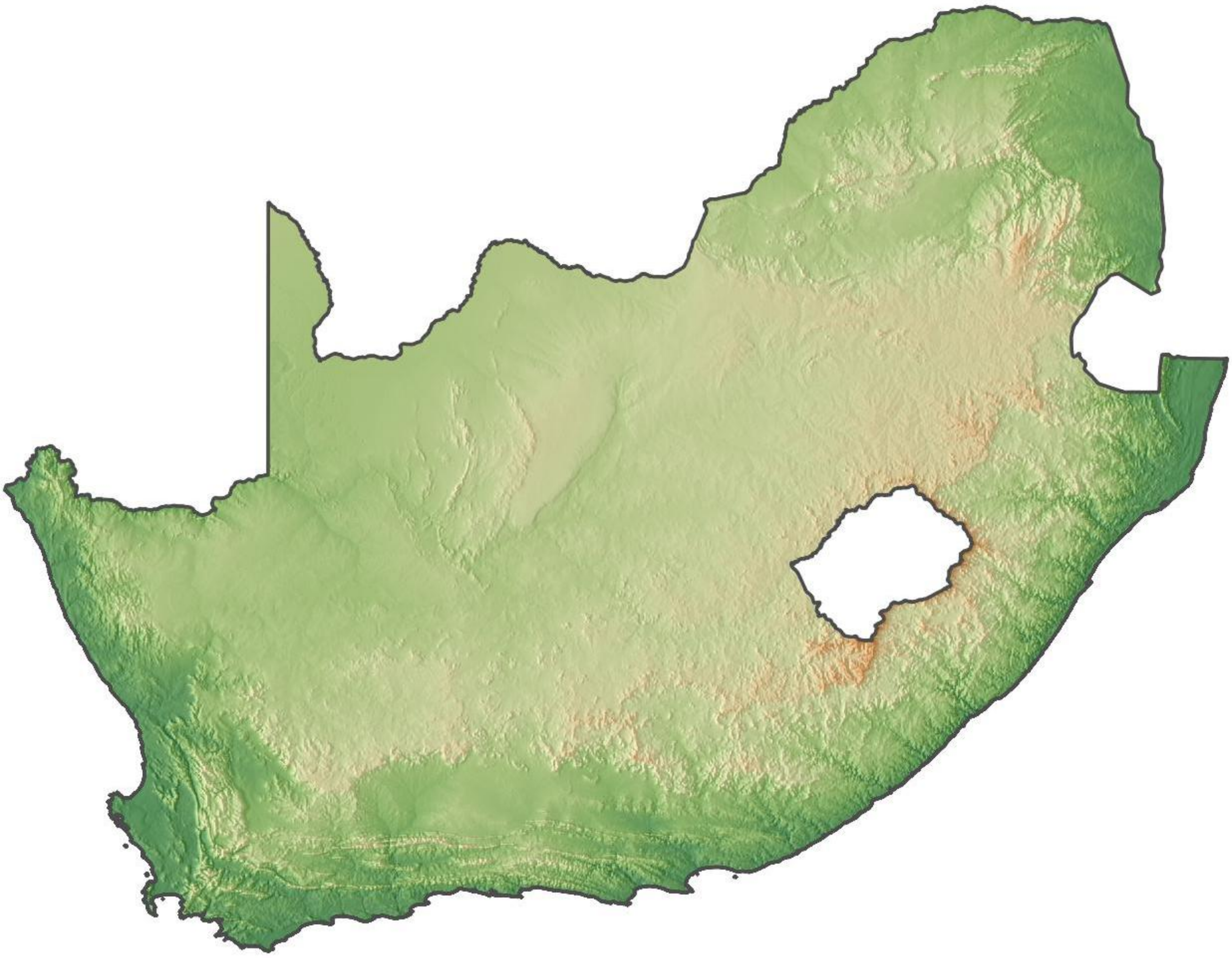
4.4	RDM/NAT00/02/CON/SWSA/0227	Close Out Report

REFINEMENT OF STRATEGIC GROUNDWATER SOURCE AREAS OF SOUTH AFRICA



Status Quo of Strategic Groundwater Source Areas of South Africa Report

Final

Prepared for:

Department of Water and Sanitation

Chief Directorate: Water Ecosystems Management

Executive Summary

Background and Motivation

South Africa's water security is increasingly under pressure due to rising demand, climate variability, and governance challenges. While national water resource management has traditionally focused on surface water, groundwater plays an equally crucial role, particularly in arid and semi-arid regions where surface water is scarce.

Strategic Water Source Areas (SWSAs), first introduced by Nel et al. (2013), are critical regions that make a significant contribution to the national water budget. In 2018, Le Maitre *et al.* refined this framework to incorporate groundwater resources, taking into account recharge potential, ecosystem sustainability, and socio-economic development. This refinement identified 37 nationally and 20 sub-nationally significant Strategic Water Source Areas for Groundwater (SWSA-gw).

This report forms part of the Refinement of Strategic Groundwater Source Areas of South Africa Project, commissioned by the Department of Water and Sanitation (DWS) Chief Directorate: Water Ecosystems Management (CD: WEM). Its primary objective is to establish a comprehensive and updated Status Quo Assessment of the 37 existing, nationally significant, SWSA-gw delineated by Le Maitre *et al.* (2018). This updated assessment serves as a baseline for refining SWSA-gw delineation and supports the development of improved groundwater protection and management strategies.

Development of the Status Quo Assessment

To address limitations in the previous SWSA-gw delineation, identified by Le Maitre *et al.* (2018) and the DWS CD: WEM, regarding its practical implementation, this Status Quo Assessment was developed using a structured framework. The framework systematically evaluates each SWSA-gw across multiple hydrogeological categories, ensuring a consistent basis for comparison.

The assessment consists of two core components:

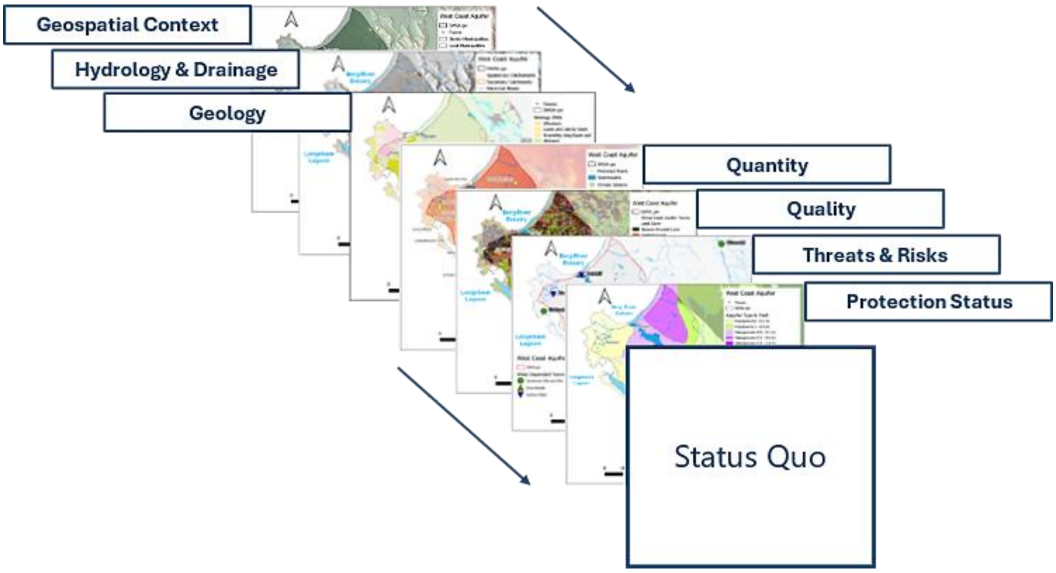
1. **Description**

   Establishes the geospatial and hydrogeological context of each SWSA-gw, covering: Geospatial Context (topography, administrative boundaries, infrastructure); Hydrology and Drainage (river systems, water bodies, surface-groundwater interactions); and Geology (aquifer classification, hydrostratigraphy, structural controls).

2. **Current Status**

   Evaluates the functional conditions of groundwater resources, including: Groundwater Quantity (aquifer recharge, abstraction trends, groundwater level trends); Groundwater Quality (water chemistry, contamination risks, long-term quality trends); Threats and Risks (climate change, land use impacts, potential pollution sources); and Protection Status (formal conservation areas, biodiversity zones, groundwater-dependent ecosystems)

This structured approach ensures a comprehensive and standardised evaluation of groundwater resources across all existing 37 SWSA-gw, integrating the latest hydrogeological data, climate assessments, groundwater abstraction records, and land-use analyses.



Conceptual illustration of how different components contribute to the development of a Status Quo assessment for each SWSA-gw.

Evaluation of the Current Status Matrix

To systematically assess groundwater conditions, a Current Status Matrix was developed to rank each SWSA-gw based on four key criteria: 1) Groundwater Quantity, 2) Groundwater Quality, 3) Threats & Risks, and 4) Protection Status. Each category was evaluated using available datasets, and SWSA-gw were classified into five status categories:

Current Status Matrix used for assessing the groundwater conditions of each SWSA-gw.

Current Status Class / Current Status Category	A (Excellent)	B (Good)	C (Moderate)	D (Poor)	E (Critical)
Quantity	High recharge, surplus water availability, minor use	Adequate recharge, stable levels, well-managed abstraction	Balanced use, moderate stress, seasonal fluctuations	Over-extraction, declining levels, unsustainable	Critical depletion, major groundwater use, severe stress
Quality	Excellent water quality, meets all standards	Minor localised contamination, mostly within safe limits	Some exceedances, moderate pollution risk	Significant contamination, widespread exceedances	High pollution levels, unfit for use
Threats and Risks	Minimal threats, well-managed risks	Some threats, managed effectively	Moderate risks, emerging issues	High threats, pollution sources, baseflow reduction	Severe threats, irreversible degradation
Protection Status	Strong policies, effective enforcement, active monitoring	Good regulation, some enforcement gaps	Moderate regulation, inconsistent enforcement	Weak protection, few monitoring efforts	No effective protection, unregulated use

This ranking provides a quantitative assessment of groundwater sustainability, helping to identify areas facing critical challenges as well as those maintaining stable conditions.

Current Status Matrix, including associated descriptions, metrics, and classification used to assess groundwater conditions for each SWSA-gw.

Current Status Category	Description	Metric	Current Status Class	
Groundwater Quantity	Total Groundwater Use Volume (Mm^3/a) per SWSA-gw vs Total Estimated Recharge Volume (Mm^3/a) per SWSA-gw Expressed as (%)	<10	A	Excellent
		10 to 30	B	Good
		30 to 60	C	Moderate
		60 to 80	D	Poor
		80 to 100	E	Critical
Groundwater Quality	Outliers & Contamination Indicators	Natural / DWQ standard	A	Excellent
		Natural	B	Good
		Pollution Indicators	C	Moderate
		Pollution Trends / Knowledge	D	Poor
		Widespread Pollution	E	Critical
Threats and Risks	% Area Land Use of Built-up Areas & Mines/Quarries per SWSA-gw	Mostly natural	A	Excellent
		Cultivation & Limited Built-Up <10%	B	Good
		Mining >10 km^2, Built-up >10%	C	Moderate
		Mining >30 km^2, Built-up >20%	D	Poor
		Mining > 40 km^2	E	Critical
	Climatic Zone, Based on Köppen-Geiger and Mean Annual Precipitation (MAP)	Humid	A	Excellent
		Semi-Humid	B	Good
		Moderate	C	Moderate
		Semi-Arid	D	Poor
		Arid	E	Critical
	Climate Change, based on change in recharge Dennis & Dennis (2012).	N/A	A	Excellent
		Increase in Recharge	B	Good
		No to Small Change	C	Moderate
		Decrease in Recharge	D	Poor
		N/A	E	Critical
	Population Growth, based on annual growth (%) per SWSA-gw	< 0	A	Excellent
		0 to 0.5	B	Good
		0.5 to 2	C	Moderate
		2 to 4	D	Poor
		≥ 4	E	Critical
Protection Status	Based on % Area Protected of the SWSA-gw	Fully Protected	A	Excellent
		Good Protection & SGWCA	B	Good
		Scattered Protection	C	Moderate
		Limited Protection	D	Poor
		No Protection	E	Critical

The Status Quo Assessment

The Status Quo Assessment provides a structured evaluation of groundwater conditions across various SWSA-gw regions. Findings are detailed in separate appendices, each corresponding to a specific groundwater system.

The table below summarises the Current Status Scores, ranking each region based on the four key parameters to illustrate groundwater sustainability trends and identify priority areas for management and protection.

Current Status Scores of each SWSA-gw based on the Current Status Matrix.

SWSA-gw		Current Status Category & Status Quo			
		Quantity	Quality	Threats & Risks	Protection Status
01	Bo-Molopo Karst Belt	C	D	C	B
02	Cape Peninsula and Cape Flats	C	D	E	C
03	Central Pan Belt	E	C	B	D
04	Coega TMG Aquifer	C	D	C	B
05	Crocodile River Valley	E	C	C	B
06	De Aar Region	B	C	C	D
07	Eastern Kalahari A	E	C	B	E
08	Eastern Kalahari B	B	B	B	E
09	Eastern Karst Belt	D	B	D	D
10	Far West Karst Region	E	B	C	D
11	George and Outeniqua	A	C	B	C
12	Giyani	D	C	C	E
13	Ixopo / Kokstad	A	A	D	D
14	Kroondal / Marikana	E	D	D	B
15	Kroonstad	A	C	B	D
16	KwaDukuza	A	C	D	E
17	Letaba Escarpment	B	C	B	D
18	Northern Ghaap Plateau	B	C	B	D
19	Northern Lowveld Escarpment	A	B	C	C
20	Northwestern Cape Ranges	C	A	B	B
21	Nyl and Dorps River Valley	C	C	B	B
22	Overberg Region	B	A	B	C
23	Phalaborwa	E	D	E	C
24	Richards Bay GW Fed Estuary	A	B	D	D
25	Sandveld	E	C	B	C
26	Sishen / Kathu	C	C	D	D
27	Southern Ghaap Plateau	E	A	D	D
28	Southwestern Cape Ranges	B	B	B	B
29	Soutpansberg	B	C	D	C
30	Transkei Middleveld	A	C	B	E
31	Tulbagh-Ashton Valley	C	C	B	C
32	Upper Sand (Polokwane) Aquifer System	E	C	D	D
33	Ventersdorp/Schoonspruit Karst Belt	C	C	B	B
34	Vivo-Dendron	E	D	B	B
35	West Coast Aquifer	B	C	D	C
36	Westrand Karst Belt	D	C	B	B
37	Zululand Coastal Plain	A	A	C	C

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List of Abbreviations and Acronyms

CALC	-	Computer Automated Land-Cover
CB	-	Capacity Building
CD: WEM	-	Chief Directorate: Water Ecosystems Management
CGS	-	Council for Geoscience
CMA	-	Catchment Management Agency
COP	-	Copernicus Global
CSIR	-	Council for Scientific and Industrial Research
DEA	-	Department of Environmental Affairs
DEM	-	Digital Elevation Model
DFFE	–	Department of Forestry, Fisheries, and the Environment
DM	-	District Municipalities
DWA	-	Department of Water Affairs
DWAF	-	Department of Water Affairs and Forestry
DWS	-	Department of Water and Sanitation
EC	-	Electrical Conductivity
Et al.	-	And Others
Etc.	-	Et cetera
GDE	-	Groundwater Dependent Ecosystem
GIS	-	Geographic Information System
GRAII	-	Groundwater Resource Assessment II
GTI	-	GeoTerraImage
IGRAC	-	International Groundwater Resources Assessment Centre
$l/s/km^2$	-	Liters per second per square kilometre
LM	-	Local Municipalities
Ltd	-	Limited Company
MAP	-	Mean Annual Precipitation
MAR	-	Mean Annual Runoff
MDB	-	Municipal Demarcation Board
mm/a	-	Millimetres per annum
Mm^3/a	-	Million cubic meters per annum
NBA	-	National Biodiversity Assessment
NFEPA	-	National Freshwater Ecosystem Priority Areas
NGA	-	National Groundwater Archive
NGI	-	National Geo-Spatial Information
NLC	-	National Land Cover
NWA	-	National Water Act
NWM5	-	National Wetland Map 5
NWRS I	-	National Water Resource Strategy Frist Edition
NWRS II	-	National Water Resource Strategy Second Edition
NWRS III	-	National Water Resource Strategy Third Edition
pH	-	Acidity/Alkalinity
PMC	-	Project Management Committee
PS	-	Public Stakeholder
PSC	-	Project Steering Committee
Pty	-	Proprietary Limited
Ramsar Sites	-	Wetlands of International Importance
SAEON	-	South African Environmental Observation Network
SANBI	-	South African National Biodiversity Institute
SGWCA	-	Subterranean Groundwater Control Area
Stats SA	-	Statistics South Africa

SWSA	-	Strategic Water Source Areas
SWSA-gw	-	Strategic Groundwater Source Areas
SWSA-sw	-	Strategic Surface Water Source Areas
ToR	-	Terms of Reference
UGEP	-	Utilisable Groundwater Exploitation Potential
WARMS	-	Water use Authorization & Registration Management System
WMA	-	Water Management Area
WMS	-	Water Management System
WP	-	Work Package
WR2005	-	Water Resources of South Africa 2005
WR2012	-	Water Resources of South Africa 2012
WR90	-	Water Resources Assessments, 1990
WRC	-	Water Research Commission
WSA	-	Water Service Authorities
WSP	-	Water Service Providers
WUA	-	Water Use Association
WWF-SA	-	Worldwide Fund for Nature in South Africa

1. INTRODUCTION

1.1. Background and Motivation

South Africa faces increasing challenges in securing sustainable and equitable access to water due to rising demand, climate variability, infrastructure challenges and governance constraints. Historically, groundwater was underrepresented in national water planning. However, the enactment of the National Water Act (NWA, Act No. 36 of 1998) and the subsequent development of the National Water Resource Strategies, NWRS I (2004), NWRS II (2013), and NWRS III (2023), have reinforced its importance within the national water strategy, formalising governance structures and promoting sustainable groundwater use. NWRS III (2023) further advances the strategic approach to groundwater resource management, emphasising groundwater's crucial role at a national scale, particularly in arid and semi-arid regions where surface water availability is limited.

The concept of Strategic Water Source Areas (SWSAs) was first introduced in 2013 (Nel *et al.*, 2013) to identify and protect key surface water resources. Using a rainfall-runoff hydrological model, the first set of 21 SWSAs was identified across the country. By 2018, the Water Research Commission (WRC) refined this framework to include Strategic Groundwater Source Areas (SWSA-gw), identifying 37 nationally significant groundwater source areas (Le Maitre *et al.*, 2018). These areas, covering approximately 9% of South Africa's land area, play a critical role in maintaining river baseflow, supporting ecosystems, agriculture, and human settlements. However, the 2018 SWSA-gw delineation was constrained by several methodological challenges, including limitations in the scale and coverage of national datasets, discrepancies in groundwater recharge estimates, variability in hydrogeological data, and inconsistent groundwater use reporting.

Beyond the results of these studies and its inclusion in NWRS III (2023), additional pressures listed in the NWRS III (2023) continue to impact the sustainable, on-the-ground management of SWSA-gw. Climate change is altering precipitation patterns and increasing the frequency and intensity of droughts, worsening national water shortages. Rapid population growth and economic expansion are driving up groundwater demand, placing further strain on vulnerable aquifers. Governance and enforcement challenges, particularly for transboundary groundwater systems, also persist, as effective groundwater management requires coordinated efforts across multiple institutions, local authorities, and stakeholders.

To strengthen existing groundwater management, the Department of Water and Sanitation (DWS) Chief Directorate: Water Ecosystems Management (CD: WEM) initiated the "Refinement of Strategic Groundwater Source Areas of South Africa" project (DWS, 2024). This project aims to enhance the identification, delineation, and protection of groundwater source areas (both nationally and transboundary) at a spatial precision fine enough to be aquifer-specific (where feasible). The refined delineation will support the implementation of protective measures mandated by the (NWA, Act No. 36 of 1998), requiring collaboration between government and non-government stakeholders in alignment with the Integrated Water Resource Management (IWRM) approach outlined in NWRS III (2023).

A critical step in this "SWSA-gw refinement" process is the Status Quo Assessment, which provides an updated evaluation of the current state of the existing 37 SWSA-gw, as delineated by Le Maitre *et al.* (2018), their contribution to national water security, and the key factors influencing their sustainability. By incorporating the most recent and most comprehensive hydrogeological data, this assessment aims to enhance evidence-based decision-making for long-term groundwater protection and sustainable use. It will also serve as the foundation for refining the overarching SWSA-gw delineation methodology while providing essential insights for groundwater protection strategies and the development of a robust management framework to safeguard South Africa's strategic groundwater resources.

1.2. Terms of Reference

The Terms of Reference (ToR) define the overarching scope, objectives, and expected outcomes of this study, providing a structured framework for refining the delineation of SWSA-gw. Developed by the DWS CD: WEM, the ToR outlines the key steps required to enhance SWSA-gw delineation and integrate them into national and transboundary water management strategies. The ToRs for the study are defined as follows (see DWS, 2024a):

The primary aim of the project is to enhance the delineation of SWSA-gw to an aquifer-specific scale, building upon the baseline information provided by the 2018 study.

The objectives for the study include:

1. Developing a scientifically sound methodology for delineating SWSA-gw for both national and transboundary aquifers/aquifer systems, incorporating considerations for groundwater quality.
2. Reviewing and refining the scale of SWSA-gw to the aquifer level.
3. Developing an approach for the protection and management of the refined SWSA-gw.

Throughout these processes, it is imperative to ensure consultative engagement, keeping all interested and affected parties, stakeholders, water users, etc., informed about developments.

By refining the delineation and classification of SWSA-gw, this project aims to strengthen groundwater conservation and management, supporting evidence-based policy-making, promoting sustainable groundwater use, and enhancing long-term water security planning.

1.3. Aims and Objectives of this Report

The Status Quo SWSA-gw Report (**Deliverable 3.1 of Phase 3**) aims to systematically assess the current state of existing SWSA-gw in South Africa, specifically the 37 areas identified by Le Maitre *et al.* (2018). This assessment serves as a foundational step in Phase 3 of this project, evaluating the existing SWSA-gw delineations, identifying key hydrogeological characteristics, and highlighting potential data limitations that may affect their integration into the refinement process. The findings of this report will inform subsequent steps in Phase 3 (see **Table 1-1**). The key tasks and expected outcomes of this report are:

Task 3.1.1

- Review the 37 existing SWSA-gw delineations as defined by Le Maitre *et al.* (2018), assessing their coverage and relevance to current groundwater management priorities.
- Evaluate groundwater quantity, quality, and protection status within these areas, identifying pressures related to abstraction, land use, and contamination risks, as well as their implications for long-term resource sustainability.
- Identify and highlight additional data limitations, providing recommendations for further data enhancement strategies to improve the refinement process.

Table 1-1 Refinement of Strategic Groundwater Source Areas Deliverables and Associated Tasks for each Project Phase.

Phase 0: Project Management, Administration, Communication and Capacity Building		
P0	**P0.1** General Project Management	
	P0.2 PMC Meetings	
	P0.3 PSC Meetings	
	P0.4 PS Meetings	
	P0.5 Ad Hoc Meetings	
	P0.6 Monthly Progress Reports	
	P0.7 Capacity Building	
Phase 1: Project Inception		
P1	**D1.1**: Inception Report	**T1.1.1**: Lit Review
Phase 2: Information and Data Gathering		
P2	**D2.1:** Gap Analysis Report	**T2.1.1:** Data and Information Assessment **T2.2.1:** Inventory of Water Resource Tools
Phase 3: Refinement of SWSA-gw		
P3	**D3.1:** Status Quo SWSA-gw Report	**T3.1.1**: Status Quo SWSA-gw Assessment
	D3.2: Refined Methodology Report	**T3.2.1**: Refined Methodology Assessment
	D3.3: Delineation of Refined SWSA-gw Report	**T3.3.1**: Delineation of Refined SWSA-gw **T3.3.2**: Groundwater Quality **T3.3.3**: Transboundary Aquifers **T3.3.4**: Updated Status Quo SWSA-gw Assessment
	D3.4: SWSA-gw Protection and Management Report	**T3.4.1**: SWSA-gw Protection and Management
Phase 4: Project Closure		
P4	**D4.1**: Refined Strategic Groundwater Source Areas of South Africa Report	**T4.1.1**: Report Integration
	D4.2: External Review Summary Report	
	D4.3: Electronic Database	
	D4.4: Close Out Report	

1.4. Report Structure

The Status Quo of Strategic Groundwater Source Areas (SWSA-gw) of South Africa Report is structured into four key sections.

Section 1 outlines the motivation for the study, highlighting the role of SWSA-gw in South Africa. It provides a brief overview of the key legislative frameworks, including the NWA (Act 36 of 1998) and the NWRS III (2023), and explains the need for refining SWSA-gw delineations.

Section 2 reviews past SWSA-gw delineation efforts, particularly the methodology developed by Le Maitre *et al.* (2018). It explains the classification of National and Sub-National groundwater source areas, the criteria used to define SWSA-gw, and key limitations in past delineation efforts, including data gaps and methodological challenges.

Section 3 establishes the Status Quo assessment framework, detailing the categories used to evaluate SWSA-gw. The framework consists of two key components: 1) Description (Geospatial Context, Hydrology & Drainage, and Geology) and 2) Current Status (Groundwater Quantity, Groundwater Quality, Threats & Risks, and Protection Status). The methodologies, datasets, and analytical techniques used in the assessment are also outlined.

Section 4 presents a summary of the comprehensive evaluation of each SWSA-gw, synthesizing hydrogeological, hydrological, and socio-environmental data. Findings are structured using a Current Status Matrix, categorizing each SWSA-gw based on the Current Status categories. The results are supported by maps, tables, and charts in the associated appendices that provide detailed analyses and supplementary data per SWSA-gw.

2. PREVIOUS METHODOLOGY

2.1. Summary of Previous Delineation

Le Maitre *et al.* (2018) developed a methodology for delineating SWSA-gw by adapting the Strategic Surface Water Source Areas (SWSA-sw) concept from the Nel *et al.* (2013) to groundwater resources. The approach addressed several key aspects missing from Nel *et al.* (2013) study, including broad-scale mapping of groundwater resources at national and sub-national levels, an improved understanding of aquifer dynamics, and a methodology for using proxies, such as groundwater recharge and hydrogeological characteristics, to assess groundwater availability and practical applicability. SWSA-gw were characterised as follows:

1. Areas that have high groundwater availability,
2. Are nationally important groundwater resources, or
3. Meet both criteria.

Groundwater availability was quantified using recharge rates as a proxy, with a threshold of >65 mm/year, representing 50% of the national recharge volume. Recharge was further assessed in relation to mean annual precipitation (MAP) to identify areas with above-average infiltration. Transboundary aquifers extending into Lesotho and Eswatini were considered but not delineated as SWSA-gw due to insufficient data (see Le Maitre *et al.*, 2018, and **Section 2.2** for further details).

The study also assessed groundwater abstraction by applying a Kernel density function to map high-use areas, highlighting regions where groundwater is critical for domestic, agricultural, or industrial activities. **Table 2-1** summarises the criteria and thresholds used in SWSA-gw (2018) delineations.

Table 2-1 A summary of the criteria used in the SWSA-gw delineations (Le Maitre *et al.*, 2018).

Criteria	Description	Threshold	Motivation
1	Recharge as mm/a (GRAII, DWAF, 2006a)	>65 mm/a	Corresponds to >50% national recharge volume
2	Ratio of recharge per 1 km^2 grid cell compared to the average recharge of the secondary catchment	>1.5	Threshold set iteratively and subjectively
3	Registered groundwater use (WARMS) as l/s per km^2 (Kernel function)	>0.3 l/s/km2	Threshold set iteratively and subjectively
4	Towns/village clusters with groundwater sole supply, for current domestic water supply, mapped as points with 10 km radius.	None (i.e. all areas included)	All areas are relevant, no threshold to be met
5	Groundwater resource unit used for current or future supply to an area of national economic importance, and groundwater control areas	None (i.e. all areas included)	National Interest

To delineate these SWSA-gw, various spatial analysis and mapping techniques were applied, considering population density and economic dependency zones. A vulnerability and risk assessment was also conducted to evaluate the sustainability of groundwater resources in these areas. Land-use pressures, such as mining, urban expansion, and intensive agriculture, were also examined for their potential impacts on groundwater quantity and quality.

The delineation criteria also aimed to differentiate nationally significant areas from sub-nationally important areas. Areas classified as “National Important” had high groundwater availability, played a key role in national water security, and supported critical economic functions. In contrast, areas classified as “Sub-Nationally Important” remained regionally significant but did not meet the threshold for national strategic classification (**Table 2-2**).

Table 2-2 Criteria for the classification of areas of national versus sub-national groundwater importance (Le Maitre *et al.*, 2018).

Criteria	National Importance	Sub-National Importance
Contribution to Water Security	Supplies a high proportion of national water needs, critical for multiple regions or sectors.	Supports regional or municipal needs but has a more localized impact.
Socio-economic Dependency	Provides water to major population centres, economic hubs (e.g., mining, power generation, export agriculture), and inter-basin transfer schemes.	Supports smaller towns, regional industries, and local agriculture.
Ecological and Strategic Role	Essential for maintaining the national ecological reserve and fulfilling transboundary water agreements (e.g., Lesotho Highlands Water Project).	Important for local ecosystems and conservation but with limited national or transboundary implications.
Vulnerability and Risk	High risk of depletion, pollution, or overuse, affecting multiple regions; critical for climate resilience.	Lower national impact if affected but remains vital for regional water security.
Utilisable Groundwater Exploitation Potential (UGEP)	Includes areas with high renewable groundwater potential; some high-recharge areas excluded due to poor aquifer properties.	Covers smaller groundwater systems with local importance and lower yield potential.

By applying the criteria outlined above, Le Maitre *et al.* (2018) identified 37 SWSA-gw and 22 SWSA-sw (**Figure 2-1**). In regions where these areas overlap, 29 in total, they are termed (SWSA-gw&sw). To facilitate a comprehensive groundwater-focused assessment, the 37 SWSA-gw and 29 SWSA-gw&sw are viewed as a single set of groundwater-focused areas. These areas are the basis for this Status Quo Assessment, ensuring a targeted evaluation of all groundwater resources. A list of the SWSA-gw is provided in **Table 2-3**.

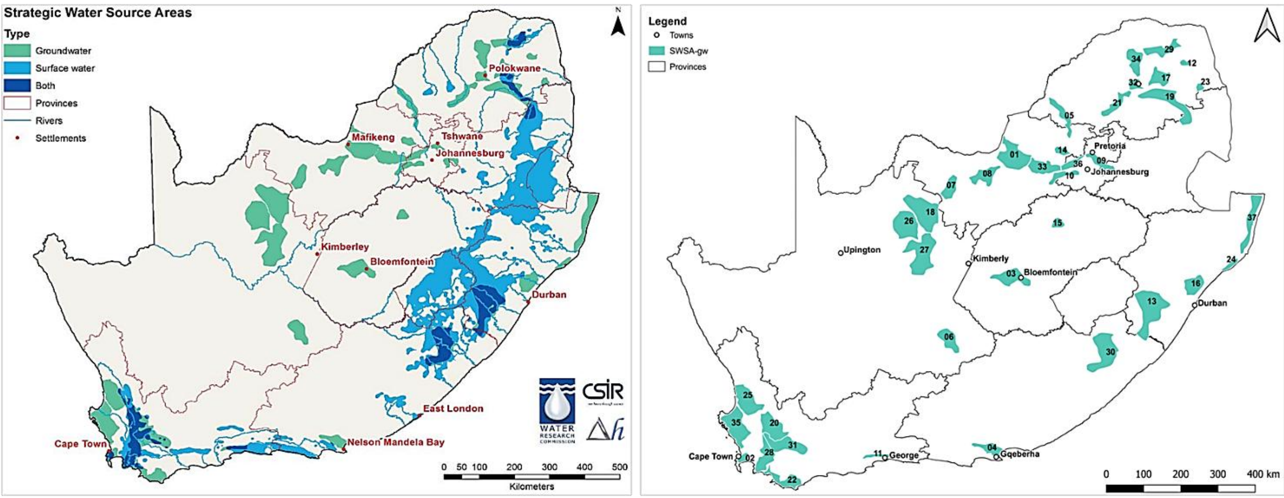

Figure 2-1 Left: Strategic Water Source Areas for Groundwater (SWSA-gw) and Surface Water (SWSA-sw). Right: The 37 SWSA-gw viewed as a single set of groundwater-focused areas as delineated by Le Maitre *et al.* (2018).

Table 2-3 List of SWSA-gw highlighting where these overlap with SWSA-sw (after Le Maitre *et al.*, 2018).

	SWSA-gw	SWSA-sw[1]
01	Bo-Molopo Karst Belt	
02	Cape Peninsula and Cape Flats	Table Mountain
03	Central Pan Belt	
04	Coega TMG Aquifer	Tsitsikamma
05	Crocodile River Valley	
06	De Aar Region	
07	Eastern Kalahari A	
08	Eastern Kalahari B	
09	Eastern Karst Belt	
10	Far West Karst Region	
11	George and Outeniqua	Outeniqua
12	Giyani	
13	Ixopo / Kokstad	Southern Drakensberg
14	Kroondal / Marikana	
15	Kroonstad	
16	KwaDukuza	Southern Drakensberg & Zululand Coast
17	Letaba Escarpment	Wolkberg
18	Northern Ghaap Plateau	
19	Northern Lowveld Escarpment	Wolkberg & Mpumalanga Drakensberg
20	Northwestern Cape Ranges	Groot Winterhoek & Boland
21	Nyl and Dorps River Valley	
22	Overberg Region	Boland
23	Phalaborwa	
24	Richards Bay GW Fed Estuary	Zululand Coast
25	Sandveld	Groot Winterhoek
26	Sishen / Kathu	
27	Southern Ghaap Plateau	
28	Southwestern Cape Ranges	Boland
29	Soutpansberg	Soutpansberg
30	Transkei Middleveld	Eastern Cape Drakensberg
31	Tulbagh-Ashton Valley	Groot Winterhoek & Langeberg & Boland
32	Upper Sand (Polokwane) Aquifer System	
33	Ventersdorp/Schoonspruit Karst Belt	
34	Vivo-Dendron	
35	West Coast Aquifer	
36	Westrand Karst Belt	
37	Zululand Coastal Plain	Zululand Coast

[1] *Only includes the SWSA-sw that overlap with SWSA-gw.*

2.2. Summary of Previous Status Quo

As part of the Le Maitre *et al.* (2018) delineation of SWSA-gw, a Status Quo assessment was conducted to evaluate hydrology and drainage, geology, groundwater availability, use, and associated risks. While this assessment was not originally designed as a formal comparative analysis of hydrogeological characteristics between different SWSA-gw, it was primarily focused on gathering and collating hydrogeological data for the spatial delineation. However, it still played a crucial role in identifying key spatial trends for these areas, hydrogeological attributes, and data limitations that influence the understanding and management of SWSA-gw. In addition to supporting the initial delineation approach, the findings also revealed critical data and methodological gaps requiring further refinement, emphasising the need for an updated assessment.

Hydrology and Drainage

- The hydrological assessment of SWSA-gw built on the Nel *et al.* (2013) study and focused on baseflow contributions to river systems, emphasizing its critical role in sustaining perennial flow in semi-arid regions. Baseflow assessments, derived from the National Water Resource Assessment (WR90) hydrological dataset (Midgley *et al.*, 1994) and river discharge records, indicated that many groundwater-dependent rivers rely on sustained groundwater contributions, particularly during dry periods. The assessment also found that man-made features were key stressors affecting groundwater discharge. Large-scale groundwater abstraction, land-use change, and dam construction have altered natural groundwater-surface water interactions, leading to reduced baseflow contributions in some catchments. Additionally, invasive alien vegetation was found to significantly reduce groundwater recharge and baseflow contributions, with some studies listed in the report estimating an impact on mean annual runoff (MAR) of approximately 2.6%. While the study recognized this hydrological variability as a risk, its scope was not designed to incorporate or develop predictive models for assessing long-term changes in groundwater recharge or baseflow sustainability.

Geology

- The geological assessment of SWSA-gw utilized data from 1: 1000 000 national geological maps (Council for Geoscience, CGS), the National Groundwater Archive (NGA), and Vegter (1995) to classify aquifers based on their hydrogeological properties and recharge potential. Based on these Hydrogeological maps, the study distinguished between primary and secondary aquifers, with SWSA-gw predominantly linked to dolomitic, fractured, and alluvial aquifers, all of which have high recharge rates and storage capacity. The study also noted the geological control on groundwater availability, particularly in rural areas where groundwater serves as the primary or sole water source. However, limited hydrogeological data in multi-layered aquifer systems was identified as a significant gap, highlighting the need for additional investigations, verifications, geophysical surveys, and potential groundwater modelling (in certain areas) to improve the understanding of groundwater storage and recharge dynamics in SWSA-gw.

Groundwater Quality

- While groundwater quality was not a key consideration for the SWSA-gw delineation and not comprehensively assessed, the study highlighted major contamination risks, including acid mine drainage from coal mining (WRC, 2016), salinity impacts from irrigation return flows (DWA, 2010) and urban pollution linked to wastewater mismanagement. Various maps were also used to identify high-risk groundwater resources, particularly for dolomitic and sandy aquifers, where contaminants spread rapidly (DWAF, 2006). However, no specific water quality parameters were analysed.

Groundwater Quantity

- MAP was estimated using the WR90 dataset (Midgley *et al.,* 1994), interpolating long-term rainfall records across South Africa at a 1x1-minute resolution. The study incorporated topographic analysis to assess orographic rainfall effects, particularly in high-elevation regions. While primarily used for the SWSA-sw delineation, the WR90 dataset influenced the SWSA-gw status quo, as rainfall is a key driver of groundwater recharge (i.e., the criteria used as a proxy for groundwater availability). However, no updated precipitation dataset was generated, and existing hydrological models were relied upon.
- Recharge estimates were derived from Groundwater Resource Assessment II (GRAII) (DWAF, 2006a) and Vegter (1995). The chloride mass balance method was applied in GRAII, estimating recharge based on the ratio of rainfall chloride concentration to groundwater chloride concentration. Recharge was therefore mapped at a 1 km^2 resolution and compared to baseflow contributions in river systems. Areas with GRAII recharge rates above 65 mm/a were classified as high-recharge SWSA-gw. However, Le Maitre *et al.* (2018) acknowledged high uncertainty in recharge estimates due to interpolation errors and the absence of data on losing river recharge.
- Groundwater use was assessed using the Water use Authorization & Registration Management System (WARMS) dataset and the All Towns Reconciliation Strategy (DWA, 2012a). Some geolocation errors in WARMS were corrected using land ownership records, and a Kernel Density Estimation was applied to identify high-use groundwater clusters. Municipalities where more than 50% of total water supply originated from groundwater were mapped as sole groundwater supply towns (with a 10 km buffer applied and used for the delineation). Future groundwater demand was analytically projected for 26 major economic hubs, incorporating some planned municipal abstraction projects. However, the study noted that due to unregistered abstraction, actual groundwater use may have been underestimated.
- Groundwater dependence was analysed using the WARMS dataset and the All Towns Reconciliation Strategy (DWA, 2012a). The study found that 24% of sole groundwater supply towns were within SWSA-gw, and 47% of groundwater used for agriculture and industry originated from SWSA-gw. Groundwater-dependent towns were identified as particularly vulnerable to climate variability and contamination risks, given their reliance on a single water source, however no specific climate models were applied and therefore was not used it in the SWSA-gw delineation.
- Population data from the Council for Scientific and Industrial Research (CSIR) Geospatial Analysis Platform and the All Towns Reconciliation Strategy (DWA, 2012a) was used to assess urban and rural water demand from SWSAs. The study determined that 60% of South Africa’s population depends on SWSA-sw, with high population pressure in some regions. While groundwater-dependent rural settlements were mapped, no detailed population growth analysis was conducted, and therefore it was not used in the SWSA-gw delineation.

Threats & Risks

- Climate Variability: Climate variability was assessed using WR90 precipitation data (Midgley *et al*., 1994) and topographic analysis from the National Spatial Biodiversity Assessment (Driver *et al*., 2005). Climate impacts were more directly used for the SWSA-sw, as rainfall influences runoff generation. For SWSA-gw, climate change was linked to variations in recharge rates, particularly in semi-arid regions. The study acknowledged climate change risks, predicting increased drought frequency and declining recharge rates, but no specific climate models were applied to quantify these impacts and therefore was not used in the SWSA-gw delineation.

- Land Use Impacts: Land use analysis incorporated the National Land Cover (NLC) dataset from GeoTerraImage (GTI, 2015), the Mine Water Atlas (WRC, 2016), and the CSIR land-use datasets. Key land use pressures identified included forestry plantations reducing recharge in high-yield aquifers (e.g., Mpumalanga and KwaZulu-Natal), irrigation-dominated groundwater use in SWSA-sw, coal mining contamination risks in Mpumalanga and Limpopo, and invasive alien plants reducing runoff by 2.6%, impacting both surface and groundwater availability.

Protection Status and Conservation Considerations

- Protection Status: The study assessed protection levels using the National Biodiversity Assessment (NBA 2018), the South African Protected and Conservation Areas Database, and the Department of Environmental Affairs (DEA) Protected Areas Register. Findings revealed that only 11% of all SWSAs were under formal protection, with 10 major SWSAs completely unprotected, making them highly vulnerable to land-use changes.
- Biodiversity & Ecosystems: Biodiversity assessments were conducted using the NBA (2018) and South African National Biodiversity Institute (SANBI, 2011) datasets. The study emphasized the ecological role of SWSA-sw in sustaining freshwater ecosystems, particularly through riparian zones, wetlands, and river corridors. However, no specific analysis was done for groundwater dependent ecosystems (GDEs).
- Conservation Areas: Conservation areas were mapped using the South African Protected Areas Database and the DEA Protected Areas Register. The study found that grassland-based SWSAs lacked formal conservation status, making them highly vulnerable to land-use change and degradation. This highlighted the urgent need for expanded conservation efforts to protect SWSAs and ensure long-term water security.

3. DEVELOPING THE STATUS QUO

Developing a comprehensive Status Quo assessment requires a structured framework to consistently evaluate the current state of SWSA-gw across different regions. This Status Quo assessment, designed to review the existing 37 SWSA-gw, focuses on two key components: (1) Description and (2) Current Status.

The Description provides the geospatial context by detailing hydrology, drainage patterns, and geological formations that influence groundwater dynamics in the area. The Current Status assesses specific groundwater conditions, including quantity, quality, potential risks, and existing protection measures, offering a holistic view of groundwater resources and associated management and conservation frameworks (**Figure 3-2**).

By integrating both physical and socio-environmental factors, this approach ensures a comprehensive understanding of groundwater systems. It also facilitates a data-driven, side-by-side comparison of different SWSA-gw, supporting the development of more effective identification and refinement of SWSA-gw, as well as designing management strategies for long-term groundwater sustainability.

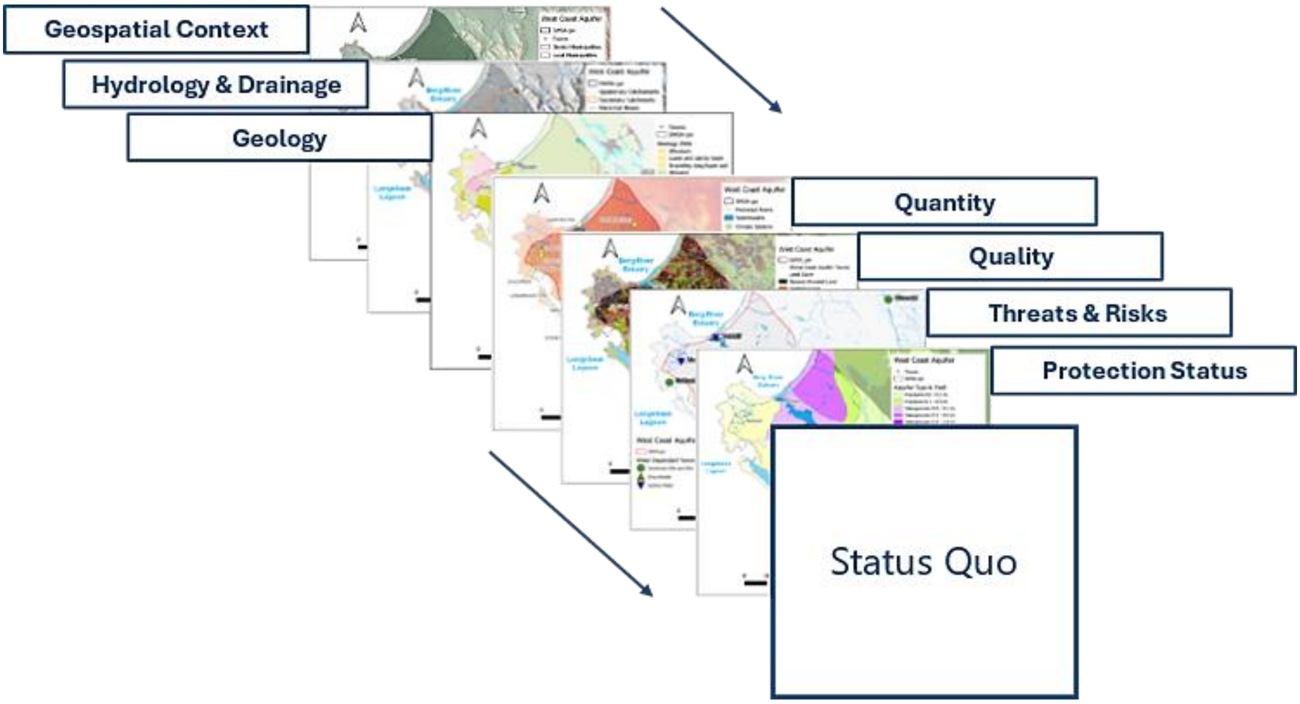

Figure 3-1 Conceptual illustration of how different components contribute to the development of a Status Quo assessment for each SWSA-gw.

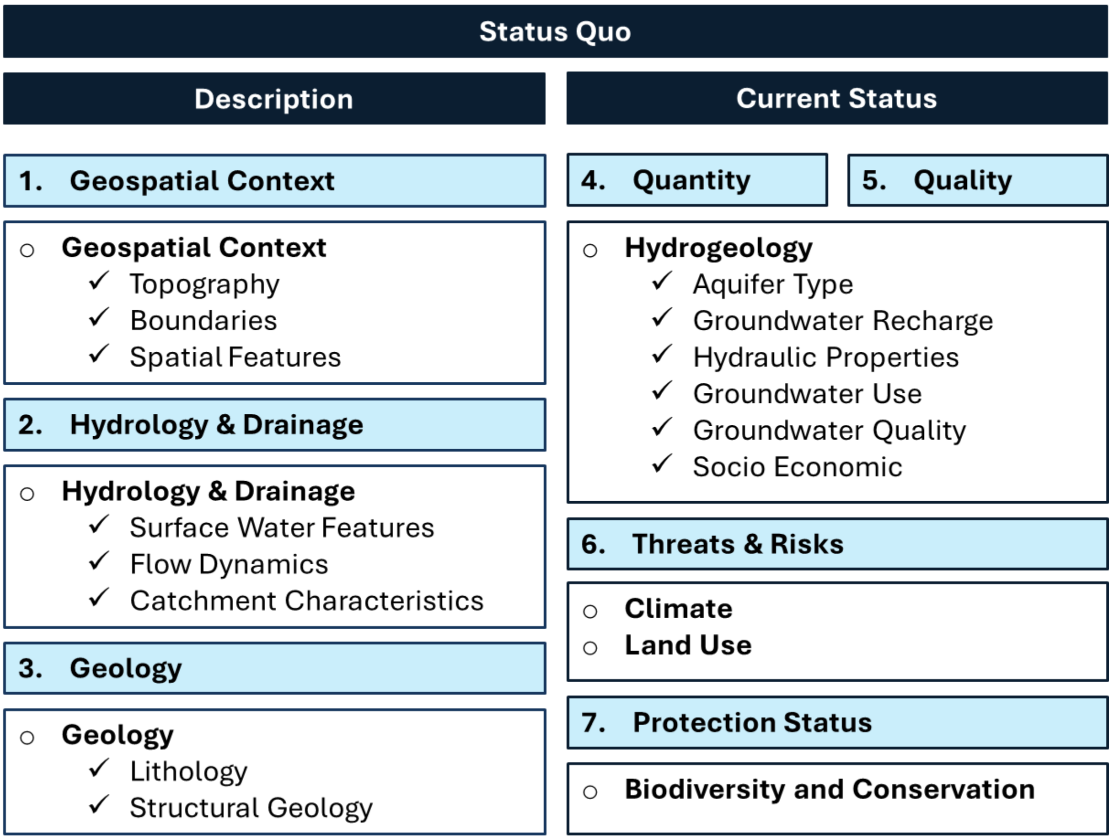

Figure 3-2 Summary of the data categories and components used in the Description and Current Status subsections of the Status Quo assessment framework.

3.1. Description

Building on the structured approach outlined above, each SWSA-gw is described using a consistent framework to characterise its geospatial context, hydrology and drainage, and geology (**Figure 3-1** and **Figure 3-2**). Applying this methodology across all 37 SWSA-gw ensures a standardised and comparable evaluation of groundwater-related characteristics.

The assessment relies on high-quality spatial datasets, prioritising broad coverage over the finest possible spatial scale to capture key hydrogeological attributes relevant to groundwater resource management. This ensures a robust foundation for understanding regional groundwater conditions. The methodology for each component is outlined below.

3.1.1. Geospatial Context

The geospatial characteristics of each SWSA-gw are described based on topographic and administrative features, including:

- **Topography**

  Elevation, slope, and landform characteristics were derived from the European Space Agency (2024) Copernicus Global (COP) 30m Digital Elevation Model (DEM). These features influence surface water flow, groundwater recharge potential, and overall hydrogeological dynamics.

- **Administrative Boundaries**

  Provinces, district municipalities (DMs), and local municipalities (LMs) were identified, along with major towns and settlements (Municipal Demarcation Board, 2018). These boundaries provide essential context for regional and national groundwater governance.

- **Key Infrastructure**

  Transport networks, particularly major roads (NGI, 2022), were documented alongside an overview of water supply infrastructure, including bulk water supply schemes, major pipelines, and reservoirs. These elements play a crucial role in groundwater management and utilisation.

3.1.2. Hydrology and Drainage

The hydrological and drainage characteristics of each SWSA-gw are described based on:

- **River Systems**

  Major perennial and non-perennial rivers from NGI (2018) and the National Freshwater Ecosystem Priority Areas project (NFEPA, 2011) were identified and described according to their flow regime, source catchments, and hydrological significance.

- **Surface Water Bodies**

  Both natural and anthropogenic water bodies, including wetlands, lakes, reservoirs, and major dams (SANBI, 2018, WRC, 2012), were documented due to their influence on groundwater recharge, baseflow contributions, and regional water balances.

- **Catchment Classification**

  Secondary, tertiary and quaternary catchments (WRC, 2012) were described to highlight their role in defining drainage patterns and influencing groundwater movement and recharge.

- **Water Management Areas**

  Water Management Areas (WMA; DWS, 2023a) were included to indicate their role in linking groundwater systems to broader hydrological governance structures.

3.1.3. Geology

Each SWSA-gw geological characteristics are described based on:

- **Geological Mapping**

  Lithological units and geological formations relevant to groundwater occurrence and hydrostratigraphy were derived from the 1:250,000 geology dataset from the Council for Geoscience (CGS) and resources from Johnson, *et al.*, (2006).

- **Structural Features**

  Key geological structures, including faults, folds, and fractures (Johnson, *et al*., 2006), were identified and described due to their significant influence on aquifer properties, groundwater flow paths, and recharge potential.

- **Hydrostratigraphy**

  Where possible, geological formations were classified based on their groundwater-bearing properties (Johnson, *et al*., 2006), supporting aquifer characterisation, groundwater storage potential, and regional water supply assessments.

3.2. Current Status

Building on the detailed description of each SWSA-gw's geospatial context, hydrology, drainage, and geology (**Section 3.1**), the Current Status focuses on evaluating the functional aspects of groundwater resources. Each SWSA-gw was assessed using a structured framework that examines groundwater Quantity, Quality, Threats and Risks, and Protection Status. Applying this methodology across all 37 SWSA-gw ensures a consistent and comparable evaluation of groundwater-related characteristics.

Similar to the Description, the Current Status assessments are based on high-quality spatial datasets, prioritising broad coverage over the finest possible spatial scale to capture key hydrogeological attributes. This approach provides a robust foundation for understanding the dynamic status of groundwater conditions, with a detailed methodology for each component outlined below.

3.2.1. Quantity

Groundwater quantity was assessed by classifying aquifers, evaluating groundwater recharge, and analysing groundwater use based on registered water use.

- **Aquifer Classification**
  - **Aquifer Class and Type**

    Aquifer classification was based on the DWS 1:1 000 000 Hydrogeological Map series of South Africa (DWS, 2012) dataset, which includes Aquifer Type (e.g., fractured, intergranular, karst), Aquifer Class (e.g., minor, major, or sole-source aquifers), and Aquifer Yield (potential litres per second or m^3/day) (DWS, n.d.).

  - **Groundwater Targets**

    Groundwater targets and average groundwater levels were determined using the National Groundwater Archive (NGA, downloaded Feb 2025), analysing long-term water level trends and borehole depth distributions over the past 25 years. This assessment aimed to evaluate groundwater availability and accessibility by identifying depth ranges commonly targeted for groundwater development. The approach considered percentile distributions of borehole depths to define primary and secondary groundwater targets, while statistical analysis of water level records provided insights into regional fluctuations and long-term groundwater trends.

- **Rainfall**

  The Water Resources of South Africa 2012 (WR2012) study (Bailey *et al.*, 2015), provides a comprehensive assessment of South Africa's water resources, building on previous studies like WR2005 (Middleton & Bailey, 2008) and South African Atlas of Climatology and Agrohydrology (R.E. Schulze, 2009). It includes geographic information system (GIS) layers such as Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), water quality, and groundwater parameters. The WR2012 MAP layer was developed using rainfall data patched and validated up to 2010, ensuring consistency and accuracy across quaternary catchments and various WMAs (2012). Given that the WR2012 dataset has become a standard reference for water resource modelling in South Africa, it was necessary to assess whether the MAP layer remains relevant for this study (as an important input to recharge estimations), particularly since ~ 14 years have passed since the WR2012 data was last updated.

  A MAP comparison was therefore conducted using more recent rainfall data, focusing on weather stations with both 10+ and 30+ years of records. While a 30-year Climate Norm[2] MAP is only available for select stations, the MAP was calculated at each station. A comparison of these values with the WR2012 MAP reveals differences ranging from 2% to 24%, with an arithmetic mean of 12%. Although this mean falls within an acceptable range, confirming the continued applicability of the WR2012 MAP dataset for first-order recharge estimations in the Status Quo, it must be noted that the MAP ranges for local weather stations may differ. To account for these potential discrepancies, MAP values were determined per SWSA-gw, expressed as both an average rate (mm/a) and a total volume (Mm^3/a).

- **Recharge**

  Groundwater recharge is a highly variable parameter and challenging to quantify due to the influence of multiple hydrogeological factors. To simplify the first-order recharge estimation for the Status Quo assessment, this study utilized GRAII recharge estimates (DWAF, 2006a), which provide long-term average recharge rates (mm/a) mapped on a 1 km x 1 km raster grid. This approach is consistent with the methodology applied in Le Maitre *et al.* (2018). While the GRAII estimates are considered a reliable baseline, they do not fully account for site-specific variables such as rainfall intensity, fracture-dominated flow, or localized aquifer characteristics.

  Using a GIS-based approach, the GRAII recharge rates were determined per SWSA-gw, expressed as both an average recharge rate (mm/a) and a total recharge volume (Mm^3/a). Additionally, by comparing MAP values with recharge rates and volumes, the percentage of MAP contributing to recharge was estimated, providing further insight into regional groundwater replenishment dynamics.

- **Groundwater Use**

  Groundwater use was assessed using data from the WARMS (downloaded April 2024), which records registered groundwater users and their allocated abstraction volumes (Mm^3/a) per sector (e.g., domestic, industrial, and agricultural, etc). This dataset provides key insights into abstraction trends and helps identify water use hotspots across SWSA-gw. The dataset was filtered to include groundwater use only, ensuring a focused analysis of groundwater-dependent sectors per SWSA-gw. Additionally, groundwater-dependent towns and settlements were identified using the Water Source Dependent Towns Map (DWS, 2024), providing a spatial understanding of municipalities that rely primarily on groundwater for supply.

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[2] *30-year Climate Norm (1991 to 2020): Climate Normal is a three-decade average of climatological parameters.*

- **Socio-Economic and Governance**
  - **Population Growth**

    Socio-economic and governance aspects were assessed using population distribution and growth trends derived from Stats SA: Census (2011) and Census (2022). The annual population growth rate was calculated for each Local Municipality (LM) based on Census (2011) and Census (2022) data. These growth rates were then applied to the portions of wards falling within the SWSA-gw. For example, the growth rate of each LM was applied to the corresponding ward sections within that LM. The projections were then extended to 2025, and the aggregated estimates were used to determine the population per SWSA-gw.
  - **Groundwater Dependence**

    Population dependency on groundwater sources was assessed and compared, alongside an evaluation of governance and groundwater policies within the context of the NWRS (2023). This analysis included regional and local water management frameworks, such as Catchment Management Agencies (CMA), Water User Associations (WUA), Water Management Areas (WMA), Water Service Authorities (WSAs), and Water Service Providers (WSP).

    Similar to the approach used for population growth rates, groundwater dependence growth rates were determined per LM for each dependency category. These rates were then applied to the portions of Wards within the SWSA-gw to estimate the projected 2025 population reliant on regional schemes, groundwater, and surface water.

3.2.2. Quality

Groundwater quality was evaluated using monitoring data, key water quality indicators, and potential contamination risks.

- **Groundwater Quality**

  Groundwater quality was assessed using data from the Water Management System (WMS) database (downloaded April 2024), focusing on key parameters including pH (acidity/alkalinity), Electrical Conductivity (EC), and major ions such as fluoride, sulphates, and nitrate + nitrite nitrogen. Long-term contamination trends from 2000 to 2024 were analysed, with a specific focus on vulnerable regions impacted by agricultural and industrial activities.

  To enhance spatial analysis, these results were compared with data from the Spatial Distribution of Groundwater Geosites in South Africa maps (October 2024). Areas with elevated nitrate, fluoride, and sulphate concentrations were identified as potential contamination hotspots, linked to pollution, seawater intrusion, or aquifer degradation (where possible).
- **Potentially Contaminating Activities**

  Potential contamination risks were assessed based on land use impacts using the NLC Dataset (DFFE, 2022 – 73 Class). Urban, industrial, mining, and agricultural activities were analysed for their influence on groundwater quality, particularly in terms of chemical loading and potential pollution sources.

3.2.3. Threats and Risks

Groundwater vulnerability was assessed in relation to climatic conditions and land use activities.

- **Climate**

  Climate classification was based on Köppen-Geiger Climate Data (Beck *et al.*, 2018), incorporating seasonal temperature extremes and evapotranspiration rates from the SA Atlas of Climatology and Agrohydrology (R.E. Schulze, 2009), both of which influence groundwater recharge rates.

  Climate change predictions, including changes in the DART Index (Depth to Water Level Change, Aquifer Type, Recharge, and Transmissivity) and their impact on recharge rates, were taken from Dennis & Dennis (2012).

- **Land Use**

  Land use impacts were evaluated and described using NLC 73-class (DFFE, 2022), identifying agricultural, industrial, urban, and conservation areas and their potential effects on groundwater recharge. The spatial extent of these land uses was mapped and analysed relative to each SWSA-gw, with a focus on urban expansion, mining operations, and intensive agriculture as key groundwater stressors.

3.2.4. Protection Status

The protection status of SWSA-gw was assessed based on conservation areas, biodiversity zones, and groundwater-dependent ecosystems (GDEs).

- **Biodiversity and Conservation Areas**

  Protected areas were mapped and described using DFFE Conservation Data (DEA, 2018; DFFE, 2024), including National Parks, Nature Reserves (DFFE, 2024), Subterranean Groundwater Control Areas (SGWCA) (CSIR, 1998), Biosphere Reserves, and Marine Protected Areas (DFFE, 2024).

- **Groundwater-Dependent Ecosystems**

  Wetlands and groundwater-dependent ecosystems (GDEs) were identified using spatial datasets from CSIR's National Wetland Map 5 (NWM5, 2018), DWA (2010), and CSIR (2011). These sources were used to classify wetlands within SWSA-gw according to their degree of dependence on groundwater - ranging from low to high. Additionally, Ramsar Sites as defined by DFFE (2024) - internationally recognised wetlands of ecological and hydrological significance - were reviewed to determine their reliance on groundwater inputs for ecosystem functioning.

3.3. Status Quo

In terms of developing a Status Quo per SWSA-gw, a Current Status Matrix has been developed to systematically assess groundwater conditions within the SWSA-gw. This matrix integrates key hydrogeological, geospatial, and socio-environmental factors (see **Sections 3.1** and **3.2**) to provide a structured evaluation of groundwater availability and sustainability. It considers the four primary categories of the Current Status: (1) Groundwater Quantity, (2) Groundwater Quality, (3) Threats & Risks, and (4) Protection Status.

To construct the matrix, available data on groundwater recharge, abstraction rates, contamination levels, pollution sources, and regulatory frameworks were analysed. These parameters were then categorised into five Current Status Classes (**Table 3-1**), and ranked as follows**:**

A (Excellent): Optimal conditions with high recharge, minimal contamination, well-managed risks, and strong regulatory oversight.

B (Good): Stable conditions with minor localised contamination, manageable risks, and mostly effective regulation.

C (Moderate): Balanced use with moderate stress, pollution risks, and emerging threats due to inconsistent enforcement.

D (Poor): Over-extraction, significant contamination, and increasing risks due to weak regulatory protection.

E (Critical): Severe depletion and irreversible degradation, with unregulated use and high pollution levels making groundwater unsuitable for use.

Table 3-1 Overview and summary of the Current Status Matrix used for assessing the groundwater conditions of each SWSA-gw.

	A (Excellent)	B (Good)	C (Moderate)	D (Poor)	E (Critical)
Quantity	High recharge, surplus water availability, minor use	Adequate recharge, stable levels, well-managed abstraction	Balanced use, moderate stress, seasonal fluctuations	Over-extraction, declining levels, unsustainable	Critical depletion, major groundwater use, severe stress
Quality	Excellent water quality, meets all standards	Minor localised contamination, mostly within safe limits	Some exceedances, moderate pollution risk	Significant contamination, widespread exceedances	High pollution levels, unfit for use
Threats and Risks	Minimal threats, well-managed risks	Some threats, managed effectively	Moderate risks, emerging issues	High threats, pollution sources, baseflow reduction	Severe threats, irreversible degradation
Protection Status	Strong policies, effective enforcement, active monitoring	Good regulation, some enforcement gaps	Moderate regulation, inconsistent enforcement	Weak protection, few monitoring efforts	No effective protection, unregulated use

Table 3-2 Current Status Matrix, including associated descriptions, metrics, and classification used to assess groundwater conditions for each SWSA-gw.

Current Status Category	Description	Metric	Current Status Class	
Groundwater Quantity	Total Groundwater Use Volume (Mm^3/a) per SWSA-gw vs Total Estimated Recharge Volume (Mm^3/a) per SWSA-gw Expressed as (%)	<10	A	Excellent
		10 to 30	B	Good
		30 to 60	C	Moderate
		60 to 80	D	Poor
		80 to 100	E	Critical
Groundwater Quality	Outliers & Contamination Indicators	Natural / DWQ standard	A	Excellent
		Natural	B	Good
		Pollution Indicators	C	Moderate
		Pollution Trends / Knowledge	D	Poor
		Widespread Pollution	E	Critical
Threats and Risks	% Area Land Use of Built-up Areas & Mines/Quarries per SWSA-gw	Mostly natural	A	Excellent
		Cultivation & Limited Built-Up <10%	B	Good
		Mining >10 km^2, Built-up >10%	C	Moderate
		Mining >30 km^2, Built-up >20%	D	Poor
		Mining > 40 km^2	E	Critical
	Climatic Zone, Based on Köppen-Geiger and Mean Annual Precipitation (MAP)	Humid	A	Excellent
		Semi-Humid	B	Good
		Moderate	C	Moderate
		Semi-Arid	D	Poor
		Arid	E	Critical
	Climate Change, based on change in recharge Dennis & Dennis (2012).	N/A	A	Excellent
		Increase in Recharge	B	Good
		No to Small Change	C	Moderate
		Decrease in Recharge	D	Poor
		N/A	E	Critical
	Population Growth, based on annual growth (%) per SWSA-gw	< 0	A	Excellent
		0 to 0.5	B	Good
		0.5 to 2	C	Moderate
		2 to 4	D	Poor
		≥ 4	E	Critical
Protection Status	Based on % Area Protected of the SWSA-gw	Fully Protected	A	Excellent
		Good Protection & SGWCA	B	Good
		Scattered Protection	C	Moderate
		Limited Protection	D	Poor
		No Protection	E	Critical

4. STATUS QUO ASSESSMENT

The Status Quo Assessment provides a structured evaluation of groundwater conditions across various SWSA-gw regions. **Table 4-1** lists the Appendix Numbers, each corresponding to a specific groundwater system. **Table 4-6** presents the Status Quo Scores, ranking each region based on four Current Status parameters. These rankings offer a quantitative assessment of groundwater sustainability, identifying regions facing critical challenges as well as those maintaining stable conditions.

Table 4-1 Status Quo appendix numbers corresponding to each SWSA-gw.

Appendix Number	SWSA-gw Name
01	Bo-Molopo Karst Belt
02	Cape Peninsula and Cape Flats
03	Central Pan Belt
04	Coega TMG Aquifer
05	Crocodile River Valley
06	De Aar Region
07	Eastern Kalahari A
08	Eastern Kalahari B
09	Eastern Karst Belt
10	Far West Karst Region
11	George and Outeniqua
12	Giyani
13	Ixopo / Kokstad
14	Kroondal / Marikana
15	Kroonstad
16	KwaDukuza
17	Letaba Escarpment
18	Northern Ghaap Plateau
19	Northern Lowveld Escarpment
20	Northwestern Cape Ranges
21	Nyl and Dorps River Valley
22	Overberg Region
23	Phalaborwa
24	Richards Bay GW Fed Estuary
25	Sandveld
26	Sishen / Kathu
27	Southern Ghaap Plateau
28	Southwestern Cape Ranges
29	Soutpansberg
30	Transkei Middleveld
31	Tulbagh-Ashton Valley
32	Upper Sand (Polokwane) Aquifer System
33	Ventersdorp/Schoonspruit Karst Belt
34	Vivo-Dendron
35	West Coast Aquifer
36	Westrand Karst Belt
37	Zululand Coastal Plain

Table 4-2 Summary of the Quantity Status Quo for the 37 SWSA-gw.

SWSA-gw		Status Quo Quantity
01	Bo-Molopo Karst Belt	C
02	Cape Peninsula and Cape Flats	C
03	Central Pan Belt	E
04	Coega TMG Aquifer	C
05	Crocodile River Valley	E
06	De Aar Region	B
07	Eastern Kalahari A	E
08	Eastern Kalahari B	B
09	Eastern Karst Belt	D
10	Far West Karst Region	E
11	George and Outeniqua	A
12	Giyani	D
13	Ixopo / Kokstad	A
14	Kroondal / Marikana	E
15	Kroonstad	A
16	KwaDukuza	A
17	Letaba Escarpment	B
18	Northern Ghaap Plateau	B
19	Northern Lowveld Escarpment	A
20	Northwestern Cape Ranges	C
21	Nyl and Dorps River Valley	C
22	Overberg Region	B
23	Phalaborwa	E
24	Richards Bay GW Fed Estuary	A
25	Sandveld	E
26	Sishen / Kathu	C
27	Southern Ghaap Plateau	E
28	Southwestern Cape Ranges	B
29	Soutpansberg	B
30	Transkei Middleveld	A
31	Tulbagh-Ashton Valley	C
32	Upper Sand (Polokwane) Aquifer System	E
33	Ventersdorp/Schoonspruit Karst Belt	C
34	Vivo-Dendron	E
35	West Coast Aquifer	B
36	Westrand Karst Belt	D
37	Zululand Coastal Plain	A

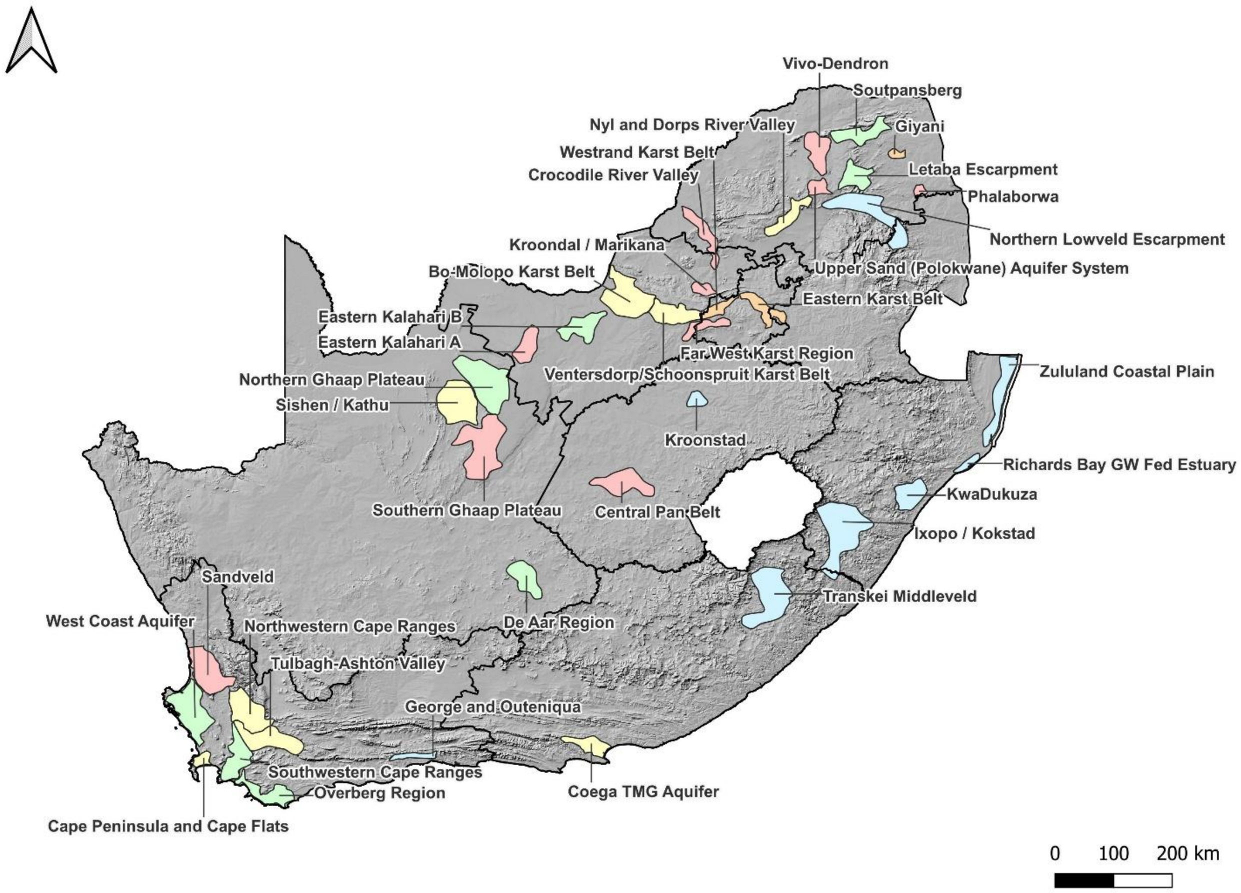

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Table 4-3 Summary of the Quality Status Quo for the 37 SWSA-gw.

SWSA-gw		Status Quo Quality
01	Bo-Molopo Karst Belt	D
02	Cape Peninsula and Cape Flats	D
03	Central Pan Belt	C
04	Coega TMG Aquifer	D
05	Crocodile River Valley	C
06	De Aar Region	C
07	Eastern Kalahari A	C
08	Eastern Kalahari B	B
09	Eastern Karst Belt	B
10	Far West Karst Region	B
11	George and Outeniqua	C
12	Giyani	C
13	Ixopo / Kokstad	A
14	Kroondal / Marikana	D
15	Kroonstad	C
16	KwaDukuza	C
17	Letaba Escarpment	C
18	Northern Ghaap Plateau	C
19	Northern Lowveld Escarpment	B
20	Northwestern Cape Ranges	A
21	Nyl and Dorps River Valley	C
22	Overberg Region	A
23	Phalaborwa	D
24	Richards Bay GW Fed Estuary	B
25	Sandveld	C
26	Sishen / Kathu	C
27	Southern Ghaap Plateau	A
28	Southwestern Cape Ranges	B
29	Soutpansberg	C
30	Transkei Middleveld	C
31	Tulbagh-Ashton Valley	C
32	Upper Sand (Polokwane) Aquifer System	C
33	Ventersdorp/Schoonspruit Karst Belt	C
34	Vivo-Dendron	D
35	West Coast Aquifer	C
36	Westrand Karst Belt	C
37	Zululand Coastal Plain	A

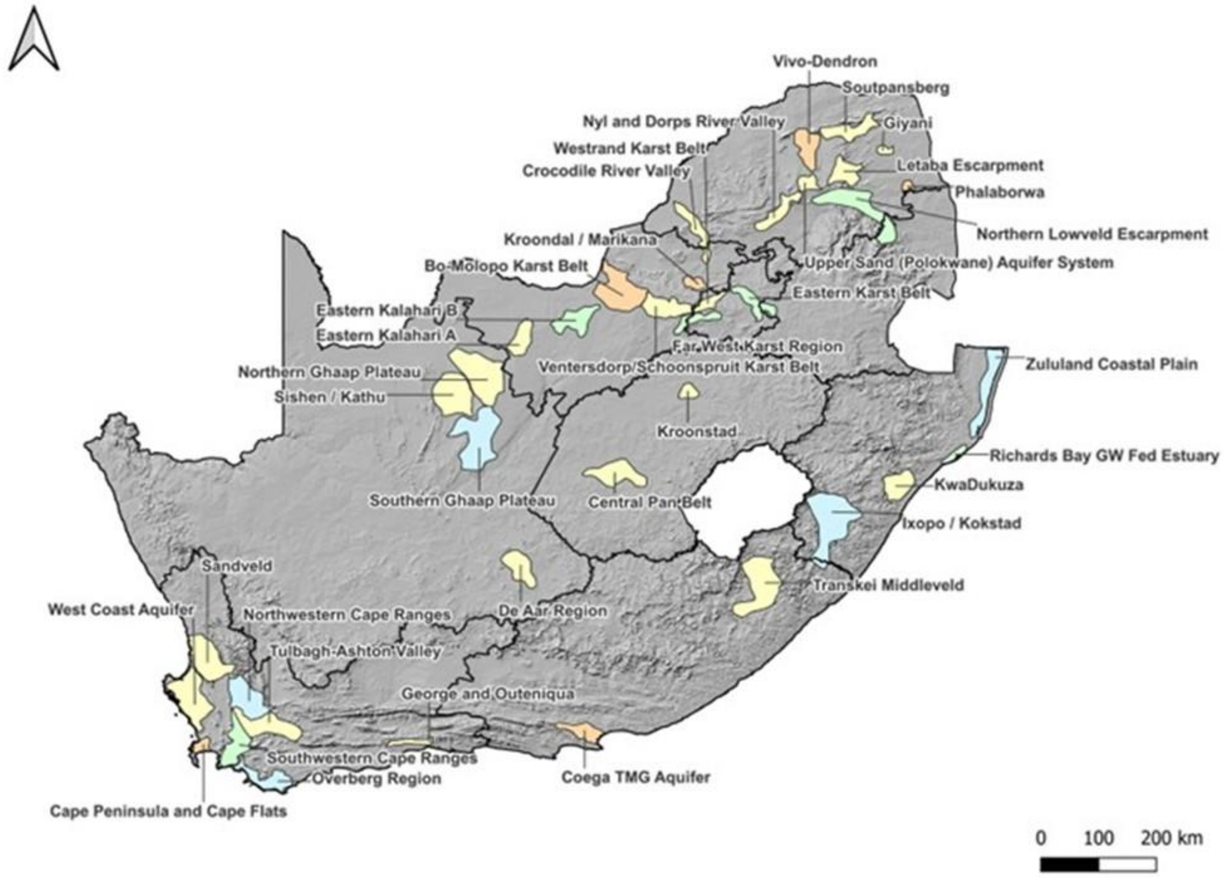

Table 4-4 Summary of the Threats and Risks Status Quo for the 37 SWSA-gw.

SWSA-gw		Status Quo Threats & Risks
01	Bo-Molopo Karst Belt	C
02	Cape Peninsula and Cape Flats	E
03	Central Pan Belt	B
04	Coega TMG Aquifer	C
05	Crocodile River Valley	C
06	De Aar Region	C
07	Eastern Kalahari A	B
08	Eastern Kalahari B	B
09	Eastern Karst Belt	D
10	Far West Karst Region	C
11	George and Outeniqua	B
12	Giyani	C
13	Ixopo / Kokstad	D
14	Kroondal / Marikana	D
15	Kroonstad	B
16	KwaDukuza	D
17	Letaba Escarpment	B
18	Northern Ghaap Plateau	B
19	Northern Lowveld Escarpment	C
20	Northwestern Cape Ranges	B
21	Nyl and Dorps River Valley	B
22	Overberg Region	B
23	Phalaborwa	E
24	Richards Bay GW Fed Estuary	D
25	Sandveld	B
26	Sishen / Kathu	D
27	Southern Ghaap Plateau	D
28	Southwestern Cape Ranges	B
29	Soutpansberg	D
30	Transkei Middleveld	B
31	Tulbagh-Ashton Valley	B
32	Upper Sand (Polokwane) Aquifer System	D
33	Ventersdorp/Schoonspruit Karst Belt	B
34	Vivo-Dendron	B
35	West Coast Aquifer	D
36	Westrand Karst Belt	B
37	Zululand Coastal Plain	C

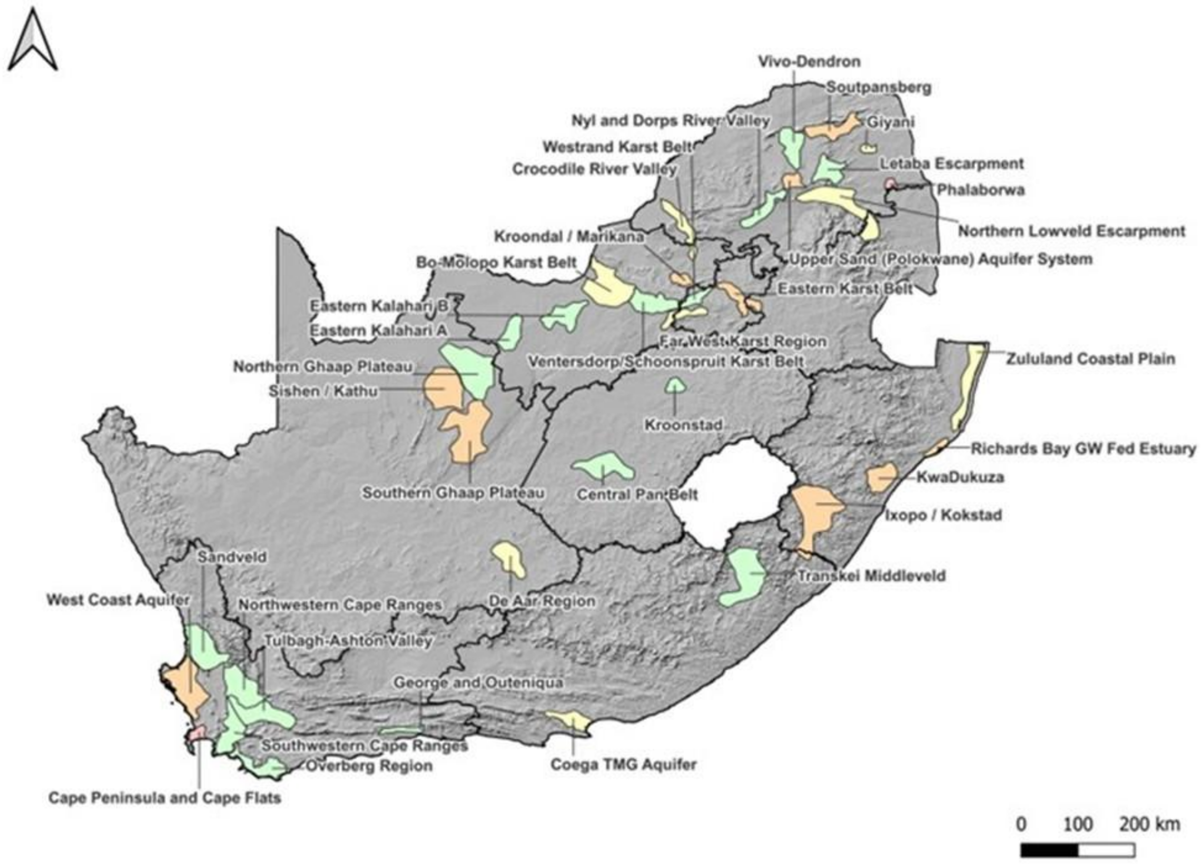

Table 4-5 Summary of the Protection Status Status Quo for the 37 SWSA-gw.

SWSA-gw		Status Quo Protection Status
01	Bo-Molopo Karst Belt	B
02	Cape Peninsula and Cape Flats	C
03	Central Pan Belt	D
04	Coega TMG Aquifer	B
05	Crocodile River Valley	B
06	De Aar Region	D
07	Eastern Kalahari A	E
08	Eastern Kalahari B	E
09	Eastern Karst Belt	D
10	Far West Karst Region	D
11	George and Outeniqua	C
12	Giyani	E
13	Ixopo / Kokstad	D
14	Kroondal / Marikana	B
15	Kroonstad	D
16	KwaDukuza	E
17	Letaba Escarpment	D
18	Northern Ghaap Plateau	D
19	Northern Lowveld Escarpment	C
20	Northwestern Cape Ranges	B
21	Nyl and Dorps River Valley	B
22	Overberg Region	C
23	Phalaborwa	C
24	Richards Bay GW Fed Estuary	D
25	Sandveld	C
26	Sishen / Kathu	D
27	Southern Ghaap Plateau	D
28	Southwestern Cape Ranges	B
29	Soutpansberg	C
30	Transkei Middleveld	E
31	Tulbagh-Ashton Valley	C
32	Upper Sand (Polokwane) Aquifer System	D
33	Ventersdorp/Schoonspruit Karst Belt	B
34	Vivo-Dendron	B
35	West Coast Aquifer	C
36	Westrand Karst Belt	B
37	Zululand Coastal Plain	C

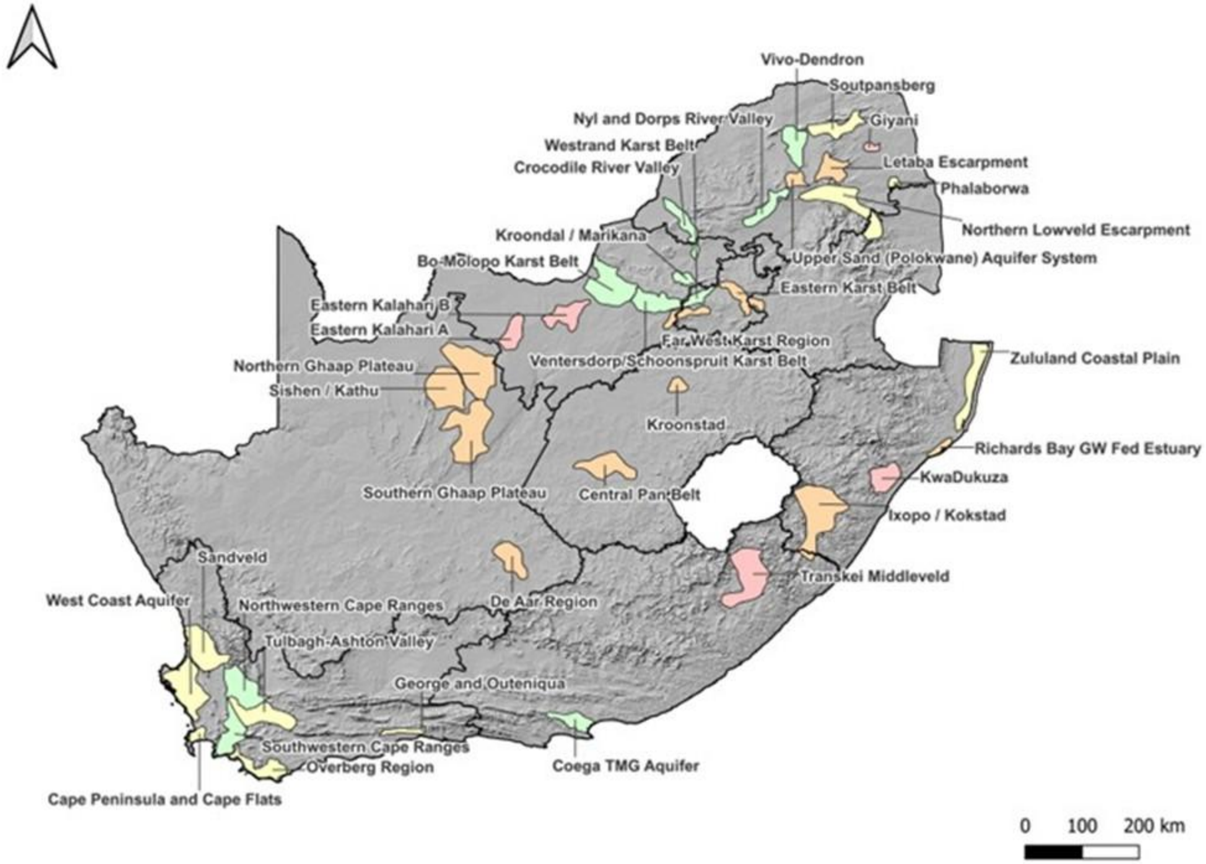

Table 4-6 Summary of the Status Quo Scores of each SWSA-gw based on the Current Status Matrix.

SWSA-gw		Current Status Category & Status Quo			
		Quantity	Quality	Threats & Risks	Protection Status
01	Bo-Molopo Karst Belt	C	D	C	B
02	Cape Peninsula and Cape Flats	C	D	E	C
03	Central Pan Belt	E	C	B	D
04	Coega TMG Aquifer	C	D	C	B
05	Crocodile River Valley	E	C	C	B
06	De Aar Region	B	C	C	D
07	Eastern Kalahari A	E	C	B	E
08	Eastern Kalahari B	B	B	B	E
09	Eastern Karst Belt	D	B	D	D
10	Far West Karst Region	E	B	C	D
11	George and Outeniqua	A	C	B	C
12	Giyani	D	C	C	E
13	Ixopo / Kokstad	A	A	D	D
14	Kroondal / Marikana	E	D	D	B
15	Kroonstad	A	C	B	D
16	KwaDukuza	A	C	D	E
17	Letaba Escarpment	B	C	B	D
18	Northern Ghaap Plateau	B	C	B	D
19	Northern Lowveld Escarpment	A	B	C	C
20	Northwestern Cape Ranges	C	A	B	B
21	Nyl and Dorps River Valley	C	C	B	B
22	Overberg Region	B	A	B	C
23	Phalaborwa	E	D	E	C
24	Richards Bay GW Fed Estuary	A	B	D	D
25	Sandveld	E	C	B	C
26	Sishen / Kathu	C	C	D	D
27	Southern Ghaap Plateau	E	A	D	D
28	Southwestern Cape Ranges	B	B	B	B
29	Soutpansberg	B	C	D	C
30	Transkei Middleveld	A	C	B	E
31	Tulbagh-Ashton Valley	C	C	B	C
32	Upper Sand (Polokwane) Aquifer System	E	C	D	D
33	Ventersdorp/Schoonspruit Karst Belt	C	C	B	B
34	Vivo-Dendron	E	D	B	B
35	West Coast Aquifer	B	C	D	C
36	Westrand Karst Belt	D	C	B	B
37	Zululand Coastal Plain	A	A	C	C

The SWSA-gw assessment reveals a varied hydrogeological landscape across South Africa's major groundwater regions. While certain areas such as the Zululand Coastal Plain, Ixopo/Kokstad, and Kroonstad exhibit strong groundwater conditions with high quality and minimal threats, several regions face pressing challenges. In particular, areas like the Bo-Molopo Karst Belt, Cape Flats, and Phalaborwa reflect low water quality and elevated threats, despite differing levels of protection. Quality and protection status show the greatest variability, suggesting gaps in management and resilience to pressures. Notably, regions such as Eastern Kalahari A, Giyani, and Upper Sand Aquifer rank poorly across multiple dimensions, indicating a critical need for focused protection and remediation efforts. Overall, the data underscores the importance of tailored groundwater governance and sustainable management strategies, especially in vulnerable regions where aquifer quality and protection are inadequate. A prioritised, region-specific approach will be essential to ensure groundwater security under increasing environmental and anthropogenic pressures.

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