High Confidence Groundwater Reserve Determination Study in the Berg Catchment

WP11398 Groundwater Reserve Determination Report

Report Number: RDM/WMA19/02/CON/COMP/0124 February 2024



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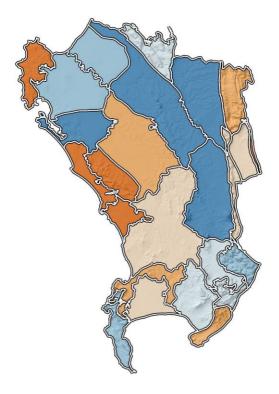
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High Confidence Groundwater Reserve Determination Study in the Berg Catchment

WP11398

Groundwater Reserve Determination Report



Report Number: RDM/WMA19/02/CON/COMP/0124

Version 1 – Final Prepared for:

Department of Water and Sanitation Chief Directorate: Water Ecosystems Management

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APPROVED BY

UMVOTO South Africa (Pty) Ltd Director **Kornelius Riemann**

UMVOTO South Africa (Pty) Ltd **Technical Reviewer David McGibbon**

Department of Water and Sanitation Chief Directorate: Water Ecosystems Management Project Manager Philani Khoza

Department of Water and Sanitation Chief Directorate: Water Ecosystems

Management Director Yakeen Atwaru Department of Water and Sanitation **Chief Directorate: Water Ecosystems** Management Scientific Manager Kwazikwakhe Majola



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3.9	RDM/WMA19/02/CON/COMP/0324	Gazette Template



Executive Summary

In response to the increasing number of Water Use Licence Applications (WULAs) in the Berg catchment and the potential impacts of proposed developments on water resource quantity and quality, the Department of Water and Sanitation (DWS), Chief Directorate: Water Ecosystems Management (CD: WEM), initiated a 'High Confidence Groundwater Reserve Determination Study for the Berg Catchment'.

The National Water Act (NWA, No. 36 of 1998) establishes a legal framework for the effective and sustainable management of significant water resources in South Africa. The Resource Directed Measures (RDM), aimed at balancing the protection, use, conservation, management, and control of water resources, is an important tool within the NWAs framework and consist of three main components (see **Figure 1**): Classification, Reserve, and Resource Quality Objectives (RQOs). The Reserve, designated as the water 'set aside' to fulfil Basic Human Needs (BHN) and Ecological Water Requirements (EWR), is the only right to water in the NWA, and takes precedence over all other water uses. These requirements, coupled with other critical water demands on these water resources, are safeguarded by the RQOs identified for priority water resource sites.

Given that two components of the RDM (i.e., the 'Classification' and the 'RQOs') have already been completed and gazetted (Gazette No.42451:121) for the Berg catchment, this study sought to conclude the RDM process and align with the gazetted water requirements. It is noteworthy that while the NWA explicitly includes groundwater in the definition of a 'water resource', the distinctive characteristics of groundwater systems sometimes require a unique management approach. Therefore, in determining the groundwater Reserve for the Berg catchment, careful consideration was given to the volume of groundwater that can be sustainably abstracted without adversely affecting its contribution to surface water flow.

The primary objective of this study was to provide insights into the groundwater resource systems within the Berg catchment, considering both the established conservation status of priority water resources and the complex geological and hydrogeological features of the study area. The overarching goal was to offer aquifer-specific information to facilitate well-informed management decisions concerning stressed or over-utilized groundwater resources.

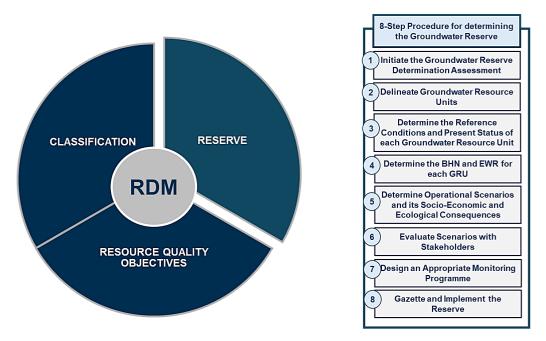


Figure 1 The overarching components of the RDM and the 8-step procedure for determining the Groundwater Reserve (after WRC, 2013).

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In accordance with Regulation 2(4) of the NWA (Act No. 36 of 1998), the Groundwater Reserve Determination (GRD) process followed the eight-step procedure outlined and published in the RDM (WRC, 2013). This report represents Step 8 of Phase 3 of this procedure (see **Figure 1**), which involved initiating the Gazetting process and implementing the Groundwater Reserve. This phase included compiling a single Groundwater Reserve Determination Report (**Deliverable 3.7**), providing a comprehensive summary of findings and recommendations for the catchment. The primary goal was to offer aquifer-specific information for various hydrogeological components considered for the Groundwater Reserve, specifically addressing the groundwater quantity and quality components of the BHN and EWR.

1. Groundwater Quantity Component

The Berg catchment comprises 30 Quaternary Catchments delineated into 25 Groundwater Resource Units (GRUs). It's important to note that groundwater systems may not always correspond directly to surface water catchments; GRUs can encompass one or more quaternary catchments, or portions thereof, depending on their hydrogeological characteristics. The Groundwater Quantity Component was calculated considering the total groundwater contribution (i.e., volume) to both the EWR and the BHN Reserves.

a. Basic Human Needs

The BHN addresses individuals without access to a formal water supply and residing beyond 500 meters from a perennial river, with a daily water demand set at a fixed value of 25 liters per person per day ($\ell/p/d$).

b. Ecological Water Requirements

The EWR involved using baseflow separation, wherein groundwater discharge was calculated using monthly flow data calibrated to meet Target Ecological Categories (TECs) for each node, and factoring in cumulative flow effects downstream. A recharge ratio was applied to the total dry season contribution of groundwater to baseflow per GRU and associated aquifer types.

2. Groundwater Quality Component

Data from various sources were collected and analysed to evaluate baseline water quality and identify potential sources of contamination across the GRUs. The evaluation also included an assessment of selected groundwater parameters for compliance with gazetted RQOs (Gazette No.42451:121).

The primary water quality dataset was sourced from the Water Management System (WMS). Other datasets were used in GRUs where WMS monitoring points were lacking. A total of 379 unique monitoring locations were considered across the 25 GRUs, with 7 GRUs lacking monitoring data, primarily within the fractured Table Mountain Group Aquifers (TMGA).

The Groundwater Quality Component of the Reserve was determined by assessing two primary components:

a. Groundwater Quality Reserve

The Groundwater Quality Reserve was determined based on statistical analysis of the baseline and median plus 10% concentrations (per chemical parameter) within specific aquifers in the GRUs.

b. Groundwater Quality Requirement for BHN

Upper limit of Class I Water Quality [Drinking] - South African Water Quality Guidelines, Volume 1: Domestic Water Use, 2nd Ed. 1996. Department of Water Affairs, Pretoria, South Africa.

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HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT





List of abbreviations, acronyms, symbols and units of measurement

~ <	Approximately Less than
a	annum
Berg WAAS	Berg Water Availability Assessment
BH	Borehole
BHN	Basic Human Needs
CD: WEM	Chief Directorate: Water Ecosystems Management
CFA	Cape Flats Aquifer
CGS	Cape Granite Suite
CoCT	City of Cape Town
Conc.	Concentration
DWS	Department of Water and Sanitation
e.g.	For example
Et al. etc.	and others etcetera
EWR	Ecological Water Requirement
Fm	Formation
GDE	Groundwater Dependent Ecosystems
GIS	Geographic Information System
GRD	Groundwater Reserve Determination
GRDM	Groundwater Resource Directed Measure
GRU	Groundwater Resource Unit
GW	Groundwater
i.e.	That is.
IAP	Invasive Alian Plants
IRF	Irrigation Return Flow
IUA	Integrated Unit of Analysis
km	Kilometres
ℓ/p/d	Litres per person per day
Ltd. m	Limited Liability Metres
M m ³	Million Cubic Metres
m ³	Cubic Metres
MAP	Mean Annual Precipitation
MAT	Mean Annual Temperature
mm	Millimetres
mm/a	Millimetres per annum
N	North
NGA	National Groundwater Archive
No.	Number
NWA	National Water Ac
pg. PHA	Page Philippi Horticulture Area
PS	Present Status
PSP	Professional Service Provider
Pty.	Proprietary
RDM	Resource Directed Measure
Ref	Reference
RQO	Resource Quality Objective



RU Sc SGWCA SI SWSA TEC TMG TMGA TOR WARMS WCWSS WMA WMS WQ WR2012 WRC WRCs WUII	Resource Unit Scenario Subterranean Government Water Control Areas Stress Index Strategic Water Source Areas Target Ecological Category Table Mountain Group Table Mountain Group Aquifer Terms of Reference Water Use Authorization & Registration Management System Western Cape Water Supply System Water Management Area Water Management Area Water Management System Water Quality Water Resources of South Africa Study (2012) Water Research Commission Water Resource Classes Water Use Licence
WRCs WUL WULA	Water Resource Classes Water Use Licence Water Use Licence Application

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1. INTRODUCTION

1.1. Background of the Study

In response to the increasing number of Water Use Licence Applications (WULAs) in the Berg catchment and the potential impacts proposed developments may have on water resource quantity and quality, the Department of Water and Sanitation (DWS): Chief Directorate: Water Ecosystems Management (CD: WEM) initiated a "High Confidence Groundwater Reserve Determination Study for the Berg Catchment". This study aimed to complete the Resource Directed Measures (RDM) process (**Figure 1-1**) for the Berg catchment and support the Water Resource Classes (WRCs) and Resource Quality Objectives (RQOs) gazetted on the 10th of May 2019 (Gazette No.42451:121, hereafter referred to as 'DWS, 2019b: 121').

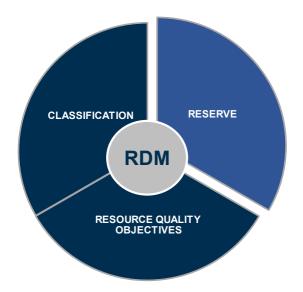


Figure 1-1 The three main components of the Resource Directed Measures (RDM) process as defined by Regulation 2(4) of the National Water Act (NWA; No. 36 of 1998).

The primary objective of this study was to offer insights into the groundwater resource systems within the Berg catchment, taking into account both the conservation status of priority water resources and the complex geological and hydrogeological features of the study area. The overarching goal was to provide aquifer-specific information with a high level of confidence to facilitate well-informed management decisions concerning stressed or over-utilized groundwater resources. This study therefore aimed to align with the gazetted requirements for the Berg catchment and to determine the necessary groundwater contribution to the Reserve. Specifically, the focus was on the groundwater contribution to Basic Human Needs (BHN) and Ecological Water Requirements (EWR), as outlined in the project's Terms of Reference (TORs) (refer to **Section 1.2**).

For the Berg catchment, WRCs and. RQOs were officially gazetted as an outcome of the 'Determination of Water Resource Classifications and Resource Quality Objectives in the Berg Catchment' study (hereafter referred to as 'DWS, 2016' or 'The Berg Catchment WRCs and RQOs Study'). The WRCs were completed in accordance with Section 13(4)(a)(i)(aa) of the National Water Act (NWA) of 1998 and the RQOs were completed for prioritized Resource Units (RUs) in accordance with Section 13(4)(a)(i)(bb) of the NWA of 1998. A summary of the information presented in the Gazette is provided in DWS (2022e).



1.2. Terms of Reference

The Terms of Reference (TOR), as provided by the DWS CD: WEM, and outlined in the projects Inception Report (DWS, 2022a), stipulates the aims and objectives for this study as follows:

"The objective of this study is to determine a high confidence groundwater Reserve requirements (quantity and quality) to satisfy the basic human needs and to protect aquatic ecosystems in priority water resources within the Berg catchment".

- BID no. WP 11398

"Detailed determinations aim to produce high-confidence results, are based on sitespecific data collected by specialists and are used for all compulsory licensing exercises, as well as for the individual licence applications that could have a large impact on any catchment, or a relatively small impact on ecologically important and sensitive catchments".

- BID no. WP 11398

1.3. The Study Area

The Berg catchment, delineated in the 19 Water Management Area (2004), serves as the primary study area boundary, and is situated within the Western Cape Province of South Africa. It covers approximately 13,891 km² and includes secondary drainage regions G1 and G2 (**Figure 1-1**).

This catchment experiences a Mediterranean climate characterized by winter rainfall, where the mean annual precipitation (MAP) varies significantly due to the region's topography, ranging from 300 mm in the low-lying coastal plains (northwest) to 3,000 mm in the high mountain ranges (east). Mean annual temperature's (MAT) also exhibits variation, with cooler temperatures in mountainous areas (10 - 14°C) and warmer temperatures along the coastal lowlands (16 - 20°C). Evaporation rates increase with latitude, particularly northwards (approximately 2200 – 2600 mm), while southern areas, around Cape Town, experience lower evaporation rates (approximately 1800 – 2200 mm).

Hydrologically, the Berg River (G1) catchment is the largest within the study area, covering approximately 8908 km². The study area includes 22 estuaries, with the Berg River estuary and Langebaan Lagoon among them, both receiving contributions from groundwater. Significant wetlands, such as the Edith Stephens Wetland Park, Zeekoevlei, Rondevlei, Zoarvlei, and Rietvlei, are also present. Additionally, six major dams are situated in the catchment, namely the Upper and Lower Steenbras, Wemmershoek, Voëlvlei, Theewaterskloof, and Berg River Dam.

Geologically, the majority of the Berg catchment is underlain by Klipheuwel and Malmesbury Group rocks. These basement rocks were intruded by the Cape Granite Suite (CGS), leading to a prolonged period of uplift and erosion. This geological process resulted in the deposition of sandstones forming the Table Mountain Group (TMG). The Peninsula and Nardouw Aquifers (TMG), arising from these formations, contribute to deep fractured rock aquifers. Further erosion of these formations, particularly the softer Malmesbury Group, shaped eroded valleys, leading to sediment deposition in the western and coastal portions of the catchment (see **Figure 1-2**). These sand deposits form the Bredasdorp Group, Sandveld Group, and Quaternary age deposits, comprising major primary sedimentary/intergranular aquifers such as the Cape Flats Aquifer (CFA), Atlantis/Silwerstroom aquifers, and the West Coast Aquifers (Yzerfontein, Adamboerskraal, Elandsfontein, and Langebaan Road Aquifers) (DWS, 2022a).



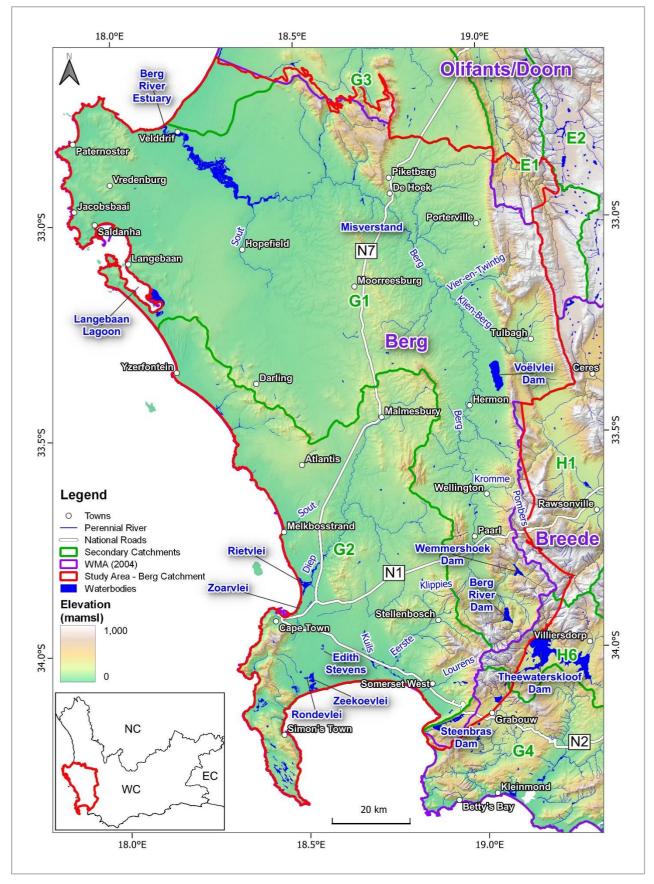


Figure 1-2 The Berg catchment and the project study area.



1.4. Study Methodology & Approach

As outlined in **Section 1.5**, the Groundwater Reserve Determination process followed the eight-step GRD procedure outlined GRDM (WRC, 2013). Consequently, the project was subdivided into three phases, each further split into tasks and key deliverables. These are summarized in **Table 1-1** and **Figure 1-3** as well as in the Inception Report (DWS, 2022a).

Table 1-1 Summary of project phases, tasks, and associated deliverables for the study.

Phase 1	Project Inception		
Task 1	Inception		Deliverable 1: Inception Report
Phase 2	Review o	f Water Resource Information	and Data
Task 2.1	Data colle	ction and collation	Deliverable 2.1: Gap Analysis Report Deliverable 2.2: Inventory of Water Resource Models
Phase 3	Reserve I	Determination	
Task 3.1	Step 1	Initiate Groundwater Reserve Study	Recorded in Deliverable 2.1 and Deliverable 2.2
Task 3.2	Step 2	Water RU Delineation	Deliverable 3.1: Delineation of Water RUs Report
Task 3.3	Step 3	Ecological Reference Conditions of RUs	Deliverable 3.2: Ecological Reference Conditions Report
Task 3.4	Step 4	Determine BHN and EWR	Deliverable 3.3: BHN and EWR Requirement Report
Task 3.5	Step 5	Operational Scenarios & Socio-economic	Deliverable 3.4: Operational Scenarios & Socio-Economic and Ecological Consequences Report
Task 3.6	Step 6	Evaluate Operational Scenarios with Stakeholders	Deliverable 3.5: Stakeholder Engagement of Operational Scenarios Report
Task 3.7	Step 7	Monitoring Programme	Deliverables 3.6: Monitoring Programme Report
Task 3.8	Step 8	Gazette & implement Reserve	Deliverable 3.7: Groundwater Reserve Determination Report Deliverable 3.8: Database Deliverable 3.9: Gazette Template

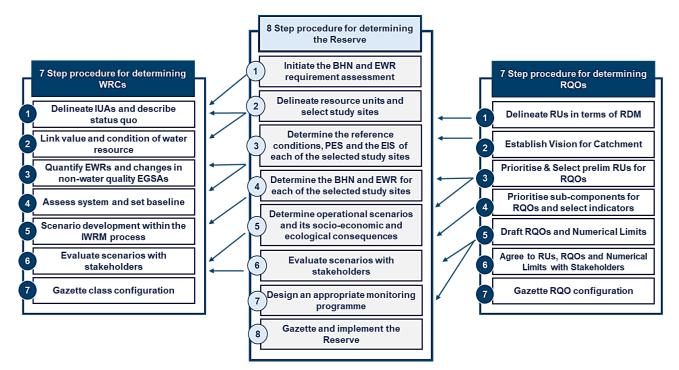


Figure 1-3 The eight-step GRD procedure and its alignment with the seven-step WRCs & RQO procedure (after WRC, 2013).



1.5. Aim of this Report

As per Regulation 2(4) of the NWA (No. 36 of 1998), the Reserve determination process must follow the eight-step procedure outlined in the RDM manuals. To differentiate between the general RDM and RDM specifically related to groundwater, the term Groundwater Resource Directed Measures (GRDM) is utilized. The GRDM manuals referenced in this report include WRC (2007), WRC (2013), and preliminary findings from an ongoing review of GRDM manuals conducted by the Water Research Commission (WRC).

The purpose of this report is to present a comprehensive summary of the findings and recommendations resulting from the Groundwater Reserve Determination (GRD) process conducted for the Berg catchment. Each section in this report presents a summary of the information and outputs of the detailed reports for each step of the eight-step GRD procedure.

In terms of the report structure, **Chapter 1** serves as an introduction, providing insights into the study area and the GRD methodology. **Chapter 2** provides a summary of the eight-step GRD procedure for the Berg Catchment, including the delineation of Groundwater Resource Units (GRUs), the assessment of ecological reference conditions, the requirements for BHN and EWR, operational scenarios and an analysis of the socio-economic and ecological consequences, and the proposed monitoring programme to be implemented for the Reserve. Finally, **Chapter 3** concludes the report with the outcomes of the study per GRU.

It must be noted that the perspectives, expertise, and concerns of stakeholders played an important role in shaping outcomes of this study, ensuring that the results of the assessment were well-informed, balanced, and reflective of the interests and needs of all involved parties.



2. **RESERVE DETERMINATION**

The National Water Act (No. 36 of 1998) establishes a legal framework for the effective and sustainable management of significant water resources in South Africa. The RDM, required to balance the protection, use, conservation, management, and control of water resources, comprises three main components: Classification, Reserve, and Resource Quality Objectives (RQOs) as detailed in **Section 1.1**. The Reserve, i.e., the water "set aside" to provide for BHN and EWR, is the <u>only</u> right to water in NWA, taking precedence over all other water use. Simply put, the Reserve's water requirements must be fulfilled before allocating water resources to other users. These requirements, along with other demands on water resources, are safeguarded by RQOs identified for priority sites in the Berg catchment.

Although the NWA explicitly includes groundwater in the definition of a "water resource", the distinctive characteristics of groundwater systems a sometimes necessitate a unique management approach. Consequently, in determining the groundwater Reserve for the Berg catchment, consideration was given to the volume of groundwater that can be sustainably abstracted without adversely affecting its contribution to surface water flow (WRC, 2013).

The following subsections offer a summary of the key outcomes of each step in the eight-step GRD process outlined in **Section 1.4**.

2.1. Step 1: Data and Water Resource Models

Following an extensive literature review, multiple data sources were collated and utilised in this GRD study. The Berg Catchment WRCs and RQOs Study (DWS, 2016) and the Berg Water Availability Assessment Study (Berg WAAS) project (DWAF, 2008) formed a crucial foundation, contributing information on aquifer type classification, aquifer boundaries, general hydrogeologic characteristics, regional groundwater flow, recharge, and groundwater quality. Additional studies, including the Pre-Feasibility and Feasibility Studies for the Augmentation of the Western Cape Water Supply System (WCWSS) (DWA, 2012), the Water Reconciliation Strategy for the WCWSS (DWS, 2016f), the Water Resources of South Africa Study (WRC, 2012), the Groundwater Projects associated with City of Cape Town's New Water Programme, and the Berg River Baseline Monitoring Programme (DWAF, 2007a & b), also provided valuable inputs.

After reviewing the available data and information, it became clear that a significant re-evaluation of surface water RUs was unnecessary within the defined project scope. The DWS (2016) conducted a comprehensive review of surface water data, which was effectively integrated into this GRD assessment. The study revealed no significant gaps in surface water information. Information on the spatial extent and groundwater dependency of wetlands was lacking sufficient regional mapping, and therefore additional data was integrated into an updated understanding of surface-groundwater interactions (DWS, 2022b).

Groundwater data was collated from national databases such as the National Groundwater Archive (NGA), Water Management System (WMS), Water Use Authorization & Registration Management System (WARMS), and Hydstra database and then underwent a rigorous quality check. Smaller scale geological maps (1:50 000) were used, with preference given to finer resolution maps in certain areas. Water resource models were also assessed and categorized, encompassing various model types such as desktop feasibility, conceptual, water balance, yield/storage, and numerical models. While aquifer-scale groundwater numerical models were developed for major aquifers, proprietary constraints limited access to the datafiles.

Detailed information on data and water resource models were provided in both the Gap Analysis Report (DWS, 2022b) and the Inventory of Water Resource Models Report (DWS, 2022c). These reports correspond to Step 1 in the eight-step GRD procedure, as illustrated in **Table 1-1** and **Figure 1-3**.



2.2. Step 2: Delineation of Groundwater Resource Units

The delineation of GRUs in the Berg Catchment WRCs and RQOs Study (DWS, 2016) was initially based on surface water catchments, resulting in the grouping of various aquifer systems into single GRUs to integrate them with surface water systems. Unfortunately, this approach had limitations, leading to potential groundwater management issues for the catchment, such as the exclusion of significant aquifer systems like the Table Mountain Group Aquifers (TMGA) in the Steenbras area.

The geology of the Berg catchment strongly influences topography, recharge (drainage, and orogenic control over precipitation), and groundwater chemistry. Due to the complex geological characteristics of different aquifers (i.e., the Sandveld Group, Table Mountain Group (TMG), and Basement Aquifers) and the strong compartmentalization of TMG formations due to major faults or fault zones, the existing GRU extents did not align with the actual aquifer boundaries.

To address these issues, Step 2 of the GRD process focused on delineating aquifer-specific GRUs and identifying areas requiring further investigation. This step aimed to refine the delineation process, ensuring the inclusion of overlooked aquifers and improving mapping accuracy for groundwater Reserve determination.

Three main criteria—physical, management, and functional—were used to re-delineate aquiferspecific GRUs. The approach involved analysing physical aquifer geometry, existing aquifer boundaries, recharge areas, topography, structural geology (faults, folds, hydrotects), and potential discharge areas. Functional and management criteria considered existing Integrated Units of Analysis (IUAs), WRCs, RQOs, Strategic Water Source Areas (SWSAs), Subterranean Government Water Control Areas (SGWCA), groundwater use, aquifer reliance, and groundwater-surface water interactions.

The updated GRU extents are presented in **Table 2-1** and displayed on a geological map in **Figure 2-1**. Comprehensive details on the approach, methodology, and results can be found in the Delineation of Groundwater Resource Units Report (DWS, 2022d).

GRU Name	Associated Quaternary Catchment				
Primary / Int	Primary / Intergranular Aquifers				
Cape Flats	G22C, G22D and G22E				
Atlantis	G21A, G21B and G21D				
Yzerfontein	G21A				
Elandsfontein	G10M and G10L				
Langebaan Road	G10M and G10L				
Adamboerskraal	G10M, G10K and G30A				
Fractured Table N	Mountain Group Aquifers				
Cape Peninsula	G22A, G22B, G22C and G22D				
Steenbras-Nuweberg	G40B, G40A, G40D, G22J, G22K, H60A and G40C				
Drakensteinberge	G10A, G10C, G22F, G22J, H60A and H60B				
Wemmershoek	G10B, G10A, G10C, H10J, H60B and H10K				
Voëlvlei-Slanghoek	G10E, G10J, G10D, G10F, H10E, H10F and H10J				
Witzenberg	G10E				
Groot Winterhoek	G10J, G10E, G10H, E10C and G10G				
Piketberg	G10M, G30D, G10K, G30A and G10H				
Fractured and I	ntergranular Basement				
Cape Town Rim	G22C, G22E, G22B and G22D				
Stellenbosch-Helderberg	G22G, G22H, G22F, G22J and G22K				
Paarl-Franschoek	G10C, G10A and G10B				
Malmesbury	G201E, G21C, G21D, G21F and G21B				
Wellington	G10D and G10F				
Tulbagh	G10E and G10G				
Eendekuil Basin	G10H, G10J, G10F and G10K				
Middle-Lower Berg	G10J, G30A, G10K and G10M				
Northern Swartland	G10L				
Darling	G10L and G21A				
Vredenburg	G10M				

Table 2-1 Summary of revised GRUs for the Berg catchment.



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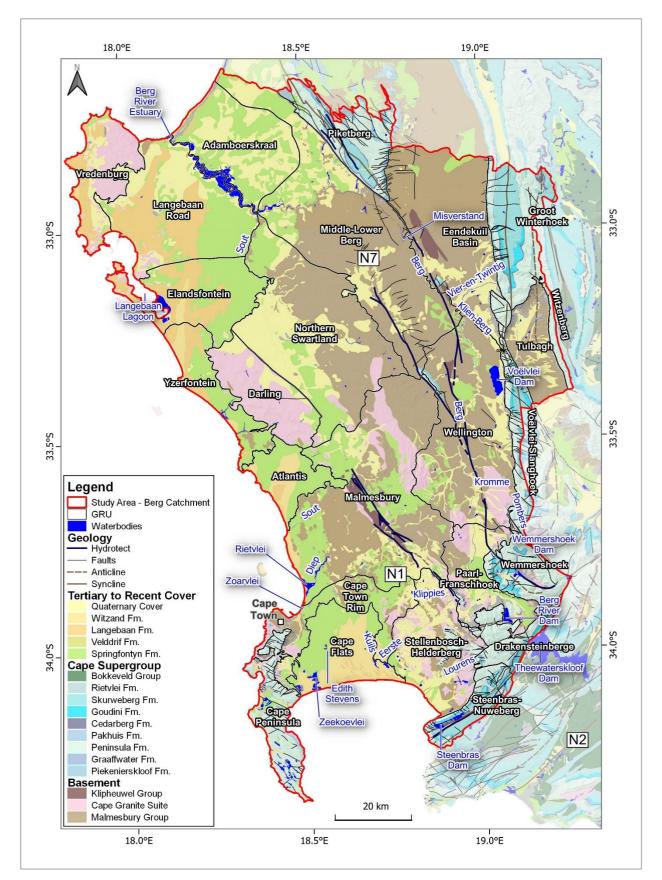


Figure 2-1 Summary of revised GRUs extents for the Berg catchment with associated geology and relevant structural features.



2.3. Step 3: Ecological Reference Conditions

To ensure alignment with the aquifer-specific GRUs identified in Step 2 (**Section 2.2**) as well as the information related to the gazetted WRCs and RQOs (DWS, 2019b: 121), Step 3 of the GRD process re-evaluated the ecological reference conditions and present status (PS) of the catchment. In the context of this study, 'ecological reference conditions' referred to the ambient or natural state of groundwater systems, while 'present status' referred to the current state in terms of groundwater utilization and water quality.

The objective of this step was to establish a correlation between the earlier assessments of the groundwater status quo in the Berg catchment (following DWS, 2016). This involved providing insights into the updated approach and criteria considered for a revised assessment of the groundwater status quo. This encompassed five critical hydrogeological components: 1) Recharge, 2) Groundwater Use, 3) Discharge, 4) Groundwater Quality, and 5) Aquifer Stress.

1. RECHARGE

Various recharge estimation techniques were used based on the hydrogeological characteristics of specific GRUs. The selection considered the confidence level and associated limitations of the technique; the amount, spread, and availability of data across the GRU; and the applicability of published datasets. The assessment took into account artificial recharge and lateral recharge (where applicable).

2. GROUNDWATER USE

Various data sources were collated to assess current groundwater use in the study area, providing a quantitative means of assessment per GRU as input to the groundwater Stress Index (SI). The index considered both groundwater availability (natural/artificial recharge) and groundwater use, aiming to quantify Aquifer Stress by assigning an associated PS category.

3. DISCHARGE

Groundwater discharge represented the outflow of groundwater from aquifers to the surface or surface water systems, either directly or laterally via an adjacent aquifer unit. Groundwater contribution to baseflow was calculated to provide aquifer-specific estimates.

4. GROUNDWATER QUALITY

Data from various sources were collated to provide a hydrochemical summary per GRU. Baseline water quality was assessed for each GRU (for select parameters), and potential sources of contamination were identified. Selected groundwater parameters were also evaluated for compliance with RQOs (DWS, 2019b:121), and groundwater quality PS categories were assigned per GRU.

5. AQUIFER STRESS

Three guidance tables were used in the aquifer stress assessment including 1) sustainable use, 2) level of stress, and 3) contamination / water quality, to define PS Category for both groundwater availability and groundwater quality per GRU.

A guide for determining Groundwater Availability and Water Quality PS Category is outline in **Table 2-6** while a summary of the results is presented per GRU in **Table 2-3**. Comprehensive details regarding the approach, methodology, and associated results can be found in the Ecological Reference Conditions Report (DWS, 2022e).



Table 2-2Guide for determining both Groundwater Availability and Water Quality PS Categories
(after WRC, 2007).

		er Availability tus Category		Quality tus Category
	Stress Index (GW use / Recharge)	Description	Percentage Exceedance	Description
А	<0.05	Unstressed or slightly stressed	<16.7 %	Unmodified, pristine conditions
в	0.05 – 0.20	Unstressed or slightly stressed	16.7 – 33.4 %	Localised, low levels of contamination, but no negative impacts apparent
С	0.20 - 0.40	Moderately stressed	33.4 – 50.1 %	Moderate levels of localised contamination, but little or no negative impacts apparent
D	0.40 - 0.65	Moderately stressed	50.1 - 66.8 %	Moderate levels of widespread contamination, which limit the use of potential use of the aquifer
E	0.65 – 0.95	Highly stressed	66.8 - 83.5 %	High levels of local contamination which render parts of the aquifer unusable
F	>0.95	Critically stressed	>83.5 %	High levels of widespread contamination which render the aquifer unusable

Table 2-3Summary of the PS Category per GRU for both Groundwater Availability and
Groundwater Quality.

GRU	Groundwater Availability Present Status Category	Groundwater Quality Present Status Category				
	Primary / Intergranular Aquifers					
Cape Flats	С	D				
Atlantis	В	С				
Yzerfontein	А	А				
Elandsfontein	В	В				
Langebaan Road	C	В				
Adamboerskraal	В	В				
	Fractured Table Mountain Group Aquifers					
Cape Peninsula	В	В				
Steenbras-Nuweberg	В	В				
Drakensteinberge	Α	-				
Wemmershoek	Α	А				
Voëlvlei-Slanghoek	А	-				
Witzenberg	Α	-				
Groot Winterhoek	В	-				
Piketberg	С	-				
	Fractured and Intergranular Basement					
Cape Town Rim	С	С				
Stellenbosch-Helderberg	С	С				
Paarl-Franschhoek	C	-				
Malmesbury	C	В				
Wellington	В	В				
Tulbagh	C	-				
Eendekuil Basin	C	С				
Middle-Lower Berg	В	С				
Northern Swartland	В	С				
Darling	В	С				
Vredenberg	В	-				



2.4. Step 4: BHN and EWR Requirements

Step 4 of the GRD involved determining the groundwater component of both the BHN and EWR for the aquifer-specific GRUs updated in Step 2 (**Section 2.2**). These components were calculated as independent volumes, collectively constituting the Groundwater Reserve.

1. Basic Human Needs

The groundwater component of the BHN addresses individuals without access to a formal water supply and residing beyond 500 meters from a perennial river (here after referred to as the "Qualifying Population"). The Qualifying Population was calculated as 257,331 individuals within the Berg catchment, with a daily water demand set at a fixed value of 25 $\ell/p/d$. Therefore, the groundwater component of the BHN was determined to be 2.35 Mm³/a. The Cape Flats (0.70 Mm³/a), Malmesbury (0.34 Mm³/a), Stellenbosch-Helderberg (0.24 Mm³/a), and Wellington (0.24 Mm³/a) GRUs collectively account for about 65% of the total groundwater component of the BHN Reserve (**Table 2-4** and **Figure 2-2**).

2. Ecological Water Requirements

Quantifying the groundwater component of the EWR involved using a baseflow separation technique, wherein groundwater discharge was calculated using monthly flow data calibrated to meet Target Ecological Categories (TECs) for all river nodes and priority estuaries in the study area. A "balancing and routing" tool factored in cumulative flow downstream, allowing calculations of changes in flow and TECs for downstream river nodes and estuaries. To assess the groundwater contribution to the EWR per GRU accurately, a detailed GIS-based catchment analysis re-evaluated incremental contributing catchments based on local topography, flow direction, aquifer model extents, and available literature. A recharge ratio was then applied to the total dry-season contribution of groundwater to baseflow per GRU and associated aquifer types.

The groundwater component of the EWR Reserve was calculated as 69.98 Mm³/a, with the Middle-Lower Berg (11.15 Mm³/a), Wellington (6.75 Mm³/a), Adamboerskraal (6.00 Mm³/a), Elandsfontein (6.39 Mm³/a), Langebaan Road (5.52 Mm³/a), and Eendekuil Basin (6.95 Mm³/a) GRUs accounting for approximately 61% of the total groundwater component of the EWR Reserve (**Table 2-4** and **Figure 2-2**).

The Groundwater Reserve, supporting both BHNs and EWRs, was therefore determined to be 72.33 Mm³/a. While groundwater is more widely distributed than surface water, this component is just part of the larger geohydrological system considered under the RDM. Once the volume of the Groundwater Reserve is quantified and RQOs have been met, the remaining water resource can be allocated to users. Since RQOs were defined for the Berg catchment before this high-confidence groundwater Reserve study, it is likely that RQOs will require adjustment or updating to accommodate the Groundwater Reserve.

Table 2-4 and the associated maps displayed in **Figure 2-2** present a summary of the groundwater contribution to the BHN and EWR, while the comprehensive details regarding the approach, methodology, and results can be found in the BHN and EWR Requirements Report (DWS, 2023a).



Table 2-4

Summary of the groundwater contribution to BHN and EWR per GRU.

GRU	The groundwater contribution to EWR (Mm³/a)	The groundwater contribution to BHN (Mm³/a)	The groundwater contribution to Reserve (Mm³/a)		
	Primary / Interg	ranular Aquifers			
Cape Flats	0.51	0.701	1.211		
Atlantis	0.08	0.026	0.106		
Yzerfontein	0.02	0.009	0.029		
Elandsfontein	6.39	0.005	6.395		
Langebaan Road	5.52	0.017	5.537		
Adamboerskraal	6.00	0.008	6.008		
	Fractured Table Mou	ntain Group Aquifers			
Cape Peninsula	5.43	0.085	5.515		
Steenbras-Nuweberg	1.16	0.016	1.176		
Drakensteinberge	2.88	0.003	2.883		
Wemmershoek	3.59	0.002	3.592		
Voëlvlei-Slanghoek	1.62	0.007	1.627		
Witzenberg	0.18	0.002	0.182		
Groot Winterhoek	0.77	0.017	0.787		
Piketberg	2.07	0.036	2.106		
	Fractured and Inter	rgranular Basement			
Cape Town Rim	0.87	0.195	1.065		
Stellenbosch-Helderberg	2.34	0.242	2.582		
Paarl-Franschhoek	3.01	0.127	3.137		
Malmesbury	1.18	0.343	1.523		
Wellington	6.75	0.235	6.985		
Tulbagh	1.28	0.023	1.303		
Middle-Lower Berg	11.15	0.085	11.235		
Northern Swartland	0.20	0.047	0.247		
Darling	0.03	0.015	0.045		
Vredenburg	0.00	0.011	0.011		
TOTAL	69.98	2.35	72.33		





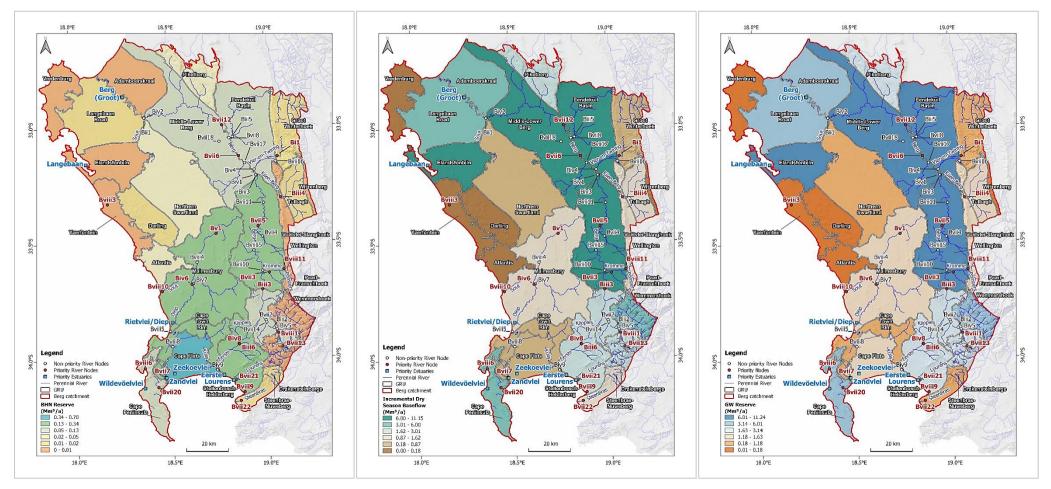


Figure 2-2 Left: the groundwater contribution to BHN per GRU; Middle: the groundwater contribution to EWR per GRU; and Right: Groundwater Reserve per GRU.



2.5. Step 5 & Step 6: Operational Scenarios

Steps 5 and 6 of the GRD process involved developing operational scenarios (refer to **Table 2-5**) aimed at assessing the socio-economic and ecological impacts on the Groundwater Reserve. These scenarios took into account inputs from relevant stakeholders which ensured that the assessment results were well-informed, balanced, and reflective of the diverse interests and needs of all parties involved (**Section 1.5**).

The scenarios offered valuable insights into both current and future trends of GRUs in the Berg catchment, focusing on aspects such as climate change, population growth, water supply scheme development, water conveyance, water sectoral growth, and the impact of invasive alien plants (IAPs). By integrating hydrogeological data, climate projections, and socio-economic trends, these scenarios provided a comprehensive understanding of the potential outcomes and challenges that may arise in maintaining the Groundwater Reserve and estimating allocable groundwater volumes.

By synthesizing findings from scenarios Sc 1 to Sc 6, two combined scenarios were developed: Sc 7a (Worst Case) and Sc 7b (Most-Likely Case). The Most-Likely Case (Sc 7b) considered factors such as the reduction in recharge due to climate change, the removal of all IAPs, the increase in groundwater contribution to the BHN Reserve based on population growth rate, and the augmented groundwater usage resulting from sectoral growth and the implementation of groundwater development schemes. These scenarios directly influenced the parameters used in determining the Groundwater Reserve, consequently impacting the still-allocable groundwater volumes¹. A comparative analysis of projected volumes in 2050 with baseline values from the Present Status (PS) provided valuable insights into the cumulative effects of the identified factors.

Scenario No.	Scenario Name	Scenario Description
Sc 1	Population Growth	Assess the impact of population growth on the groundwater component of the BHN Reserve and estimate volumes by projecting the qualifying population.
Sc 2	Water System Evaluation	Evaluate the national assessment of municipal wastewater conveyance and treatment systems, to estimate potential increase in groundwater reliance based on the deterioration of the water system.
Sc 3	Sectoral Water Demand	Explore historical trends in groundwater demand per sector, focusing on agriculture, industry, and other sectors, to understand future water use.
Sc 4	Groundwater Developments	Evaluate scheduled groundwater developments and strategies for the Berg catchment, calculating their impact on the Reserve and allocable volumes.
Sc 5	Climate Change	Investigate the impact of climate change, particularly under warmer conditions, on groundwater recharge rates and its effects on the Reserve.
Sc 6	Alien and Invasive Species	Examine the impacts of Invasive Alien Plants (IAPs) on groundwater recharge (Sc 6a – Clearing vs Sc 6b – Left Unchecked) and evaluate their effects on the Reserve and allocable volumes.
Sc 7a	Combination Scenario (Worst Case)	Integrate population growth, sectoral growth, groundwater developments, climate change, increased groundwater reliance based on the improvement of water system, and absence of clearing alien vegetation for impact assessment.
Sc 7b	Combination Scenario (Most-Likely Case)	Integrate population growth, groundwater developments, climate change, increased groundwater reliance based on the improvement of water system, and clearing alien vegetation for impact assessment.

Table 2-5	Description of the scenarios considered in modelling the impacts on the groundwater
	Reserve and the associated allocable groundwater volume in the Berg catchment.



¹ Still Allocable Groundwater: This term denotes the volume of groundwater that remains available for allocation or distribution after accounting for Reserve requirements and current water usage (WRC, 2013).

To evaluate the potential impact on GRUs, an "Allocation Factor" was developed which represents the ratio of still-allocable groundwater volume to the total recharge for the GRU. The Allocation Factor was categorized into six groups, labelled 'A' through 'F', reflecting a spectrum from unstressed to potentially critically stressed conditions (**Table 2-6**). As the ratio approaches zero, the stress level potentially increases, indicating minimal remaining volumes that are still allocable and posing a potential threat to the groundwater Reserve.

Allocation Category	Description	Allocation Factor (Still Allocable Volume / Recharge Volume)				
А	Unstressed or slightly stressed	>0.95				
В	Unstressed or slightly stressed	0.75 – 0.95				
С	Moderately stressed	0.5 - 0.75				
D	Moderately stressed	0.35 – 0.50				
E	Potentially highly stressed	0.15 – 0.35				
F	Potentially critically stressed	<0.15				

Table 2-6Guide for determining the Allocation Factor.

Table 2-7 presents a summary of the results of the Sc 7b (Most-Likely Case) for the Berg catchment while the comprehensive details regarding the approach, methodology, and results of the operational scenario analysis can be found in the Operational Scenarios & Socio-Economic and Ecological Consequences Report (DWS, 2023c) and the Stakeholder Engagement of Operational Scenarios Report (DWS, 2023d).

It is important to highlight that Scenarios 1 to 6, which provided the necessary inputs for determining Scenario 7a (the Worst Case) and Scenario 7b (the Most-Likely Case), were thoroughly discussed and updated through stakeholder engagement.





 Table 2-7
 Summary table comparing parameters for calculating Groundwater Reserve and allocable volume per GRU, including results and parameters for Scenario 7b: Combination Scenario – Most-Likely Case.

				Groundwa	ter Reserve)			Combination Scenario – Most-Likely Case							
GRU	Recharge (Mm³/a)	EWR Reserve (Mm³/a)	BHN Reserve (Mm³/a)	GW Reserve (Mm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm³/a)	Still Allocable (Mm³/a)	Allocable Factor	Recharge (Mm³/a)	EWR Reserve (Mm³/a)	BHN Reserve (Mm³/a)	GW Reserve (Mm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm³/a)	Still Allocable (Mm³/a)	Allocable Factor
	Primary / Intergranular Aquifers															
Cape Flats	41.25 ²	0.51	0.70	1.21	40.04	12.00 ³	28.04	0.68	38.70	0.51	1.29	1.80	36.90	23.02	13.88	0.36
Atlantis	22.74 ⁴	0.08	0.03	0.11	22.63	1.7 ⁵	20.93	0.83	21.63	0.08	0.05	0.13	21.50	3.31	18.19	0.84
Yzerfontein	9.2	0.02	0.01	0.03	9.17	0.26	8.91	0.97	7.60	0.02	0.02	0.04	7.56	2.26	5.30	0.70
Elandsfontein	15.47	6.39	0.01	6.40	9.08	1.09	7.99	0.52	13.17	6.39	0.01	6.40	6.77	2.70	4.07	0.31
Langebaan Road	23.28	5.52	0.02	5.54	17.74	8.59	9.15	0.39	20.18	5.52	0.03	5.55	14.63	11.09	3.55	0.18
Adamboerskraal	21.61	6.00	0.01	6.01	15.60	2.13	13.47	0.62	20.83	6.00	0.01	6.01	14.81	3.69	11.13	0.53
					Fi	ractured Ta	able Mounta	ain Group A	quifers							
Cape Peninsula	10.99	5.43	0.09	5.52	5.48	0.07	5.41	0.49	9.19	5.43	0.16	5.59	3.60	0.15	3.45	0.38
Steenbras- Nuweberg	58.76 ⁶	1.16	0.02	1.18	57.58	8.00 ⁷	49.58	0.84	57.97	1.16	0.02	1.18	56.79	24.52	32.26	0.56
Drakensteinberge	27.6	2.88	0.00	2.88	24.72	0.05	24.67	0.89	26.86	2.88	0.01	2.89	23.97	1.21	22.77	0.85
Wemmershoek	26.83	3.59	0.00	3.59	23.24	0.81	22.43	0.84	25.60	3.59	0.00	3.59	22.01	1.56	20.45	0.80
Voëlvlei-Slanghoek	14.1	1.62	0.01	1.63	12.47	0.13	12.34	0.88	12.87	1.62	0.01	1.63	11.24	0.31	10.93	0.85
Witzenberg	2.78	0.18	0.00	0.18	2.60	0.08	2.52	0.91	2.60	0.18	0.00	0.18	2.42	0.16	2.26	0.87
Groot Winterhoek	22.5	0.77	0.02	0.79	21.71	1.39	20.32	0.90	20.11	0.77	0.03	0.80	19.31	3.27	16.04	0.80
Piketberg	20.33	2.07	0.04	2.11	18.22	5.58	12.64	0.62	19.02	2.07	0.06	2.13	16.89	9.80	7.09	0.37
	Fractured and Intergranular Basement															
Cape Town Rim	18.6	0.87	0.20	1.07	17.54	6.21	11.33	0.61	16.26	0.87	0.36	1.23	15.03	8.71	6.32	0.39
Stellenbosch-Helderberg	41.52	2.34	0.24	2.58	38.94	8.81	30.13	0.73	38.49	2.34	0.46	2.80	35.69	11.30	24.39	0.63
Paarl-Franschhoek	26.61	3.01	0.13	3.14	23.47	9.82	13.65	0.51	24.60	3.01	0.21	3.22	21.38	15.50	5.88	0.24
Malmesbury	52.65	1.18	0.34	1.52	51.13	14.75	36.38	0.69	44.42	1.18	0.64	1.82	42.61	25.12	17.49	0.39
Wellington	39.49	6.75	0.24	6.99	32.51	4.48	28.03	0.71	33.07	6.75	0.39	7.14	25.92	8.79	17.13	0.52

² Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2020).

³ Includes city municipal abstraction of 20 Mm³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e)WUL) of up to 14.6 Mm³/a (as a negative water use).

⁴ Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2018).

⁵ Includes city municipal abstraction of 5 Mm³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) WUL) of up to 4.2 Mm³/a (as a negative water use).

⁶ Rainfall recharge value is from the first order GRAII Spatial Distribution (modified after CoCT, 2022).

⁷ Includes city municipal abstraction of 8 Mm³/a in development (phase 1) as per NWA Section 21(a).



HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT

				Groundwa	ter Reserve)	-	Combination Scenario – Most-Likely Case								
GRU	Recharge (Mm³/a)	EWR Reserve (Mm³/a)	BHN Reserve (Mm³/a)	GW Reserve (Mm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm³/a)	Still Allocable (Mm³/a)	Allocable Factor	Recharge (Mm³/a)	EWR Reserve (Mm³/a)	BHN Reserve (Mm³/a)	GW Reserve (Mm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm³/a)	Still Allocable (Mm³/a)	Allocable Factor
Tulbagh	10.87	1.28	0.02	1.30	9.57	3.78	5.79	0.53	9.34	1.28	0.05	1.33	8.01	6.66	1.35	0.14
Eendekuil Basin	21.88	6.95	0.09	7.04	14.84	4.85	9.99	0.46	17.31	6.95	0.16	7.11	10.21	6.57	3.64	0.21
Middle-Lower Berg	42.49	11.15	0.09	11.24	31.26	2.23	29.03	0.68	36.88	11.15	0.16	11.31	25.57	5.09	20.48	0.56
Northern Swartland	31.85	0.20	0.05	0.25	31.60	1.79	29.81	0.94	26.11	0.20	0.09	0.29	25.82	2.92	22.90	0.88
Darling	9.95	0.03	0.02	0.05	9.91	0.76 ⁸	9.15	0.92	8.02	0.03	0.03	0.06	7.97	1.40	6.56	0.82
Vredenburg	7.43	0.00	0.01	0.01	7.42	1.16	6.26	0.84	6.63	0.00	0.02	0.02	6.61	1.97	4.64	0.70
TOTAL	620.78	69.98	2.35	72.33	548.45	102.66	445.79		557.47	69.98	4.27	74.25	483.23	181.06	302.16	



⁸ The WARMS dataset places Yzerfontein's municipal abstraction of 0.26 Mm³/a in the Darling GRU. It has been updated to reflect for the Yzerfontein GRU.

2.6. Step 7: Monitoring Programme

Step 7 of the GRD process focused on designing a Monitoring Programme for the Berg catchment aimed at the sustainable management of the groundwater contribution to the Reserve. To achieve this, the report evaluated existing monitoring sites, considering both their spatial distribution and their relevance to the target aquifer unit, in order to determine their suitability for monitoring site-specific parameters. This effort built upon insights gained from The Berg Catchment WRCs and RQOs Study (DWS, 2016) as well as the other literature and data sources listed in **Section 2.1**, specifically the Groundwater Projects associated with City of Cape Town's New Water Programme, and the Berg River Baseline Monitoring Programme (DWAF, 2007).

Specific "Management Options" for the groundwater contribution to both the EWR and BHN Reserve, were developed, assigned, and prioritised using an Impact vs. Influence Matrix. Based on the outcomes of Steps 1-7 of the GRD process, the matrix integrated 'impact' factors, such as the 'Allocation Factor' (i.e., still allocable volume / recharge) and the 'Qualifying Population Density per GRU', as well as 'influence' factors such as the 'Groundwater Contribution to Baseflow' and the 'Groundwater Contribution to the BHN Reserve per GRU' (see **Figure 2-3** and **Table 2-8**).

While this matrix provided the overall prioritization framework, an additional layer of complexity was introduced to select aquifer-specific monitoring sites. Two key factors were considered: 1) the spatial misalignment between GRUs and surface water catchments, and 2) the need to monitor catchment-specific baseflow contributions.

To overcome these challenges, the groundwater contribution to baseflow (and by extension, its contribution to the EWR) was disaggregated to the respective river or estuary node's catchment area, aquifer type, and GRU. This approach identified catchments with the most significant influence on baseflow and therefore allowed for more representative monitoring site selection (**Figure 2-4**).

Similarly, for monitoring the groundwater contribution to the BHN Reserve, a higher resolution dataset for the 'Qualifying Population Density' was used to identify specific high-density areas within a GRU. This information guided the site selection in those areas (**Figure 2-4**).

Once the monitoring network was established, guidelines for monitoring activities, frequency, and the specific data collection at selected sites, were defined. Unique objectives were set for the groundwater contribution to both the EWR and BHN and was tailored to each GRU's respective Management Option. In instances where existing boreholes were inactive or no longer effective as a monitoring site (e.g., inaccessible or targeting the wrong aquifer unit, etc), recommendations on the locations of proposed new boreholes were provided.

Comprehensive details about the approach, methodology, and results can be found in the Monitoring Programme Report (DWS, 2023e).





HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT

Allocation Factor (Still Allocable GW Volume / Contribution Recharge) to Baseflow (Mm ³ /a)	A (>0.95)	B (0.75 – 0.95)	C (0.50 - 0.75)	D (0.35 – 0.50)	E (0.15 – 0.35)	F (<0.15)	Population Density (pop/km²) Population 6W contribution to BHN (Mm³/a) 0.00 2.29 20.09 43.00 62.68 43.00 62.68
0.00 - 0.18							0.00 - 0.05
0.18 - 0.87							0.05 - 0.10
0.87 - 1.62							0.10 - 0.30
1.62 - 3.01							0.30 – 0.50
3.01 - 6.00							0.50 – 1.00
6.00 - 11.15							1.00 – 1.29

Figure 2-3 The Impact vs. Influence Matrix for groundwater contribution to the EWR Reserve (left) and for groundwater contribution to the BHN Reserve (right).

Table 2-8Summary table of the Management Options per GRU for groundwater contribution to
both the EWR and BHN, including the associated 'impact' and 'influence' variables
considered in the Impact vs. Influence Matrix.

GRU	Allocation Factor per GRU	Groundwater Contribution to Baseflow per GRU (M m³/a)	Management Options for Groundwater Contribution to EWR	Groundwater Contribution to the BHN Reserve (M m³/a)	Qualifying Population Density per GRU (pop/km²)	Management Options for Groundwater Contribution to BHN
		Primary / Intergra	nular Aquifers			
Cape Flats	0.36	0.51	2	1.29	329.43	3
Atlantis	0.84	0.08	1	0.05	20.09	1
Yzerfontein	0.70	0.02	1	0.02	5.84	1
Elandsfontein	0.31	6.39	3	0.01	1.97	1
Langebaan Road	0.18	5.52	3	0.03	4.00	1
Adamboerskraal	0.53	6.00	3	0.01	2.50	1
	Fract	ured Table Moun	tain Group Aqui	ifers		
Cape Peninsula	0.38	5.43	3	0.16	56.44	2
Steenbras- Nuweberg	0.56	1.16	2	0.02	13.11	1
Drakensteinberge	0.85	2.88	2	0.01	3.94	1
Wemmershoek	0.80	3.59	2	0.00	1.27	1
Voëlvlei-Slanghoek	0.85	1.62	2	0.01	6.11	1
Witzenberg	0.87	0.18	1	0.00	11.22	1
Groot Winterhoek	0.80	0.77	1	0.03	7.68	1
Piketberg	0.37	2.07	3	0.06	17.57	1
	Fra	ctured and Interg	ranular Baseme	ent		
Cape Town Rim	0.39	0.87	2	0.36	100.31	3
Stellenbosch-Helderberg	0.63	2.34	2	0.46	87.79	3
Paarl-Franschhoek	0.24	3.01	3	0.21	62.68	2
Malmesbury	0.39	1.18	2	0.64	43.46	3
Wellington	0.52	6.75	3	0.39	39.70	2
Tulbagh	0.14	1.28	3	0.05	17.74	1
Eendekuil Basin	0.21	6.95	3	0.16	18.16	2
Middle-Lower Berg	0.56	11.15	3	0.16	11.82	2
Northern Swartland	0.88	0.20	1	0.09	7.90	1
Darling	0.82	0.03	1	0.03	7.72	1
Vredenburg	0.70	0.00	1	0.02	6.24	1
TOTAL		69.98		4.27		



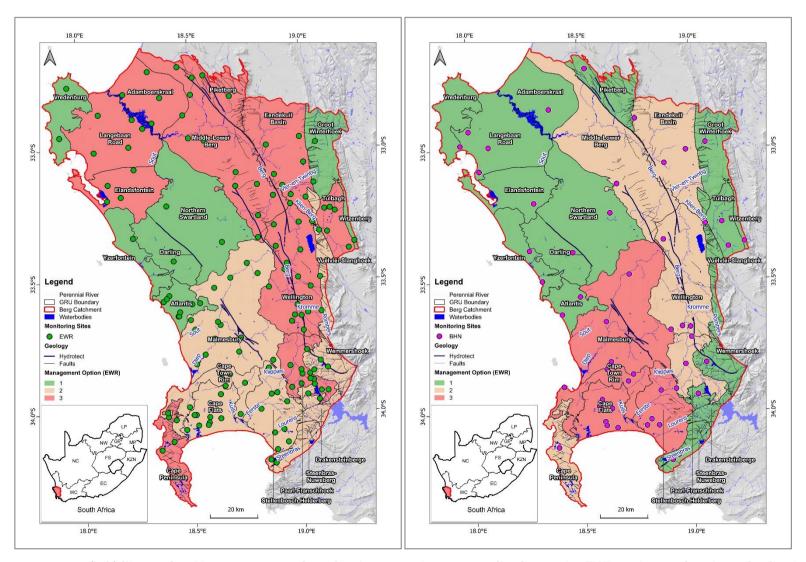


Figure 2-4 Summary maps (left) illustrating Management Options for the groundwater contribution to the EWR and associated monitoring locations (left); and (right) illustrating Management Options for the groundwater contribution to BHN Reserve and associated monitoring locations.



3. SUMMARY

Step 8 of the GRD process involved initiating the Gazetting process and implementing the Groundwater Reserve (see **Section 1.4**). This phase included the compilation of a single Groundwater Reserve Determination Report (i.e., Deliverable 3.7), offering a comprehensive summary of findings and recommendations resulting from the GRD process conducted for the Berg catchment. The overarching goal was to provide aquifer-specific information for various hydrogeological components considered for the Groundwater Reserve, specifically the groundwater contribution to the BHN and EWR.

The report integrated insights from the Ecological Reference Conditions Report (Step 3 of the GRD process), involving a reassessment of ecological conditions and present status of the catchment. It also correlated the analysis of various hydrogeological components, including Recharge, Groundwater Use, Discharge, Groundwater Quality, and Aquifer Stress. Building on the foundation of Step 3 and incorporating information from Steps 4 to 7 (see **Section 1.4**), this report offers a holistic perspective on the hydrogeological components for the catchment, with organized tables describing the Groundwater Reserve per GRU. The Reserve components are outlined below:

1. Groundwater Quantity Component

The groundwater quantity component of the Reserve was outlined in the GRU-specific tables provided below (refer to **Section 3.1** - **3.3**) and further discussed in **Sections 2.3** and **2.4**. It was calculated by considering the total groundwater contribution to both the EWR and BHN Reserves.

2. Groundwater Quality Component

The groundwater quality component of the Reserve was outlined in the GRU-specific tables provided below (refer to **Section 3.1** - **3.3**) and further discussed in **Sections 2.3** and **2.4**. It was determined by assessing two primary components:

a. Groundwater Quality Reserve

The groundwater quality reserve was selected based on the higher concentration of either the Baseline or the Median + 10% concentration within the specific aquifer in a GRU.

- i) Baseline Concentration⁹: Reflecting the ambient or present state of the aquifer system (refer to DWS, 2022d, 2022e, and 2023a for detailed information).
- ii) Median +10% Concentration: Determined by taking the Median concentration plus 10%. If this value was lower than the Baseline Concentration, the Baseline value was chosen. If it exceeded the Maximum concentration, then the Maximum value was selected.

b. Groundwater Quality Requirement for BHN

The groundwater quality BHN requirement or "BHN Threshold" was determined to be the Upper limit of Class I Water Quality (Drinking) [see General Chemistry: South African Water Quality Guidelines, Volume 1: Domestic Water Use, 2nd Ed. 1996. Department of Water Affairs, Pretoria, South Africa].

In essence, the Groundwater Reserve Determination Report signified the culmination of the High Confidence Groundwater Reserve Determination project for the Berg catchment, aligning with the gazetted requirements for the region as outlined in Gazette No. 42451:121.



⁹ In the Berg catchment, determining true baseline concentrations, unaffected by human activities, was challenging due to diverse anthropogenic influences. Therefore, an approximation of the baseline was made using monitoring sites in areas with minimal human impact. To mitigate outliers, the 95th percentile statistical method was favoured over maximum concentrations, capturing the majority of data while excluding extreme values.

3.1. **Primary / Intergranular GRUs**

3.1.1. Cape Flats GRU

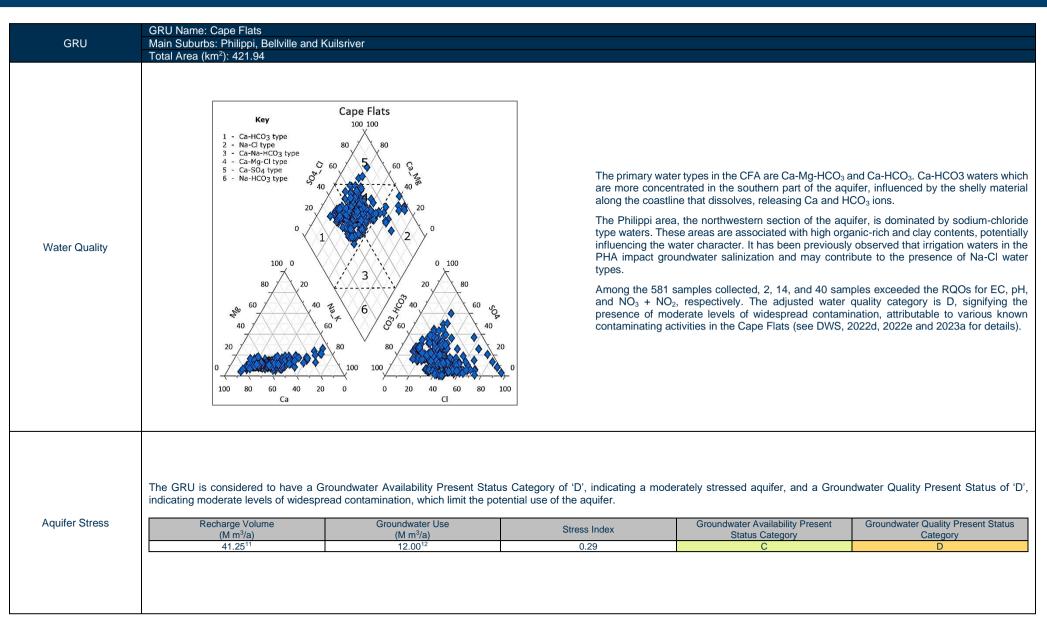
	GRU Name: Cape Flats
GRU	Main Suburbs: Philippi, Bellville and Kuilsriver
	Total Area (km ²): 421.94
GRU Boundary Description	The Cape Flats GRU was delineated using the City of Cape Town's CFA model boundary (CoCT, 2018; 2020a). The aquifer model employed a slope separation criterion (<2 degrees) to distinguish the Cape Flats area from the adjacent hills and mountains. Additionally, it incorporated an interpolated geological extent of the basement, encompassing the Cape Granite Suite (CGS) and the Malmesbury Group rocks, along the GRU periphery. The southern boundary of the GRU was defined by the False Bay coastline (refer to Figure 3-1 and DWS, 2022d and 2023a).
Quaternary Catchments	G22C, G22D, G22E and G22H (see Figure 3-1)
Resource Unit	Primary / Intergranular Aquifer
Description	Geologically, the Cape Flats GRU comprises the Tertiary and Quaternary sedimentary deposits of the Sandveld Group, including fluvial, marine, and aeolian formations. These deposits micronformably overlie weathered Neoproterozoic to early Cambrian Malmesbury Group and CGS basement rocks (see Figure 3-1 and the cross section below). Hydrostratigraphically, the major aquifer units within the larger CFA are the Elandstontyn, Varswater, and Springfortyn Prn. The CFA itself is a large, heterogeneous, stratified, intergranular, or primary (i.e., prorus sedimentary/sandy) aquifer within the Sandveld Group. The primary aquifer thickness to approximately 50 m towards the centre of the GRU and fills the placechannels coincides with the Philippi Horticultural Area (PHA; DWAF, 2008a; DWS, 2022d and 2023a).



	GRU Name: Cape Flat							
GRU	Main Suburbs: Philippi							
	Total Area (km ²): 421.9	94						
Surface Water System	These rivers and wetla paleochannels, or on a only with the uppermos	nds are expected to be smaller local scale whe st unconfined sand unit (otus, and Elsieskraal river hydraulically linked to the ere the aquifer is semi-cor CoCT, 2021). Wetlands s WS, 2022d and 2023a).	relatively shallow gro fined by laterally disc	oundwater. In cases whe	ere the aquifer is semi-co ay lenses, rivers and we	onfined, such as with tlands are likely to b	nin the deep gravels in the connected hydraulication
Water Resource	II, while the remaining	portions lack a Ground	ats IUA (E12) and has a water Resource Class de 3-1 and the table below).	signation. This IUA				
Classes & RQOs	IUA	Water Resource Class	Quaternary Catchment	RU	Resource Name	Biophysical Node	TEC	nMAR
			G22D	E12-R15	Keysers	Bvii7	D	93
	E12 Cape Flats	III	G22K	E12-E05	Zandvlei	Bxi9	С	93
			G22K	E12-E05	Zeekoevlei	Bxi9	D	N/A
Recharge	recharge rate was calc because the model cal	culated at 97.76 mm/a b ibration considers both r thod	tained from a model-base ased on the total GRU ar natural recharge and Irriga Area (ki	rea. A first-order rechation Return Flow (IR	arge calculation was pe F). Refer to DWS (2022	erformed for the GRU wh	hich differs from the further details.	table below). The avera CoCT (2018) estimation harge Rate (mm/a)
Recharge	recharge rate was calc because the model cal Me Model-based ca	culated at 97.76 mm/a b ibration considers both r	tained from a model-base ased on the total GRU ar natural recharge and Irriga	rea. A first-order rech ation Return Flow (IR m ²)	arge calculation was pe F). Refer to DWS (2022 Recharge Vol	erformed for the GRU wh a, 2022e and 2023a) for	hich differs from the further details.	CoCT (2018) estimation

¹⁰ Includes city municipal abstraction of 20 Mm³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) WUL) of up to 14.6 Mm³/a (as a negative water use).





¹¹ Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2020).



¹² Includes city municipal abstraction of 20 Mm³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e)WUL) of up to 14.6 Mm³/a (as a negative water use).

	GRU Name: Cap	e Flats											
GRU	Main Suburbs: P		ville and Kuilsrive	r									
CINO	Total Area (km ²):												
	Total Area (Kill).	421.34											
	Groundwater Qua The groundwater and 2) the Ground	quality cor	nponent of the Re			e below and d	escribed in Sect	tion 2.3 &	& 2.4, is deter	mined as two c	components 1) th	e Groundwater (Quality Reserve,
	Aquifer Unit	Par	rameter	Unit	No. BHs	No. Sam	ples Baselii Conc		Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshold
			pН		37	581	8.30)	5.07	8.55	7.84	8.55	5 – 9
		Electrical	Conductivity	mS/m	37	581	113.7	2	13.00	578.00	88.85	113.72	150
		Sodiu	um as Na	mg/l	37	581	111.3	6	3.30	784.00	58.90	111.36	200
		Calci	um as Ca	mg/l	37	581	112.1	6	3.81	266.50	101.50	112.16	150
	Deire en 1	Magne	sium as Mg	mg/l	37	581	14.62	2	1.00	124.70	11.60	14.62	70
	Primary /	Chlor	ride as Cl	mg/l	37	581	209.2	2	5.00	1993.00	100.00	209.22	200
Creating deviation Dessention	Intergranular Aquifer		e + Nitrite	mg/l	37	581	8.35		0.02	23.20	1.12	8.35	400
Groundwater Reserve	Aquilei	Fluo	ride as F	mg/l	37	581	0.26		0.05	3.05	0.15	0.26	10
			nia as NH3	mg/l	37	581	0.08		0.02	31.89	0.06	0.08	1.5
		Orthophos	sphate as PO4	mg/l	37	581	0.03		0.00	1.35	0.01	0.03	-
			sium as K	mg/l	37	581	2.95		0.15	53.66	1.90	2.95	-
		Sulphate a	as SO4 as SO4	mg/l	37	581	44.4()	2.00	326.00	45.40	49.94	-
	Groundwater Quantity Con The groundwater quantity the EWR and BHN Reserved Recharge (Mm ³ /a) 41.25 ¹³		omponent of the F		detailed in the tab BHN Reserve (M 0.70		described in Se W Reserve (Mm ³ / 1.21		X 2.4, is calc Total Allocable (Mm³/a) 40.04	Volume	idering the total water Use (Mm³/a 12.00 ¹⁴) Still Allo	ntribution to both cable (Mm³/a) 28.04
Future Scenario 2050 (Scenario 7b)	In Scenario 7b, v factors directly in in recharge from growth and the ir attributed to popu	fluenced th 41.25 to 38 nplementat ulation grow	e parameters use 8.70 M m ³ /a, influe ion of groundwate vth. In light of thes	ed to dete enced by er develop se change	ermine the Ground both climate char pment schemes in es, the Allocation	dwater Reservinge and the eli in the area. Fu Category shift	re, specifically the mination of IAPs rthermore, the great from C to D	ne ground s. Additio groundwa (refer to s	dwater contril onally, ground ater contributio	bution to the B water use incre on to the BHN nd the table be	HN and EWR. TI eased from 12.00 Reserve rose fro low).	ne scenario invo) to 23.02 M m³/a m 0.70 to 1.29 N	lved a decrease a due to sectoral M m ³ /a, primarily
	Recharge (M	m³/a)	EWR Reserve (M	m³/a)	BHN Reserve (M	lm³/a) G	W Reserve (Mm ³ /	a)	(Mm ³ /a)		Water Use (Mm ³ /a) Still Allo	cable (Mm ³ /a)
	38.70		0.51		1.29		1.80		36.90		23.02		13.88



¹³ Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2020).

¹⁴ Includes city municipal abstraction of 20 Mm³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) WUL) of up to 14.6 Mm³/a (as a negative water use).

GRU	GRU Name: Cap Main Suburbs: P Total Area (km ²):	hilippi, Bellville a	and Kuilsriver								
	to the BHN. A tot				e BHN were stra	tegically selecte	bution to the EWR and a Management Option 3 for monitoring the groundwater contribution ad within the Cape Flats GRU (see Figure 3-1 and the table below).				
	Site Name Data Source Monitoring Area Latitude Longitude Monitoring Description EWR Management Option 2										
	001/0000			EW/D			Frequency: Quarterly				
	G2N0008	HYDSTRA	Zeekoevlei	EWR	-34.01008	18.50937					
	G2N0104	HYDSTRA	Zeekoevlei	EWR	-34.050078	18.51937	1) Groundwater level:				
	G2N0612	HYDSTRA	GRU	EWR	-34.01902	18.57068	 Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. 				
	G2N0649	HYDSTRA	GRU	EWR	-34.03966	18.56788	 2) Groundwater Quality: ○ Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ 				
	G2N0653	HYDSTRA	GRU	EWR	-34.04875	18.56313	 Site specific additions for EWR: NO₂, NO₃, NH₄ 				
Monitoring Programme	G2N0108	HYDSTRA	GRU	EWR	-34.02465	18.62082	• Site specific additions as per RQO ²⁰ :				
Monitoring Frogramme	G2N0619	HYDSTRA	GRU	EWR	-33.9331	18.62162	Bxi20 (Zeekoevlei): Nutrients (Dissolved Inorganic Nutrients [DIN] and Dissolved Inorganic				
	G2N0059	HYDSTRA	Zeekoevlei	EWR	-34.01008	18.49937	Phosphate [DIP]); Salts; Pathogens (Enterococci & Escherichia Coli); System				
	3418AB00077	NGA	Bvii7	EWR	-34.06602	18.46429	Variables (Temperature, pH, Dissolved Oxygen, etc)				
						BHN Managemen					
	3318DC00004	NGA	GRU	BHN	-33.97801	18.56871	Frequency: Monthly or Quarterly				
	3318DC00114	NGA	GRU	BHN	-33.95301	18.5826	1) Groundwater level:				
	3318DC00163	NGA	GRU	BHN	-33.98717	18.6276	 Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems. 				
	3418BA00026	NGA	GRU	BHN	-34.03686	18.59568	 automatically recorded level loggers. Possible need for telemetry systems. Groundwater Quality (Background water quality and BHN): 				
	3418BA00346	NGA	GRU	BHN	-34.06075	18.65068	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site analise additions for PLNA E additional Additinal Additiona Additional Additional Additiona Additional Add				
	88847	WMS	GRU	BHN	-34.051389	18.601389	Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms				



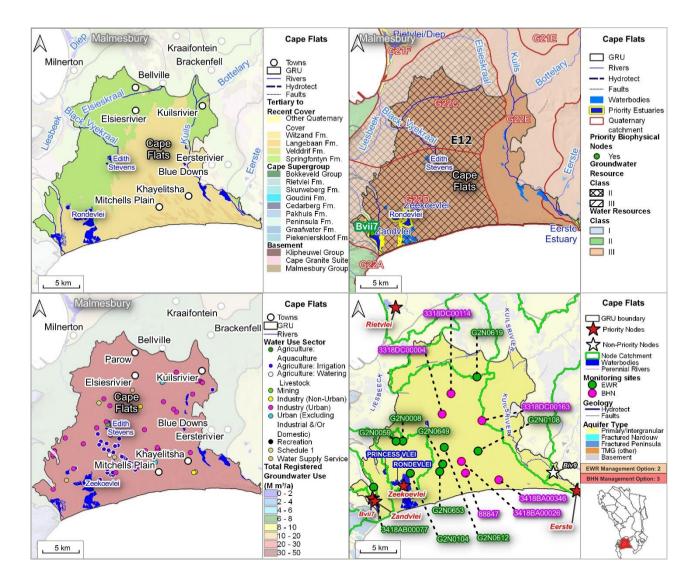


Figure 3-1 A series of maps for the Cape Flats GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.1.2. Atlantis GRU

	GRU Name: Atlantis
GRU	Main Towns: Atlantis and Melkbosstrand
	Total Area (km ²): 255.68
GRU Boundary Description	The aquifer model boundary for the GRU, as outlined by CoCT (2020b), delineates the Atlantis GRU's extent (refer to Figure 3-2 and DWS, 2022d and 2023a). This boundary wa established by considering areas with a marginal thickness of 0 m, indicating where the aquifer pinches out. The northeast and southeast boundaries are further refined by the outcro extent of low-permeability basement lithologies, namely the Malmesbury Group and the CGS. To the north, the Modder and Louwskloof rivers define the boundary, while the southwester extent is bounded by the Sout River, and the western edge is constrained by the coastline. Additionally, the boundary accounts for preferential flow directions towards the coastline on the eastern edge of the GRU (refer to Figure 3-2 and DWS, 2022d and 2023a).
Quaternary Catchments	G21A, G21B and G21D (Figure 3-2)
Resource Unit	Primary / Intergranular Aquifer
Description	The Atlantis Aquifer consists of Tertiary to Quaternary aged marine and aeolian sedimentary deposits belonging to the Sandveld Group. In the Atlantis area, these deposits, including the Lagebaan, Witzand, Springfontyn, and Varswater Fins, unconformably overlie the Neoproterozoic to early Cambrian Tygerberg Fm (Malmesbury Group) and Daring Pluton (CGS). The Concord capilier unit, approximately 40-60 meters thick, is classified as a primary, unconsolidated, intergranular aquifer, allowing groundwater movement through the pores betwee sediment. Although mainly classified as unconfined, the presence of intermittent clay and calcrede lenses in the Springfontyn Fm may lead to semi-confined conditions (see Figure 3-2). The basement aquifer includes the Malmesbury Group (i.e., Tygerberg Fm - shales/phyllies) and plutonic CGS basement rocks. Interpolated basement geology from the COCT (2020th Palmesbury Group is considered a basal aquiclude to the overlying aquifer. The potential interaction between groundwater and the weathered shales of the Tygerberg Fm and the very strang forum in very final transmitter investigation (refer to DWS, 2022d and 2023a). The sostenet aquifer the spatial variation of geology across the aquifer. Cross-section A shows the presence of the overlying Witzand Fm, while cross-sections B highlights the revealence of the Springfontyn Fm (refer to Figure 3-2 for the extent of the cross section).



	GRU Name: Atlantis				
GRU	Main Towns: Atlantis and Melkbosstrand Total Area (km ²): 255.68				
Surface Water System	The Atlantis GRU comprises of the perennial S while surface drainage to the north and east of up in summer (Tredoux et al., 2009). Groundwa The Atlantis GRU is characterized by the peren area. Additionally, surface drainage to the north drying up in the summer. In this region, groun DWS, 2022d, 2022e and 2023a for detail).	Atlantis contributes to the catchment areas of the ater may discharge and support minor wetlands annial Silwerstroom River, fed by the Silwerstroom and east of Atlantis contributes to the catchment	ne Modder, Louwskloof and Die in coastal dunes, and to subma om spring. During the winter, th ent areas of the Modder, Louwsl	p rivers respectively. All these is arine discharge (see Figure 3 - e Donkergat and Sout Rivers fictors, and Diep rivers. Notably,	ivers are non-perennial, drying 2). low to the south of the Atlantis these rivers are non-perennial,
Water Resource Classes & RQOs	The GRU falls within the West Coast (A3) and catchments G21B and G21D). This IUA does n	Diep (D10) IUAs, both holding a Water Reso ot contain any EWR sites, nor does it feature a	urce Class III and a Groundwat ny priority biophysical nodes (se	ter Resource Class of III (only ee Figure 3-2).	for portions of the GRU within
	An estimated recharge of 22.74 M m ³ /a was obt The average recharge rate was calculated as 8		urther details, please refer to DV	WS (2022e).	
Recharge	Method	Area (km ²)	Recharge Volume (M m ³ /a)	Ave	rage Recharge Rate (mm/a)
	Model-based calibrated recharge (after CoCT, 2020b)	255.68	22.74 ¹⁵		88.94
Groundwater Use	In the Atlantis GRU, there are 24 registered grou to the right) collectively utilizing 1.7 M m ³ /a of Aquifer Recharge component of -4.2 M m ³ /a). / (Urban) is the predominant sector for groundw. use in the area. Despite this high percentage, Scheme (Municipal Water Supply) is classifie Supply Service' for Atlantis, therefore, it is a database. The Mining and Agricultural Sectors each contr groundwater use, though it's essential to highlig the Managed Aquifer Recharge component. / abstraction of 1 M m ³ /a by Eskom is not registe	groundwater (note that there is a Managed According to the WARMS database, Industry ater use, accounting for 86.8% of total water it is noted that the Atlantis Water Resource d under 'Industrial use' rather than 'Water a classification discrepancy in the WARMS ibute approximately 0.5 M m ³ /a to the annual that these percentages do not incorporate Additionally, it's crucial to mention that the	Water Use Sector Agriculture: Irrigation Agriculture: Watering Livestock Industry (Non-Urban) Industry (Urban) Mining MAR Total	No. of Users Primary / Intergranular Aquifer 9 6 1 7 1 - 24	Total Volume (M m³/a) 0.16 0.33 0.04 5.00 0.37 - 4.2 1.7



¹⁵ Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2018).

GRU	GRU Name: Atlantis			
Onto .	Main Towns: Atlantis and Melkbosstrand Total Area (km ²): 255.68			
Water Quality	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	influenced by exhibiting a typ Tygerberg Fm Na-CI characte Ca-HCO ₃ wate calcareous san collected 3 san The occurrence leaching of ba compounds fro The adjusted	ater types in Atlantis are Na-Cl and Ca- the deposition of marine aerosols a bical Na-Cl signature. Boreholes situat may also contribute to elevated Na au r to the groundwater in the primary aq ers result from the dissolution of co dds of the Witzands Fm, releasing Ca nples exceeded the RQO for EC, and e of acidic waters in Atlantis (below RC asic ions from soils, anthropogenic m overlying vegetation. water quality category is C, indica (refer to DWS, 2022d, 2022e and 2023)	and recharge through coastal rain ed near shallow basement rocks of nd Cl ion concentrations, imparting uifer above. calcium carbonate minerals foun- and HCO ₃ ions. Out of the 39 sam 4 samples exceeded the RQO for QO thresholds) may be attributed to inputs, and the dissolution of ho ting the presence of some local
Aquifer Stress	The GRU is considered to have a Groundwater Availability Present Status 'C' indicating moderate levels of widespread contamination, which limit the Recharge Volume (M m ³ /a) (M m ³ /a)	Category of 'C', indicating a modera use of potential use of the aquifer (Stress Index	ately stressed aquifer, and a Groundwa refer to the table below). Groundwater Availability Present Status Category	ater Quality Present Status Catego Groundwater Quality Present Statu Category

¹⁶ Includes city municipal abstraction of 5 M m³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) WUL) of up to 4.2 M m³/a (as a negative water use).



Groundwater Reserve	groundwater of	Ility Component quality component of the dwater Quality Requireme Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K		ailed in the table to No. BHs 27 27 27 27 27 27 27 27 27 27	No. Samples 42	Baseline Conc. 7.73 99.74 116.14 46.05 17.28 240.93 24.70 0.05 1.16 1.16 1.16 0.10 5.57	Min Conc. 2.60 38.10 22.60 4.80 4.90 37.10 2.00 0.02 0.02 0.02 0.02 0.02 0.00 0.35	Max Conc. 8.35 156.70 219.40 183.50 35.80 435.40 35.570 2.19 1.33 1.22 1.30 6.86	Median Conc. 7.60 85.55 95.35 59.55 9.90 145.85 19.80 0.02 0.15 0.06 0.03 2.87	e Groundwater Quality Reserve 8.35 99.74 116.14 65.51 17.28 240.93 24.70 0.05 1.16 1.16 1.16 0.10 5.57	Quality Reserv BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 -
Groundwater Reserve	Primary /	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg	27 27 27 27 27 27 27 27 27 27 27 27 27 2	42 42 42 42 42 42 42 42 42 42 42 42 42 4	Conc. 7.73 99.74 116.14 46.05 17.28 240.93 24.70 0.05 1.16 1.16 1.16 0.10	2.60 38.10 22.60 4.80 37.10 2.00 0.02 0.05 0.02 0.02 0.00	8.35 156.70 219.40 183.50 35.80 435.40 355.70 2.19 1.33 1.22 1.30	Conc. 7.60 85.55 95.35 59.55 9.90 145.85 19.80 0.02 0.15 0.06 0.03	Quality Reserve 8.35 99.74 116.14 65.51 17.28 240.93 24.70 0.05 1.16 1.16 1.16 0.10	Threshold 5 - 9 150 200 150 200 400 10 1.5
Groundwater Reserve	ergranular -	Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l	27 27 27 27 27 27 27 27 27 27 27 27 27 2	42 42 42 42 42 42 42 42 42 42 42 42 42 4	99.74 116.14 46.05 17.28 240.93 24.70 0.05 1.16 1.16 0.10	38.10 22.60 4.80 37.10 2.00 0.02 0.05 0.02 0.00	156.70 219.40 183.50 35.80 435.40 355.70 2.19 1.33 1.22 1.30	85.55 95.35 59.55 9.90 145.85 19.80 0.02 0.15 0.06 0.03	99.74 116.14 65.51 17.28 240.93 24.70 0.05 1.16 1.16 0.10	150 200 150 70 200 400 10 1.5 -
Groundwater Reserve	ergranular -	Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l	27 27 27 27 27 27 27 27 27 27 27 27 27	42 42 42 42 42 42 42 42 42 42 42 42 42	116.14 46.05 17.28 240.93 24.70 0.05 1.16 1.16 0.10	22.60 4.80 37.10 2.00 0.02 0.05 0.02 0.02 0.00	219.40 183.50 35.80 435.40 355.70 2.19 1.33 1.22 1.30	95.35 59.55 9.90 145.85 19.80 0.02 0.15 0.06 0.03	116.14 65.51 17.28 240.93 24.70 0.05 1.16 1.16 0.10	200 150 70 200 400 10 1.5 -
Groundwater Reserve	ergranular -	Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l mg/l mg/l mg/l	27 27 27 27 27 27 27 27 27 27 27 27 27	42 42 42 42 42 42 42 42 42 42 42	46.05 17.28 240.93 24.70 0.05 1.16 1.16 0.10	22.60 4.80 37.10 2.00 0.02 0.05 0.02 0.02 0.00	183.50 35.80 435.40 355.70 2.19 1.33 1.22 1.30	59.55 9.90 145.85 19.80 0.02 0.15 0.06 0.03	65.51 17.28 240.93 24.70 0.05 1.16 1.16 0.10	200 150 70 200 400 10 1.5 -
Groundwater Reserve	ergranular -	Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l mg/l mg/l	27 27 27 27 27 27 27 27 27 27	42 42 42 42 42 42 42 42 42 42	17.28 240.93 24.70 0.05 1.16 1.16 0.10	4.90 37.10 2.00 0.02 0.05 0.02 0.00	35.80 435.40 355.70 2.19 1.33 1.22 1.30	9.90 145.85 19.80 0.02 0.15 0.06 0.03	17.28 240.93 24.70 0.05 1.16 1.16 0.10	70 200 400 10 1.5 -
Groundwater Reserve	ergranular -	Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l mg/l mg/l	27 27 27 27 27 27 27 27	42 42 42 42 42 42 42 42	240.93 24.70 0.05 1.16 1.16 0.10	37.10 2.00 0.02 0.05 0.02 0.00	435.40 355.70 2.19 1.33 1.22 1.30	145.85 19.80 0.02 0.15 0.06 0.03	240.93 24.70 0.05 1.16 1.16 0.10	200 400 10 1.5 -
Groundwater Reserve	ergranular -	Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l mg/l	27 27 27 27 27 27	42 42 42 42 42 42 42	24.70 0.05 1.16 1.16 0.10	2.00 0.02 0.05 0.02 0.00	355.70 2.19 1.33 1.22 1.30	19.80 0.02 0.15 0.06 0.03	24.70 0.05 1.16 1.16 0.10	400 10 1.5 -
Groundwater Reserve		Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l mg/l	27 27 27 27 27	42 42 42 42 42	0.05 1.16 1.16 0.10	0.02 0.05 0.02 0.00	2.19 1.33 1.22 1.30	0.02 0.15 0.06 0.03	0.05 1.16 1.16 0.10	10 1.5 -
Ground The gro the EW		Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l mg/l	27 27 27	42 42 42	1.16 1.16 0.10	0.05 0.02 0.00	1.33 1.22 1.30	0.15 0.06 0.03	1.16 1.16 0.10	1.5
The gro the EW	-	Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mg/l mg/l	27 27	42 42	1.16 0.10	0.02 0.00	1.22 1.30	0.06 0.03	1.16 0.10	-
The gro the EW		Orthophosphate as PO4 Potassium as K	mg/l	27	42	0.10	0.00	1.30	0.03	0.10	
The gro the EW		Potassium as K									
The gro the EW			mg/l	27	42	5.57	0.35	6 96			
	EWR and BHN	quantity component of the N Reserves.	e Reserve, de	etalled in the table	below and desci	ribed in Section	Total Allocable	,	dering the total (-	
	Recharge (Mm	n ³ /a) EWR Reserve	R Reserve (Mm ³ /a) BHN Reserve (Mm ³		3/a) GW Res	a) GW Reserve (Mm ³ /a)			Water Use (Mm ³ /a)	Still Allocable (Mm ³ /a)	
h. 0	22.74 ¹⁷	0.08		0.03		0.11	22.63		1.7 ¹⁸		20.93
Future Scenario 2050 (Scenario 7b)	ors directly infl charge from 2 th and the im puted to popul		used to detern ifluenced by h ater developr e conditions,	mine the Groundw both climate chan ment schemes in t the Allocation Cat BHN Reserve (Mm	vater Reserve, sp ge and the elimir the area. Furtherr tegory did not cha	becifically the gr nation of IAPs. / more, the groun ange from a cate serve (Mm ³ /a)	oundwater contr Additionally, grou dwater contribut egory B (refer to Total Allocable (Mm³/a	ibution to the BH undwater use inc ion to the BHN R Section 2.5).	HN and EWR. Th creased from 1.7 Reserve rose fro Water Use (Mm³/a)	he scenario invol 7 to 3.31 M m ³ /a om 0.03 to 0.05 M) Still Allo	lved a decrea due to secto A m³/a, prima cable (Mm³/a)
	Recharge (Mm	0.08		0.05		0.13	21.50		3.31		18.19

¹⁷ Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2018).



¹⁸ Includes city municipal abstraction of 5 Mm³/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) WUL) of up to 4.2 Mm³/a (as a negative water use).

	GRU Name: Atla	ntis														
GRU	Main Towns: Atla		osstrand													
	Total Area (km ²):	255.68														
	The Atlantis GRU to the BHN. A tot	The Atlantis GRU was assigned a Management Option 1 for monitoring the groundwater contribution to the EWR and a Management Option 1 for monitoring the groundwater contribution to the BHN. A total of 9 monitoring sites for the EWR and 2 for the BHN were strategically selected within the Atlantis GRU (Figure 3-2).														
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description									
					E	EWR Management	Option 1									
	G2N0168	HYDSTRA	Bviii10	EWR	-33.58972222	18.50138889										
	G2N0561	HYDSTRA	Biv6	EWR	-33.58638889	18.53666667	Frequency: Quarterly or Biannual (Summer & Winter)									
	AT-S17	CoCT	Silwerstroom	EWR	-33.57891838	18.37115813	 Groundwater level: Manual groundwater level measurements 									
	AT-MON01	CoCT	GRU	EWR	-33.63501833	18.43758444	 a) Groundwater Quality: b) Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ 									
	AT-EX01	CoCT	GRU	EWR	-33.55694787	18.39766521	 Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰: 									
Monitoring Programme	G2N0142	HYDSTRA	Silwerstroom	EWR	-33.55694787 18.39766521 o Site specific additions as per RQO ²⁰ : -33.57888889 18.37166667 Biv6:											
	G2N0662	HYDSTRA	GRU	EWR	-33.5683	18.38632	Nutrients (Phosphate [PO₄-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen); Toxins (Atrazine and Endusulfan).									
	G2N0160	HYDSTRA	GRU	EWR	-33.63444444	18.44055556	(Temperature, pri, Dissolved Oxygen), Toxins (Atrazine and Endusuran).									
	AT-MON05	CoCT	GRU	EWR	-33.61920291	18.44525844										
		I				BHN Management										
	91733	WMS	GRU	BHN	-33.628889	18.409722	Frequency: Quarterly or Biannual (Summer & Winter): 1) Groundwater level: O Manual groundwater level measurements O O Construction and the former set of the set of									
	3318CB00186	NGA	GRU	BHN	-33.5619	18.49342	 2) Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 									
	· •	•	•	•	•		·									



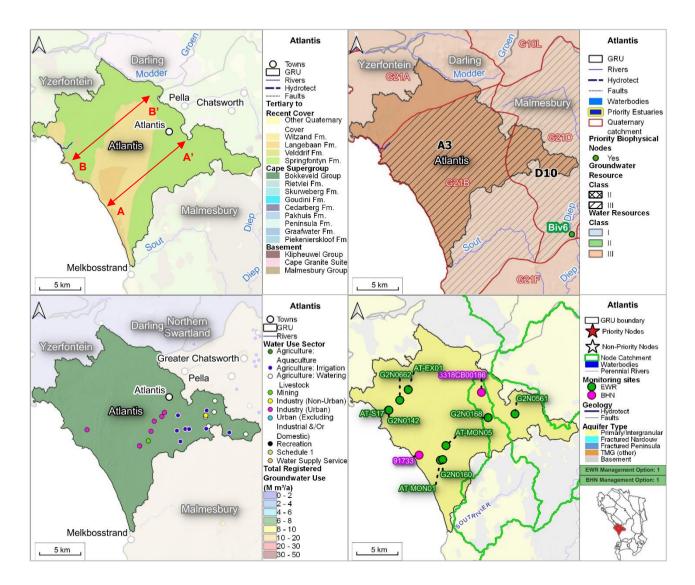


Figure 3-2 A series of maps for the Atlantis GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.1.3. Yzerfontein GRU

	GRU Name: Yzerfontein						
GRU	Main Towns: Yzerfontein						
	Total Area (km ²): 320.33						
GRU Boundary Description	The Yzerfontein GRU was delineated by the At southern and south-eastern edges. The dema catchment, taking into account the preferential that there may be a hydraulic connection betwee	arcation between the Yzerfor flow and discharge direction	ntein GRU and the in the south-west	e Elandsfontein GRU w erly direction. The coastl	as established along the ine served as the western	G10M and G21A surfa	ace water quaternary
Quaternary Catchments	G21A (Figure 3-3)						
Resource Unit			Primary / Inter	granular Aquifer			
Description	The primary aquifer in this region is formed by the difficulty in distinguishing between unconso with an approximation of around 50 meters (Tii The Sandveld Group comprises the Springfont is primarily composed of the Malmesbury Gro (see Figure 3-3 and DWS, 2022d and 2023a).	blidated deposits and weathe merman, 1985). yn Fm, which is widespread t oup, which predominantly o	ered bedrock mate	erials. Various geophysic	al prospecting methods will as the Witzand and Lang	ere employed to estimate ebaan Fms to the nort	ate the aquifer depth, hwest. The basement
Surface Water System	Primary surface water bodies in the area cons contributes to submarine discharge into the oce				e plays a role in sustainin	g minor wetlands with	in coastal dunes and
	The GRU falls within the West Coast (A3) and				e Class specified. There a	re no EWR sites withir	this IUA; however, it
Water Resource Classes & RQOs	IUA Water Resource Class	Quaternary Catchment	RU	Resource Name	Biophysical Node	TEC	nMAR 14.6
		, C		,	Biophysical Node Bviii3	TEC D	nMAR 14.6
	IUA Water Resource Class	Quaternary Catchment G21A	RU A3-R01	Resource Name	Bviii3 ation method and was cho dditional recharge estimatio	D sen as the estimated r	14.6 echarge value for the eliterature. For further arge Rate
Classes & RQOs	IUA Water Resource Class A3 Wast Coast III An estimated recharge of 9.20 M m³/a was der Aquifer Stress assessment. The average recha details, please refer to DWS (2022e). Method	Quaternary Catchment G21A ived from first-order recharge rge rate was calculated as 28 Area (km²)	RU A3-R01	ng the Map-Centric Simul on the total GRU area. An Recharge (M m	Bviii3 ation method and was cho dditional recharge estimatio	D sen as the estimated r ons can be found in the Average Rech (mm/a	14.6 echarge value for the eliterature. For further arge Rate
Classes & RQOs	IUA Water Resource Class A3 Wast Coast III An estimated recharge of 9.20 M m³/a was der Aquifer Stress assessment. The average recha details, please refer to DWS (2022e). Method	Quaternary Catchment G21A ived from first-order recharge rge rate was calculated as 28 Area (km²)	RU A3-R01	ng the Map-Centric Simul on the total GRU area. An Recharge (M m	Bviii3 ation method and was cho dditional recharge estimatio	D sen as the estimated r ons can be found in the Average Rech (mm/a	14.6 echarge value for the literature. For furthe arge Rate



GRU	GRU Name: Yzerfontein Main Towns: Yzerfontein Total Area (km²): 320.33				
Groundwater Use	In the Yzerfontein GRU, there is a single registered groundwater user with a total annual groundwater use of 0.26 M m ³ /a in the Water Supply Scheme Service Sector. Notably, the WARMS dataset incorrectly assigns Yzerfontein's municipal abstraction of 0.26 M m ³ /a to the Darling GRU (as indicated by the red arrow in Figure 3-3). This information has been rectified to accurately represent the Yzerfontein GRU.	Water Use Water Supply Total	Prima / Service	No. of Users ary / Intergranular Ar 1 1	Total Volume (M m ³ /a) quifer 0.26 0.26
Water Quality	Yzerfontein 100 100 80 5 60 5 90 5 90 5 90 5 90 5 90 60 90 7 90 100	to the deposition of Na-CI signature. waters and Ca ²⁺ witzands Fms. No RQOs have b baseline threshol influenced by the these observation	of marine aerosols a Ca-Mg-Cl waters r and Mg ²⁺ ions in the been gazetted for the d values is noted f CGS (for EC) and for ns, the adjusted wate	nd recharge throu esult from Na ⁺ c e lithology, prima e G21A drainage for EC and ortho ertilizer use (for o er quality categor	Ca-Mg-Cl. Na-Cl waters are attributed ugh coastal rainfall, displaying a typical vation exchange between Na-Cl type rily sourced from the Langebaan and region. Nevertheless, exceedance of phosphate. This could potentially be rthophosphate) in agriculture. Despite y for this GRU is A, indicating that, on S, 2022d, 2022e and 2023a for detail).
Aquifer Stress	(M m ² /a) (M m ² /a)	idicating an unstress s Index .03	sed or slightly stress Groundwater Avai Status Ca A	ilability Present	a Groundwater Quality Present Status Groundwater Quality Present Status Category A



GRU	GRU Name: Yze Main Towns: Yze Total Area (km ²):	erfontein									
	Groundwater Qua			tailed in the table b	elow and describ	bed in Section 2	2.3 & 2.4, is dete	rmined as two o	components 1) th	e Groundwater (Quality Reserve,
	Aquifer Unit	Parameter	Unit	No. BHs	No. Samples	Baseline Conc.	Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshold
		pН		49	142	7.97	1.00	8.76	7.24	7.97	5 – 9
		Electrical Conductivity	mS/m	49	142	111.70	35.20	588.00	104.10	114.51	150
		Sodium as Na	mg/l	49	138	146.72	41.80	864.80	141.65	155.82	200
		Calcium as Ca	mg/l	49	140	24.06	6.20	221.70	19.20	24.06	150
		Magnesium as Mg	mg/l	49	139	34.34	7.00	152.80	22.30	34.34	70
	Primary /	Chloride as Cl	mg/l	49	140	284.61	55.60	1646.00	263.25	289.58	200
	Intergranular	Sulphate as SO4	mg/l	49	140	109.04	2.00	277.90	40.13	109.04	400
Groundwater Reserve	Aquifer	Nitrate + Nitrite	mg/l	49	139	0.51	0.01	4.18	0.09	0.51	10
		Fluoride as F	mg/l	49	136	0.44	0.03	0.88	0.20	0.44	1.5
		Ammonia as NH3	mg/l	49	139	0.11	0.02	1.16	0.04	0.11	-
		Orthophosphate as PO4	mg/l	49	139	0.05	0.00	0.81	0.06	0.07	-
		Potassium as K	mg/l	49	138	4.22	1.17	49.00	4.52	4.97	-
	The groundwater quantity component of the EWR and BHN Reserves.					GW Reserve (Mm ³ /a)		e Volume	sidering the total water Use (Mm ³ /a	-	cable (Mm ³ /a)
			(1011178)	,	,	. ,	(Mm³/a		· · · ·		· · · ·
	9.2	0.02		0.01		0.03	9.17		0.26		8.91
Future Scenario 2050 (Scenario 7b)	factors directly in recharge from 9.2 and the implement	which projects conditions for fluenced the parameters us 2 to 7.60 M m ³ /a, influence ntation of groundwater devo wth. Under these condition m ³ /a) EWR Reserve (sed to detern d by both cl elopment sc s, the Alloca	mine the Groundwa limate change and t chemes in the area.	ter Reserve, spe he elimination of Furthermore, the ot change from a	cifically the ground IAPs. Additionates groundwater co	undwater contrib ally, groundwate ontribution to the	ution to the BH r use increased BHN Reserve 5 and the table Volume	N and EWR. The from 0.26 to 2.2 rose from 0.01 to	scenario involve 6 M m ³ /a due to 0.02 M m ³ /a, pri	ed a decrease in sectoral growth

¹⁹ The WARMS dataset places Yzerfontein's municipal abstraction of 0.26 Mm³/a in the Darling GRU. It has been updated to reflect for the Yzerfontein GRU.

HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMEN	T, CDOUNDWATED DECEDVE DETERMINATION DEDODT
IN THE CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE DERU CATCHWEN	I. GROUNDWATER RESERVE DETERMINATION REPORT

	GRU Name: Yze	rfontein								
GRU	Main Towns: Yzerfontein									
	Total Area (km ²): 320.33									
			ng sites for the I	EWR and 2 for t			ntribution to the EWR and a Management Option 1 for monitoring the groundwater contribution cted within the Yzerfontein GRU (see Figure 3-3 and the table below).			
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description			
						EWR Manager	nent Option 1			
Monitoring Programme	3318AC00090	NGA	Bviii3	EWR	-33.33662	18.23898	 Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: Manual groundwater level measurements 2) Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for EWR: NO2, NO3, NH4 			
						BHN Managen	nent Option 1			
	BG00506	NGA	GRU	BHN	-33.50172	18.32304	Frequency: Quarterly or Biannual (Summer & Winter): 1) Groundwater level: Manual groundwater level measurements 2) Crownite (Real ground water gwality and BLN);			
	89820	WMS	GRU	BHN	-33.384722	18.267778	 2) Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 			
		•	•			•				

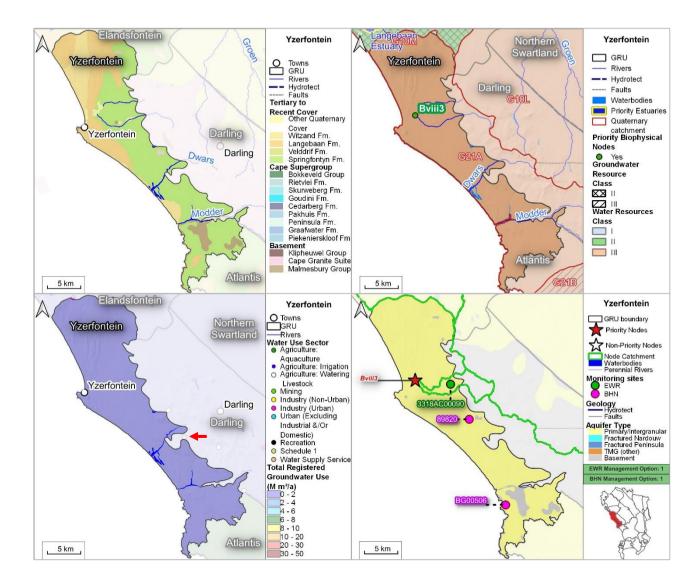


Figure 3-3 A series of maps for the Yzerfontein GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.1.4. Elandsfontein GRU

	GRU Name: Elandsfontein								
GRU	Main Towns: None								
	Total Area (km ²): 532.57								
GRU Boundary Description	The Elandsfontein GRU was confined by the boundaries of the Springfontyn Fm to the east, encompassing sections of the Sout River. Additionally, its southern extent was determined by an interpolated extension of the CGS outcrop. The surface water quaternary catchment divide, at G10M and G21A, is a shared boundary between the Yzerfontein and Elandsfontein GRUs, taking into consideration the south-westerly preferential flow direction and discharge. The demarcation between the Elandsfontein and Langebaan Road GRUs was established based on an inferred basement high, specifically the Malmesbury Group and CGS, which extended from the eastern edge of the GRU towards the coast. However, it is worth noting that there is a potential hydraulic connection between the Elandsfontein and Langebaan Road aquifers. The western boundary of the GRU was defined by the coastline (see Figure 3-4 and DWS, 2022d and 2023a).								
Quaternary Catchments	G10M and G10L (Figure 3-4)								
Resource Unit	Primary / Intergranular Aquifer								
Description	The primary aquifer in this region consists of laterally continuous layers of the Sandveld Group, with an average thickness of approximately 70 meters. The Sandveld Group includes the Springfontyn Fm, prevalent across the majority of the GRU. This formation is mainly covered with Tertiary and Quaternary unconsolidated to semi-consolidated dune sands and calcrete. The groundwater recharge, flow, and discharge in the Elandsfontein Aquifer System are influenced by basement topography (paleochannels), faults, fissures, contact zones, and the stratigraphy of the Cenozoic deposits, contributing to the aquifer's complexity (see Figure 3-4 and DWS, 2022d and 2023a). The Elandsfontein Aquifer System comprises a lower and upper sand aquifer separated by a clay unit and is situated between Hopefield and Langebaan Lagoon. Palaeo-courses of the Berg River, as noted by Timmerman (1985a, 1985b, and 1985c) and DWAF (2008e), have created incisions in the basement topography. These incisions are infilled by fluvial sediment of the Elandsfontyn Fm within the Sandveld Group and represent high-yielding zones. The basement of the aquifer is formed by Malmesbury Group shales and granites from the CGS. Granite outcrops are present in various locations, with granite underlying the Tertiary layers in the west and Malmesbury shale in the east (refer to DWS, 2022d and 2023a).								
Surface Water System	Surface water availability in the region is constrained due to factors such as low rainfall, gentle topography, and the prevalent permeable sand-dominated geology (Figure 3-4). The aquifer primarily discharges into the Langebaan Lagoon, serving as the main surface water system in the GRU (refer to DWS, 2022d and 2023a).								
Water Resource Classes & RQOs	The GRU falls within the Langebaan (A2) and Lower Berg (B4) IUAs, with Water Resource Class II and III, respectively. The segments of the GRU falling within IUA A2 (catchment G10M) are designated Groundwater Resource Class II, while those within IUA B4 (catchment G10L) have no Groundwater Resource Class assigned. Within the GRU, there is 1 priority estuary EWR site – the Langebaan Lagoon, which holds a TEC of A (see table below). IUA Water Resource Class Quaternary Catchment RU Resource Name Biophysical Node TEC nMAR A2 Langebaan II G10M A2-E04 Langebaan Bxi3 A N/A								



Total Area (km²): 52:57 Recharge An estimated recharge of 15:47 M m²/a was obtained from first-order recharge rate is 20.05 mm² based on the dag CRU area. For further details, plaser refer to DVS (2022e), A leaky by decomposition is presumed to exist between the upper and lower RU (refer to DVS, 2022a), 222a and 2023a for detail). Recharge Method Area (km²) Control Contreconter Control Control Control Contro Control Contero	GRU	GRU Name: Elandsfontein Main Towns: None				
Recharge The Aquifer Stress assessment (see table below). The average recharge rate is 29.05 mm be total GRU area. For further details, please refer to DWS (2022e). A leasy by do connection is presumed to exist between the upper and lower RU (refer to DWS, 2022d, 2022e and 2023a for details). Recharge Method Average recharge rate is 29.05 mm be total GRU area. For further details, please refer to DWS (2022e). A leasy by do connection is presumed to exist between the upper and lower RU (refer to DWS, 2022d, 2022e and 2023a for details). Groundwater Use In the Upper Primary Integranular Aquifer, there are three registered groundwater users with a collective simulation method is Agriculture (Imgation), contributing 80.5% and the total GRU area. For further details, please refer to DWS (2022e). A leasy by do consumption in this aquifer are Mning and Agriculture (Imgation), contributing 80.5% and the total GRU area. For further details, please refer to DWS (2022e). A leasy by do consumption in this aquifer area Mning and Agriculture (Imgation), contributing 80.5% and the total GRU area. For further details, please refer to DWS (2022e). A leasy by do consumption in this aquifer are Mning and Agriculture (Imgation), with an abstraction to the upper and a could be added to the right). Water Quality Water Ouesity Image: Consumption in the regression of main abstraction to a consumption in the regression of main asstraction to a consumption in the regression and the regression and recharge through coastal rainfall, exhibiting at the addition of main asstraction of main asstraction to a consumption in the regression and recharge through coastal rainfall, exhibiting at the additititititie asstraction area regression and recha		Total Area (km ²): 532.57				
Method Area (MT) (Mn/m) (mn/m) (mn/m) Mgp-Centric Simulation method 532.57 15.47 29.05 Groundwater Use In the Upper Primary Intergranular Aquifer, there are three registered groundwater users with a collective annual groundwater use of 0.87 M m ² /a. The primary sectors driving groundwater user in the Lower Primary Intergranular Aquifer (Imgation), continuing 80.6% and 163.3%, respectively, to the total annual groundwater user volume. The sole groundwater user volume of 0.22 M m ² /a (see Figure 3-4 and the table to the right). Water Use Sector Vater Use Sector 10.01 Users 0.16 Industry (Vitera) 0.16 Industry (Vitera) 0.010 Industry (Viter	Recharge	the Aquifer Stress assessment (see table below	w). The average recharge rate is 29.05 mm/a ba	sed on the total GRU area. For	method and was chosen as further details, please refer to	the estimated recharge value DWS (2022e). A leaky hydra
Map:Cantric Simulation method 532:57 15:47 29:05 Groundwater Use In the Upper Primary Intergranular Aquifer, there are three registered groundwater users with a collective annual groundwater use (0.87 M m ³ a. The primary sectors driving groundwater users 13:3%, respectively, to the total annual groundwater user volume. The solys and 10:3%, respectively. In the total annual groundwater user volume. The solys and 10:3%, respectively. In the total annual groundwater user volume. The solys and 10:3%, respectively. In the total annual groundwater user volume of 0.22 M m ³ /a (see Figure 3-4 and the table to the nght). Mater Use Sector No. of Users Total Agriculture. Infiguion 1 0.10 Water Quality Image: Sector S	-	Method	Area (km ²)		A	
Groundwater Use In the Upper Primary Intergranular Aquifer, there are three registered groundwater users with a concumption in this aquifer are Mining and Aqriculture (Irrigation), contributing 80.5%, and in the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), contributing 80.5%, and in the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), with an abstraction within the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), with an abstraction within the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), with an abstraction within the Lower Primary Intergranular Aquifer (Lower) Water Quality Image: State		Map-Centric Simulation method	532.57			
Groundwater Use In the Upper Primary Intergranular Aquifer, there are three registered groundwater users with a concumption in this aquifer are Mining and Aqriculture (Irrigation), contributing 80.5%, and in the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), contributing 80.5%, and in the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), with an abstraction within the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), with an abstraction within the Lower Primary Intergranular Aquifer is Agriculture (Irrigation), with an abstraction within the Lower Primary Intergranular Aquifer (Lower) Water Quality Image: State				Mister Her Orster	No. of Linear	T_{-1}
Groundwater Use a collective annual groundwater use of 0.87 M m ² a. The primary sectors driving groundwater to solution. Contributing 80.5% and the table annual groundwater use volume. The sole groundwater use volume. The groundw		In the Linner Drimony Intergraphilar Aquifor the	re are three registered groundwater users with			
Groundwater Use consumption in this aquifer are Mining and Agriculture (trigation), contributing 80.5% and 18.3%, respectively, to the total annual groundwater use in the Lower Primary Intergranular Aquifer 18 Agriculture (trigation), contributing 80.5% and 18.3%, respectively, to the total annual groundwater use in the Lower Primary Intergranular Aquifer 18 Agriculture (trigation), contributing 80.5% and 18.3%, respectively, to the total annual groundwater use in the Lower Primary Intergranular Aquifer 16.0% Water Quality Image: Construction of the total annual groundwater use in the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, exhibiting at the deposition of maine aerosols and recharge through coastal rainfall, e						
Groundwater Use Version plot in this studies and minutal groundwater use volume. (Imgation), both so log groundwater use volume. 1 0.70 Mining 1 0.22 Mining 1 0.70 Mining 1 0.70 Mining 1 0.70 Mining 1 0.70 Mining						
Water Quality Water Quality Image: Stress End Stress End Stress Stress Index	Groundwater Use	18.2% respectively to the total ensued ground	water use volume. The cole groundwater user			
Water Quality Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and the table to the right). Water Quality Image: See Figure 3-4 and the table to the right). Image: See Figure 3-4 and Mg ² ions in the lithology, primarily sourced from the Langebaa Witzands Fins. The Elandsfontein GRU falls under the G10L and G10M drainage regions. Four same recollected from G10L, and 1 from G10M, with all asamples meeting RQOs. Image: See Figure 3-4 and Mg ² ions in the Elandsfontein GF <t< td=""><td>2.34.14.14.01 000</td><td>in the Lower Primary Intergraphiar Aquifer in</td><td>water use volume. The sole groundwater user</td><td></td><td>-</td><td></td></t<>	2.34.14.14.01 000	in the Lower Primary Intergraphiar Aquifer in	water use volume. The sole groundwater user		-	
Water Quality Image: Character And Chara				Agriculture: Irrigation	1	0.22
Water Quality The official considered to have a Groundwater Availability Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating an unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating and unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating and unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating and unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating and unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating and unstressed or slightly stressed aquifer, and a Groundwater Quality Present Status Category of 'B', indicating and unstressed or slightly stressed aquifer, and a Groundwater Quality		volume of 0.22 with 7a (see Figure 5-4 and th	e table to the right).	Total	4	1.09
Aquifer Stress Category of 'B' indicating localised, low levels of contamination, but no negative impacts apparent (see table below). Recharge Volume Groundwater Use Groundwater Present Status Category Adjusted Groundwater Quality Present Status Category (M m³/a) (M m³/a) Stress Index Groundwater WRC, 2007) Adjusted Groundwater Quality Present Status Category	Water Quality		20 2 0 0 100 20 0 100 0 100 0 100 0 100 0 20 0 20 0 0 0 0 0 0 0 0 0 0 0 0 0	Witzands Fms. The Elandsfontein GRU falls were collected from G10L, and The adjusted water quality of contamination exist, predomi However, further monitoring	under the G10L and G10M d 1 from G10M, with all samp category is B, indicating tha nantly natural groundwater of additional locations wit	drainage regions. Four sam les meeting RQOs. t, although some low leve quality conditions are pres
15.47 1.09 0.07 B B		0 100 80 60 40 20 0 Ca	100 0 20 40 60 80 100 Cl		······································	
	Aquifer Stress	Category of 'B' indicating localised, low levels Recharge Volume	of contamination, but no negative impacts appa	icating an unstressed or slightly rent (see table below).	stressed aquifer, and a Grou	undwater Quality Present Sta

	GRU Name: Elar	ndsfontein									
GRU	Main Towns: Nor										
	Total Area (km ²):										
Groundwater Reserve	Groundwater Qua The groundwater and 2) the Groun Aquifer Unit Primary / Intergranular Aquifer Groundwater Qua	ality Component quality component of dwater Quality Require Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as CI Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO0 Potassium as K antity Component quantity component of N Reserves.	ement for BHI Unit Unit Unit Unit Unit Unit Unit Unit	N. No. BHs	No. Samples 5 6 below and desc	Baseline Conc. 7.49 49.10 55.93 37.26 3.50 100.82 12.90 4.62 0.24 0.14 0.19 1.99	Min Conc. 7.17 45.50 50.90 26.50 3.50 97.50 12.10 0.15 0.17 0.04 0.01 0.01 0.48	Max Conc. 7.60 101.90 109.70 83.40 12.60 195.10 29.20 4.62 0.82 0.14 0.30 2.03 Culated by cons e Volume a)	Median Conc. 7.35 49.10 54.40 34.20 3.50 101.00 12.10 1.51 0.19 0.12 0.19 1.02	Groundwater Quality Reserve 7.60 54.01 59.84 37.62 3.85 1111.10 13.31 4.62 0.24 0.14 0.21 1.99 groundwater cor	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - -
Future Scenario 2050 (Scenario 7b)	factors directly in in recharge from		rs used to de , influenced b	termine the Groundwoy both climate chan	vater Reserve, sp ge and the elimin the area. In light	becifically the gr ation of IAPs. A	roundwater contr Additionally, grou	ibution to the B ndwater use ind a Category shift e Volume	HN and EWR. T creased from 1.0	he scenario invo 9 to 2.70 M m ³ /a refer to Section 2	lved a decrease a due to sectoral



GRU	Main Towns: No	RU Name: Elandsfontein Iain Towns: None otal Area (km²): 532.57									
			of 4 monitoring si	ites for the EWR			ontribution to the EWR and a Management Option 1 for monitoring the groundwater ically selected within the Elandsfontein GRU (see Figure 3-4 and the table below).				
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description				
						EWR Managemer					
	G1N0516	HYDSTRA	Langebaan Lagoon	EWRII	-33.19332	18.1269	Frequency: Monthly or Quarterly 1) Groundwater level: O Manual water level measurements and continuous hourly readings from				
	G1N0035	HYDSTRA	Langebaan Lagoon	EWR	-33.180118	18.189366	 automatically recorded level loggers. Possible need for telemetry systems. Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ 				
Monitoring Programme	G1N0513	HYDSTRA	Langebaan Lagoon	EWR	-33.07631	18.2503	 Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰: Bxi3 (Langebaan): 				
	G1N0269	HYDSTRA	Langebaan Lagoon	EWR	-33.13302	18.13159	Nutrients (NO ₃); Salts; Pathogens (Enterococci & Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen, Secchi depth).				
						BHN Managemen					
	93871	WMS	GRU	BHN	-33.204722	18.291944	 Frequency: Quarterly or Biannual (Summer & Winter): Groundwater level: Manual groundwater level measurements Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 				



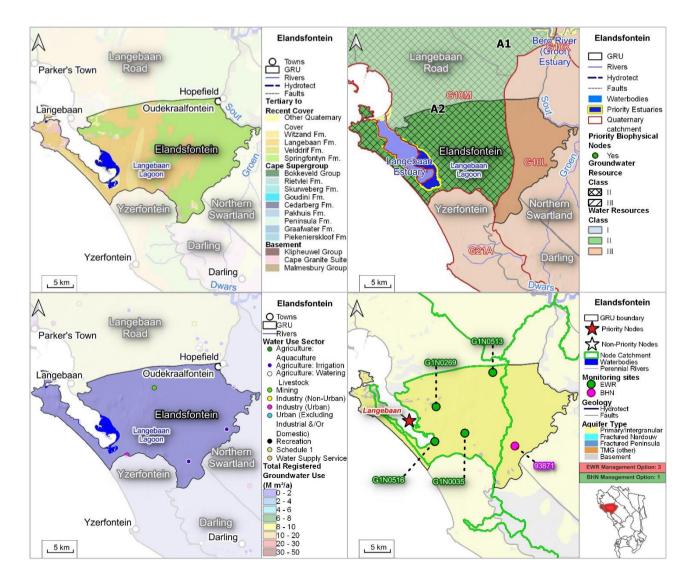


Figure 3-4 A series of maps for the Elandsfontein GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.1.5. Langebaan Road GRU

0.511	GRU Name: Langebaan Road									
GRU	Main Towns: Langebaan									
	Total Area (km ²): 903.71									
GRU Boundary Description	The north-western boundary of the Langebaan Road GRU was determined by the interpolated extent of the CGS outcrop. The division between the Elandsfontein and Langebaan Road GRUs was established based on an inferred basement high, encompassing the Malmesbury Group and the CGS, which extended from the eastern edge of the GRU towards the coast of Saldanha Bay. The Berg and Sout rivers served as the boundaries for the eastern and south-eastern edges of the GRU, while the coastlines of Saldanha Bay and St Helena Bay defined the western and northern edges, respectively. The consideration of preferential flow direction towards Saldanha Bay played a role in defining the GRU boundary (see Figure 3-5 and refer to DWS, 2022d, 2022e and 2023a for detail).									
Quaternary Catchments	G10M and G10L (Figure 3-5)									
Resource Unit	Primary / Intergranular Aquifer									
Description	The Langebaan region is characterized by semi- to unconsolidated Cenozoic sediments, with an average thickness ranging between approximately 50 meters to 70 meters. These sediments, dating from 65 million years ago to the present, unconformably overlie the metamorphosed shales of the Malmesbury Group and the granites of the CGS, which constitute the basement. The division between the Langebaan Road Aquifer System (Upper and Lower) and the Elandsfontein Aquifer System should be viewed primarily as a spatial distinction, as both aquifers are hydraulically connected in both the shallow and deep zones (WRC, 2016a). The Berg River flows roughly parallel to and just east of the regional contact between the Malmesbury Group and CGS, forming the eastern extent boundary of the GRU (Figure 3-5). The groundwater recharge, flow, and discharge in the Langebaan Road aquifer system are influenced by basement topography (paleochannels), faults, fissures, contact zones, and the stratigraphy of the Cenozoic deposits, contributing to the overall complexity of the system (refer to DWS, 2022d and 2023a).									
Surface Water System	The Langebaan Road Aquifer System releases water into Saldanha Bay, St Helena Bay, and the Berg River/Groot Estuary, constituting the primary surface water system within this GRU (see Figure 3-5 and DWS, 2022d and 2023a).									
Water Resource Classes & RQOs	The GRU falls within the Berg Estuary (A1), Langebaan (A2), and Lower Berg (B4) IUAs, with Water Resource Class II, II, and III, respectively. The segments of the GRU within IUAs A1 and A2 (catchment G10M) have a Groundwater Resource Class of II, while those within IUA B4 (catchment G10L) lack a Groundwater Resource Class designation. Within the GRU, there are 2 priority estuaries: 1) the Langebaan Lagoon (an Estuary EWR site) with a TEC of A, and 2) the Berg River (Groot) Estuary, which has a TEC of C (Figure 3-5 and the table below). IUA Water Resource Class Quaternary Catchment RU Resource Name Biophysical Node TEC nMAR A1 Berg Estuary II G10M A1-E01 Berg (Groot) Bxi1 C 52 A2 Langebaan II G10M A2-E04 Langebaan Bxi3 A N/A									



	GRU Name: Langebaan Road			
GRU	Main Towns: Langebaan			
	Total Area (km ²): 903.71			
Recharge	An estimated recharge of 23.28 M m ³ /a was dete for the Aquifer Stress assessments. The average leaky hydraulic connection is presumed to exist b Method Map-Centric Simulation method	e recharge rate is 25.76 mm/a based on the	total GRU area. Additional recharge estimation	
	In the Upper Primary/Intergranular Aquifer, there user, accounting for 91.0% of the total annual gro In the Lower Primary/Intergranular Aquifer, there Water Supply Services, representing 87.4% of th	oundwater use volume. e are 17 registered groundwater users, with e total annual groundwater use volume. Ple	a cumulative groundwater use of 7.82 M m ³ /a. ase see Figure 3-5 and the table below for deta	The primary groundwater user in this aquifer is ail.
	Water Use Sector		f Users	Total Volume (M m ³ /a)
Groundwater Use	A suiscittures luciusticus	Primary / Intergra	nular Aquifer (Upper)	0.74
Crodinawater Osc	Agriculture: Irrigation		9	0.71
	Agriculture: Watering Livestock		2	0.02
	Industry (Non-Urban)		4	0.01
	Industry (Urban)		1	0.04
		Primary / Intergra	nular Aquifer (lower)	
	Agriculture: Irrigation		6	0.87
	Agriculture: Watering Livestock		8	0.08
	Water Supply Service		3	6.87
	Total		33	8.59
Water Quality	Key Langebaan 1 - Ga-HO20 type 200 100 2 - Hard-Dype 20 20 3 - Ca-Ho20 type 20 5 4 - Ca-Ho20 type 20 5 5 - Ca-Ho20 type 20 0 5 6 - Hard-Citype 20 0 10 0 0 100 0 0 1 0 0 20 0 1 0 <th>Road 0 0 0 0 0 0 0 0 0 0 0 0 0</th> <th>deposition of marine aerosols and recharge CI signature. While Ca-HCO₃ waters are Langebaan Fm, no samples show this water rocks of the Tygerberg Fm may contribute aquifer, given the elevated Na and Cl ion cor Out of the 103 samples collected, 9 exceed NO₂. Elevated EC values are likely influence predominantly basic pH is attributed to the of extensive Langebaan Fm. The adjusted water</th> <th>Road GRU is Na-CI, primarily resulting from the through coastal rainfall, displaying a typical Na- e expected due to the extensive calcite-rich type. Boreholes situated near shallow basement to the Na-CI character in the overlying primary incentrations of this lithology. ed the RQO for EC, 18 for pH, and 1 for NO₃ + the dissolution of basic Ca and HCO₃ ions from the er quality category is B, indicating that, although ominantly natural groundwater quality conditions</th>	Road 0 0 0 0 0 0 0 0 0 0 0 0 0	deposition of marine aerosols and recharge CI signature. While Ca-HCO ₃ waters are Langebaan Fm, no samples show this water rocks of the Tygerberg Fm may contribute aquifer, given the elevated Na and Cl ion cor Out of the 103 samples collected, 9 exceed NO ₂ . Elevated EC values are likely influence predominantly basic pH is attributed to the of extensive Langebaan Fm. The adjusted water	Road GRU is Na-CI, primarily resulting from the through coastal rainfall, displaying a typical Na- e expected due to the extensive calcite-rich type. Boreholes situated near shallow basement to the Na-CI character in the overlying primary incentrations of this lithology. ed the RQO for EC, 18 for pH, and 1 for NO ₃ + the dissolution of basic Ca and HCO ₃ ions from the er quality category is B, indicating that, although ominantly natural groundwater quality conditions



GRU	GRU Name: Lar Main Towns: La Total Area (km ²)	ngebaan										
Aquifor Strees		sidered to have a Groundw alised, low levels of contam					derately stresse	d aquifer, and a	a Groundwater Q	uality Present Sta	atus Category	
Aquifer Stress		irge Volume		dwater Use	Stre	ess Index	Ground	dwater Availabilit		roundwater Quality		
	1)	M m ³ /a)		1 m ³ /a)	Olic			Status Categor	у	Catego	ту	
		23.28		8.59		0.37		С		В		
	The groundwate	ality Component r quality component of the ndwater Quality Requirement Parameter			elow and describ No. Samples	ed in Section 2 Baseline Conc.	Min Conc.	rmined as two Max Conc.	components 1) th Median Conc.	ne Groundwater (Groundwater Quality Reserve	Quality Reser BHN Threshold	
		рН		8	92	8.41	6.77	8.71	8.11	8.71	5 – 9	
		Electrical Conductivity	mS/m	8	92	59.50	59.50	289.50	152.00	167.20	150	
		Sodium as Na	mg/l	8	81	202.80	61.00	445.30	198.52	218.37	200	
		Calcium as Ca	mg/l mg/l	8	84 86	72.80 17.90	27.00 5.30	175.00 97.92	<u>68.89</u> 17.71	75.78 19.48	150 70	
	Primary /	Magnesium as Mg Chloride as Cl	mg/l	8	88	385.60	110.00	780.80	334.69	385.60	200	
	Intergranular	Sulphate as SO4	mg/l	8	89	25.18	0.60	467.60	25.50	28.05	400	
roundwater Reserve	Aquifer	Nitrate + Nitrite	mg/l	8	87	0.25	0.02	9.81	0.06	0.25	10	
		Fluoride as F	mg/l	8	82	0.70	0.22	2.11	0.61	0.70	1.5	
		Ammonia as NH3	mg/l	8	90	0.14	0.00	0.55	0.03	0.14	-	
		Orthophosphate as PO4	mg/l	8	90	0.04	0.00	0.24	0.03	0.04	-	
		Potassium as K	mg/l	8	83	4.81	1.00	27.75	4.80	5.28	-	
	Groundwater Quantity Component The groundwater quantity component of the Reserve, detailed in the table below and described in Section 2.3 & 2.4, is calculated by considering the total groundwater contribution to both the EWR and BHN Reserves.											
			e Reserve,	detailed in the table	below and descr	ibed in Section	i 2.3 & 2.4, is cal	culated by con		9.00.000		
		IN Reserves.		detailed in the table BHN Reserve (Mm ³ /		ibed in Section serve (Mm³/a)	Total Allocable (Mm³/a	e Volume	Water Use (Mm³/a	-	cable (Mm³/a)	



GRU	GRU Name: Lang Main Towns: Lan Total Area (km ²):	gebaan										
Future Scenario 2050 (Scenario 7b)	factors directly inf recharge from 23 growth and the in	fluenced the pa 3.28 to 20.18 M nplementation	arameters used to / m ³ /a, influenced of groundwater de	determine the C by both climate	Groundwater Research change and the emes in the area	serve, specifically e elimination of I a. Furthermore, th	y the grou APs. Add he ground	ndwater contribution to the itionally, groundwater use	e BHN and EWR. The scen increased from 8.59 to 11 3HN Reserve rose from 0.0	rge and Water Use. These ario involved a decrease in .09 M m³/a due to sectoral 12 to 0.03 M m³/a, primarily		
	Recharge (Mr	m³/a) E	WR Reserve (Mm³/a)) BHN Res	erve (Mm³/a)	GW Reserve (M	1m³/a)	Total Allocable Volume (Mm ³ /a)	Water Use (Mm³/a)	Still Allocable (Mm ³ /a)		
	20.18		5.52		0.03	5.55		14.63	11.09	3.55		
			of 6 monitoring site	es for the EWR					/anagement Option 1 for n Road GRU (see Figure 3- {	nonitoring the groundwater 5 and the table below).		
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description					
	EWR Management Option 3											
	G1N0050	HYDSTRA	Berg (Groot)	EWR	-32.86598	18.09559		cy: Monthly or Quarterly				
	G1N0337	HYDSTRA	Berg (Groot)	EWR	-32.990127	18.229369	1)	 Manual water level r automatically record 	automatically recorded level loggers. Possible need for telen			
	G1N0507	HYDSTRA	Bii1	EWR	-33.02503	18.34761	2)	 Site specific addition 	rrs: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ ns for EWR: NO₂, NO₃, NH₄			
Monitoring Programme	G1N0237	HYDSTRA	Berg (Groot)	EWR	-32.91996	18.2942		 Site specific addition 	ns as per RQO ²⁰ :			
Workoning Programme	G1N0372	HYDSTRA	Langebaan Lagoon	EWR	-33.00888889	18.0725	-		utuary): ed Inorganic Nutrients [DIN] Salts; Pathogens (Enterococci			
	G1N0274	HYDSTRA	Berg (Groot)	EWR	-32.88552	18.24774		Variables (Tempera	ture, pH, Dissolved Oxygen, Se	ecchi Depth).		
			· · · · · · · · · · · · · · · · · · ·		·	BHN Management						
	G1N0158	HYDSTRA	GRU	BHN	-33.080122	18.049363	Frequend	cy: Quarterly or Biannual (Sun Groundwater level:	nmer & Winter)			
	3218CC00015	NGA	GRU	BHN	-32.92805	18.00483	2)	 Manual groundwater level measurem 		k, MAIk, F, CI, PO4, SO4		
	93873	WMS	GRU	BHN	-32.989722	18.093333		 Site specific additions for BHN (microbiological): E coli, Total Coliforms 				



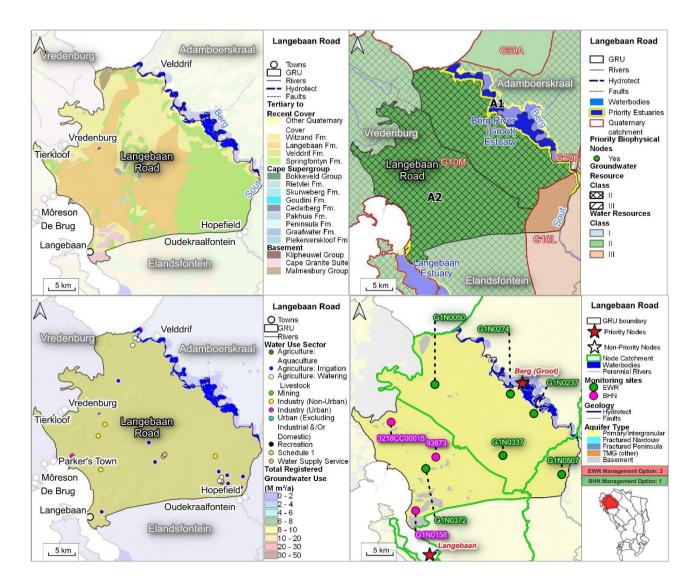


Figure 3-5 A series of maps for the Langebaan Road GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.1.6. Adamboerskraal GRU

	GRU Name: Adamboei	skraal									
GRU	Main Towns: Velddrif										
	Total Area (km ²): 612.3	0									
GRU Boundary Description	River, while the eastern thin layer of the Springform	e extent of the Adamboerskraal GRU was determined using the Adamboerskraal aquifer model boundary (SRK, 2004). The south-western edge of the GRU was defined by the Berg ver, while the eastern and southern boundaries were established by an interpolated basement lithology extent. This extent included the Malmesbury Group and the CGS, overlaid by a nate of the Springfontyn Fm. The north-westerly preferential flow direction, particularly at the Berg River Estuary, also contributed to the definition of the eastern and southern boundaries. e northern and north-western edge of the GRU is bounded by the St Helena Bay coastline (see Figure 3-6 and DWS, 2022d and 2023a).									
Quaternary Catchments	G10M, G10K and G30/	A (Figure 3-6)									
Resource Unit				Primary / Inter	granular Aquifer						
Description	sediments, dating from roughly parallel to and The groundwater recha	65 million years ago to just west of the regional arge, flow, and discharg	by the dominance of sem the present, unconformat contact between the Maln e in the Adamboerskraal r posits (Figure 3-6). These	ly overlie the metar nesbury Group and egion are influence	norphosed shales of the CGS (refer to DWS, 202 d by various factors, inc	Malmesbury Group and 2d and 2023a). Iuding basement topogra	the CGS (Figure 3-	6). The Berg River flows			
Surface Water System	The Adamboerskraal A connection between the 2022d, 2022e and 2023	e Adamboerskraal Aquif	t Helena Bay and the Berg fer System and the Langel	River/Groot Estuar baan Road Aquifer S	y, serving as the princip System beneath the Ber	al surface water system of g River, as indicated by b	within this GRU. Ther WRC (2016a). Refer	e is a probable hydraulic to Figure 3-6 and DWS,			
Water Resource Classes & RQOs	assigned a Groundwate	er Resource Class of II,	nd Lower Berg (B4) IUAs, while no Groundwater Res the Berg River (Groot) Es Quaternary Catchment G10M	ource Class is desi	gnated for the portions w	vithin IUA A1 (catchment	the GRU within IUA A G30A) and IUA B4 (c <u>TEC</u> C	A1 (catchment G10M) is catchment G10K). Within nMAR 52			
Recharge	for the Aquifer Stress a Refer to DWS (2022e)	ssessments (see table b	etermined from first-order below). The average recha Area (km 612.30	rge rate is 35.29 mn	n/a based on the total Gl	RU area. Additional recha	arge estimations are a Average R (m	stimated recharge value available in the literature. echarge Rate m/a) 5.29			



	GRU Name: Adamboerskraal			
GRU	Main Towns: Velddrif			
	Total Area (km ²): 612.30			
Groundwater Use Water Quality	In this GRU, there are 12 registered groundwater users, collectively utilizing 2.13 M m ³ /a of groundwater. The primary sectors contributing to groundwater use are Agriculture (Irrigation) and Industry, constituting 62.9% and 37.1%, respectively, of the total annual groundwater use volume (Figure 3-6 and the table to the right).	deposition of marine aerr CI signature. However, intersect the underlying Na-CI waters and a high Out of the 2 samples co quality category is B, in	1 12 e in the Adamboerskraal GR osols and recharge through or elevated salinity levels sugg basement aquifer, serving as count of exceedances for EC ollected, 1 sample exceeded to ndicating that, although som	1.34 0.79 2.13 U is Na-Cl, mainly attributed to to oastal rainfall, displaying a typical N jest that boreholes in this GRU m the likely reason for the presence
Aquifer Stress	The GRU is considered to have a Groundwater Availability Present Status Category of 'B', inc Category of 'B' indicating localised, low levels of contamination, but no negative impacts appa Recharge Volume (M m³/a) Groundwater Use Stress	rent (see table below).	slightly stressed aquifer, and a nundwater Availability Present Status Category	a Groundwater Quality Present Sta Groundwater Quality Present Status Category
	21.61 2.13 0.1	10	B	B
		iv		U



	GRU Name: Adan	nboerskraal									
GRU	Main Towns: Veld										
	Total Area (km ²):										
Groundwater Reserve	Groundwater Qua The groundwater and 2) the Ground Aquifer Unit Primary / Intergranular Aquifer Groundwater Qua	lity Component quality component of the dwater Quality Requireme Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K Intity Component quantity component of the N Reserves.	nt for BHN. Unit <u>mS/m</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l}</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l}</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l}</u> <u>mg/l</u> <u>mg/l</u>	No. BHs 2	No. Samples	Baseline Conc. 7 499.1 874.9 42 73.8 1540 52.2 0.1 0.31 0.19 0.24 11.28	Min Conc. 6.5 499.1 874.9 42 73.8 1540 52.2 0.02 0.3 0.18 0.036 9.34	Max Conc. 7 823.2 1374.9 67.4 145.1 2513.3 164 0.1 0.5 0.62 0.243 11.28 culated by cons	Median Conc. 6.6 752 1367.8 58 140.7 2442.1 143.3 0.02 0.31 0.19 0.051 10.95	Groundwater Quality Reserve 7 823.2 1374.9 63.8 145.1 2513.3 157.63 0.1 0.341 0.209 0.24 11.28 groundwater cor a) Still Allo	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - -
Future Scenario 2050 (Scenario 7b)	factors directly inf in recharge from 2	hich projects conditions fo luenced the parameters u 21.61 to 20.83 M m ³ /a, inf plementation of groundwa n ³ /a) EWR Reserve (6.00	sed to dete luenced by ater develop	ermine the Groundw both climate chang	ater Reserve, sp e and the elimin he area. Under th	ecifically the gr ation of IAPs. A	oundwater contractionally, grou	ibution to the B ndwater use inc ategory did not e Volume a)	HN and EWR. T creased from 2.1	The scenario invo 13 to 3.69 M m ³ /a (refer to Section 2 a) Still Allo	lved a decrease a due to sectoral

GRU	GRU Name: Ada Main Towns: Vel Total Area (km ²):	ddrif										
	The Adamboerskraal GRU was assigned a Management Option 3 for monitoring the groundwater contribution to the EWR and a Management Option 1 for monitoring the groundwate contribution to the BHN. A total of 5 monitoring sites for the EWR and 1 for the BHN were selected strategically within the Adamboerskraal GRU (see Figure 3-6 and the table below).											
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description					
						EWR Management	t Option 3					
	G1N0070	HYDSTRA	Berg (Groot)	EWR	-32.70555556	18.32083333	Frequency: Monthly or Quarterly 2) Groundwater level:					
	G1N0364	HYDSTRA	Berg (Groot)	EWR	-32.80504	18.374	 Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems. Groundwater Quality: 					
	G1N0239	HYDSTRA	Berg (Groot)	EWR	-32.87268	18.476	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰: 					
Monitoring Programme	G1N0240	HYDSTRA	Berg (Groot)	EWR	-32.901	18.33653	Bxi1 (Berg Groot Estuary): Nutrients (Dissolved Inorganic Nutrients [DIN] and Dissolved Inorganic					
	3218CC00394	NGA	Berg (Groot)	EWR	-32.79027	18.20829	Phosphate [DIP]); Salts; Pathogens (Enterococci & Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen, Secchi Depth).					
						BHN Management						
	93313 WMS GRU & Berg (Groot) BHN -32.85	-32.85	18.368889	 Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: Manual groundwater level measurements 2) Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 								



²⁰ Contributing catchments to the river or estuary node may extend across multiple GRUs (see DWS, 2023a), however they are still included as important RQO sites to monitor.

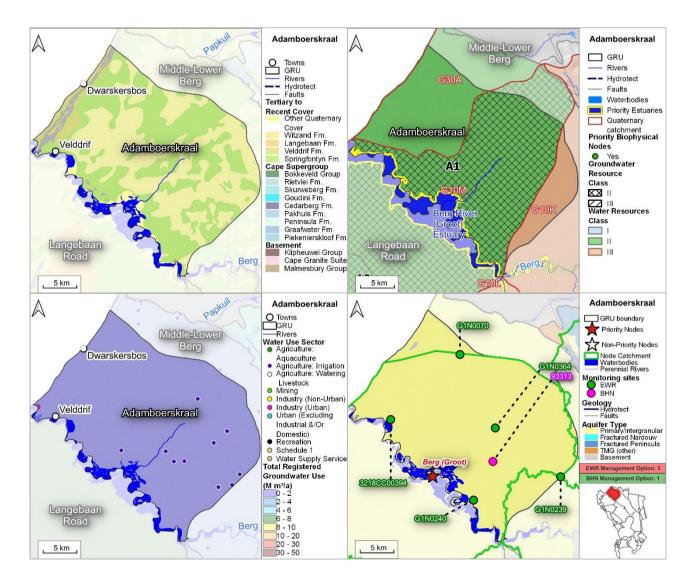


Figure 3-6 A series of maps for the Adamboerskraal GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2. Fractured Table Mountain Group GRUs

3.2.1. Cape Peninsula GRU

	GRU Name: Cape Peninsula										
GRU		, Kommetjie and Fish Hoek									
	Total Area (km ²): 292.	53									
GRU Boundary Description	The Cape Peninsula GRU is defined by the extent of the TMG outcrop, predominantly the Peninsula Fm, overlaying the CGS throughout the Cape Peninsula GRU. Additionally, the Malmesbury Group underlies the City Bowl and Devils Peak, incorporating scree aprons on the mountain slopes, particularly around the Table Mountain area. The western extent is bordered by the Atlantic coastline, while the eastern boundary is marked by the False Bay coastline. In the Fish Hoek Valley, Cenozoic sands are present, contributing to high-water tables that support wetlands and streams around the Fish Hoek and Noordhoek area (Figure 3-7). Although deep groundwater flows are not expected to be significant, some drainage from the Cape Peninsula may recharge both surface water and groundwater on the Cape Flats (refer to DWS, 2022d and 2023a).										
Quaternary Catchments	G22A, G22B, G22C and G22D (Figure 3-7)										
Resource Unit			Fract	ured Table Mour	ntain Group Aquifer						
Description	composed of the CGS descending from appro- The Peninsula Fm ext	The Cape Peninsula is primarily characterized by the presence of TMG outcrops, predominantly represented by the Peninsula Fm. The basement rock along the length of the Peninsula is composed of the CGS. Under the City Bowl and Devils Peak, the basement is constituted by the Malmesbury Group. An unconformity/nonconformity, gently dipping to the south, is observed, descending from approximately 400 meters in the north around the city to below sea level south of Fish Hoek (see Figure 3-7 and DWS, 2022d and 2023a). The Peninsula Fm exhibits varying thickness, ranging from 60 to 140 meters. The rugged terrain, mostly situated within the Table Mountain National Park, is generated by the outcrops of the TMG, contributing to the distinctive landscape of the Cape Peninsula (Figure 3-7).									
Surface Water System	Several surface water features are present in this GRU, such as Lake Michelle, Wildevöelvlei, and the Kleinplaas Dam located at the centre of the GRU (Figure 3-7). Additionally, the Silvermine, Hout Bay, Liesbeek, and Krom rivers originate from Peninsula Fm outcrops within the GRU (refer to Figure 3-7 and DWS, 2022d and 2023a).										
Water Resource Classes & RQOs	G22C) is assigned a C	Groundwater Resource Clas	s of II, while no Groundwater	Resource Class	is designated for the por	. The segment of the GRU with tions within IUA E11 (catchmer of C and 2 river nodes (see Fig <u>Biophysical Node</u> <u>Bviii6</u> <u>Bvii20</u> <u>Bxi14</u>	nts G22A and G2	2B). This IUA does			



	GRU Name: Cape Peninsula										
GRU	Main Towns: Hout Bay, Kommetjie and Fish Ho	ek -									
Gitte	Total Area (km ²): 292.53										
	101al Alea (KIII). 292.55										
Recharge	Recharge in the GRU primarily comes from rainfall, but cloud moisture, especially from the south-east wind in summer, may also contribute. While recharge on the Peninsula is considerably higher than in the surrounding areas, its thickness results in low aquifer storage, often causing recharge to be discharged as springs in a short time frame. Some of these are permanent seeps that feed mountain streams and wetlands. Scree aprons, found on the slopes of the Peninsula-formed mountain, especially around Table Mountain itself, are recharged by streams cascading off the steep cliffs. Various springs emanating from the scree aquifers, ultimately dependent on the Peninsula Aquifer, cumulatively discharge over 100 l/s to the City Bowl and Newlands areas combined (Figure 3-7 ;GEOSS, 2015). An estimated recharge of 10.99 M m ³ /a was determined from first-order recharge calculations using the Map-Centric Simulation method and was chosen as the estimated recharge value for the Aquifer Stress assessments. The average recharge rate is 37.57 mm/a based on the total GRU area. Additional recharge estimations are available in the literature. Refer to the table below and DWS (2022e) for further details.										
	Mathad	Area (km ²)	Recharge Volume		Average Recharge Rate						
	Method	Area (km ²)	(M m³/a)		(mm/a)						
	Map Centric Simulation Method	292.53	10.99		37.57						
				ł							
Groundwater Use	In this GRU, there are 8 registered groundwate groundwater. The predominant sectors in grou Agriculture (Livestock Watering), accounting groundwater use volume (Figure 3-7 and the ta	Indwater use are Agriculture (Irrigation) and for a combined 90.7% of the total annual	Water Use Sector Agriculture: Aquaculture Agriculture: Irrigation Agriculture: Watering Livestock Industry (Urban) Agriculture: Irrigation Industry (Urban) Total	No. of Users Fractured TMG Aquifer 1 Fractured TMG Aquifer 1 1 Primary / Intergranula 2 2 8	(Nardouw) 0.01 (Peninsula) 0.02 0.01 0.01						
Water Quality	Key Cape Pen 1 - Ca+RcD type 300 10 2 - Na-Chype 80 3 - Ca+Rd-CD type 80 4 - Ca+Rd-CD type 64 5 - Ca+Rd-CD type 64 6 - No+HCOS type 7 6 - No+HCOS type 7 7 7 80 7 90 10 100 9 100 10	nsula x_0	result from the deposition of m Ca-Mg-Cl type waters arise fro and Mg ²⁺ ions in the lithology. Approximately 50% of the sam + nitrite, with activities in urb adjusted water quality categor	arine aerosols and re om Na+ cation exchan ples collected exceed anized areas being p ory is B, indicating th oncerns arise from na	U are Na-Cl and Ca-Mg-Cl. Na-Cl waters echarge through coastal rainfall, whereas nge between Na-Cl type waters and Ca ² + led baselines for sulphate, EC, and nitrate potential sources of contamination. The hat predominantly natural water quality atural factors such as acidic pH, elevated d, 2022e and 2023a for detail).						



	GRU Name: Ca	ne Peninsula										
GRU		out Bay, Kommetjie and Fis	h Hoek									
Cito	Total Area (km ²)		THOOR									
Aquifer Stress	The GRU is considered to have a Groundwater Availability Present Status Category of 'A', indicating an unmodified, pristine conditions aquifer, and a Groundwater Quality Present Status Category of 'B' indicating localised, low levels of contamination, but no negative impacts apparent (see table below).											
	Recha	arge Volume	Groundwater Use		Str	Stress Index		Groundwater Availability Present			ability Present	
		M m ³ /a)		m³/a) .073				Status Catego	ory	Status Cat	egory	
		10.99	0	.073		0.01		A		В		
	The groundwate	uality Component er quality component of the ndwater Quality Requireme Parameter			below and describ	bed in Section 2 Baseline Conc.	Min Conc.	Max Conc.	Modion	Groundwater Quality Reserve	Quality Reserve, BHN Threshold	
		pH		11	11	6.96	6.54	7.57	7.10	7.57	5 – 9	
		Electrical Conductivity	mS/m	11	11	25.80	25.80	119.00	89.80	98.78	150	
		Sodium as Na	mg/l	11	11	31.30	31.30	115.40	89.10	98.01	200	
	Fractured	Calcium as Ca	mg/l	11	11	3.60	3.60	109.60	30.70	33.77	150	
	Table	Magnesium as Mg	mg/l	11	11	3.50	3.50	31.40	16.70	18.37	70	
	Mountain	Chloride as Cl	mg/l	11	11	54.70	54.70	207.10	147.20	161.92	200	
Groundwater Reserve	Group	Sulphate as SO4 Nitrate + Nitrite	mg/l	<u>11</u> 11	11 11	12.20 0.07	12.20 0.02	107.40 10.89	72.20	79.42 0.35	400 10	
	Aquifer	Fluoride as F	mg/l mg/l	11	11	0.26	0.02	0.33	0.32	0.35	1.5	
		Ammonia as NH3	mg/l	11	11	0.02	0.03	2.51	0.02	0.02	-	
		Orthophosphate as PO4	mg/l	11	11	1.02	0.01	1.08	0.02	1.02	-	
		Potassium as K	mg/l	11	11	1.79	0.83	46.71	5.95	6.55	-	
		/Im³/a) EWR Reserve		detailed in the table BHN Reserve (Mm 0.09		ibed in Section serve (Mm³/a) 5.52	Total Allocabl (Mm ³ / 5.48	e Volume a)	Water Use (Mm ³ 0.073	-	ntribution to both ocable (Mm³/a) 5.41	



		D · · ·										
	GRU Name: Cap											
GRU			netjie and Fish Hoel	Κ								
	Total Area (km ²):	292.53										
Future Scenario 2050 (Scenario 7b)	factors directly in recharge from 10 and the implement	fluenced the .99 to 9.19 M ntation of gro	parameters used to I m ³ /a, influenced by undwater developm	determine the y both climate cl ent schemes in	Groundwater Res hange and the eli the area. Furthe	serve, specificall imination of IAPs rmore, the groun	y the grounts. Additionation	ndwater contribution to the ally, groundwater use incre ntribution to the BHN Rese to Section 2.5 and the tab	BHN and EWR. The scer ased from 0.07 to 0.15 M rve rose from 0.09 to 0.16	arge and Water Use. These ario involved a decrease in m ³ /a due to sectoral growth M m ³ /a, primarily attributed		
	Recharge (M	m³/a)	EWR Reserve (Mm ³ /a		BHN Reserve (Mm ³ /a)		/lm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm³/a)	Still Allocable (Mm ³ /a)		
	9.19		5.43		0.16	5.59		3.60	0.15	3.45		
	contribution to th	e BHN. A tota	al of 4 monitoring sit		and 1 for the BF			ted within the Cape Penins	sula GRU (see Figure 3-7	nonitoring the groundwater and the table below).		
	Site Name	Data Source	Area	Objective	Objective			Monitoring Description				
						EWR Management						
	3418AB00024	NGA	Wildevöelvlei	EWR	-34.14185	18.34929	Frequency: Monthly or Quarterly 1) Groundwater level: o Manual water level measurements and automatically recorded level loggers. P					
	G2N0048	HYDSTRA	Bviii6	EWR	-34.0008	18.379366	2)	 Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, F Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰: 				
Monitoring Programme	Proposed BH		GRU	EWR	-34.10991286	18.40487755	Bxi14 (Wildevöelvlei): Nutrients (Dissolved Inorganic Nutrients [DIN] and Dissolve Phosphate [DIP]); Salts; Pathogens (Enterococci & Escherichia (Variables (Temperature, pH, Dissolved Oxygen).					
	96073	WMS	GRU	EWR	-34.222778	18.410833	Bviii6: Nutrients (Phosphate [PO ₄ -P] and Total Inorganic Nitrogen [T (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System (Temperature, pH, Dissolved Oxygen).					
		1	-			BHN Management						
	96069	WMS	GRU	BHN	-34.132222	18.380833	Frequenc 1) 2)	from automatically re Groundwater Quality (Backo o Standard Parameters	level measurements, as well corded level logger. ground water quality and BHN s: pH, EC, Ca, Mg, Na, K, Pal s for BHN: E coli, Total Colifor): k, MAIk, F, CI, PO4, SO4		



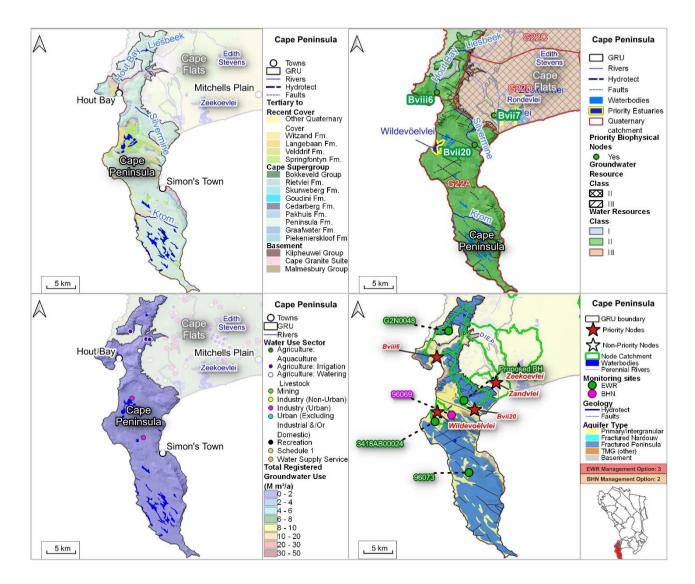


Figure 3-7 A series of maps for the Cape Peninsula GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



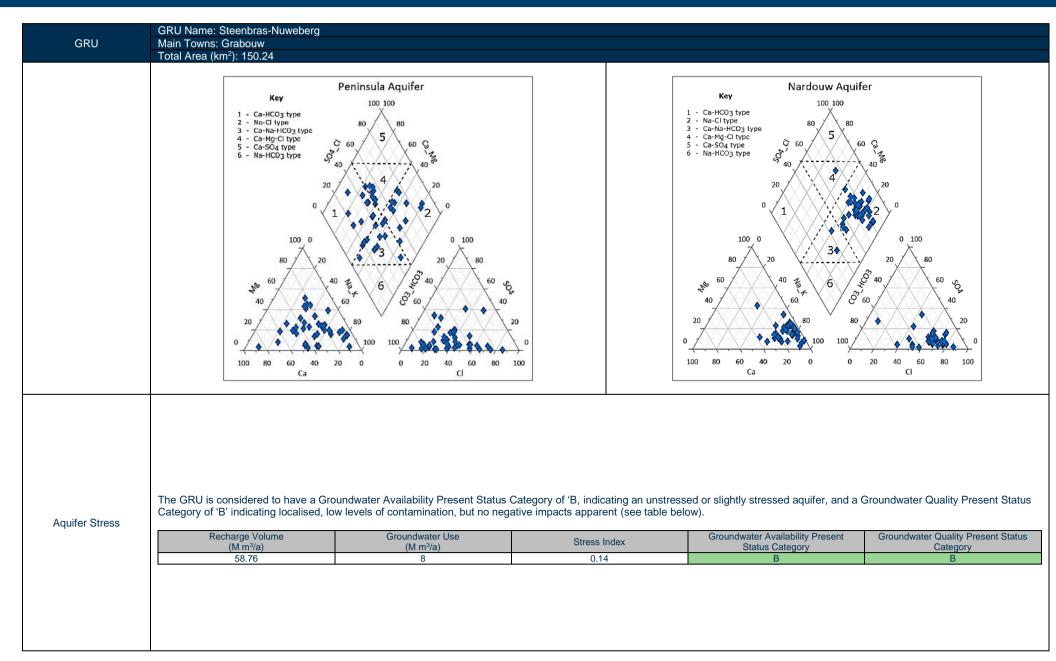
3.2.2. Steenbras-Nuweberg GRU

0.2.2. 0100	enbras-Nuweberg GNO
	GRU Name: Steenbras-Nuweberg
GRU	Main Towns: Grabouw
	Total Area (km²): 150.24
GRU Boundary Description	The aquifer model boundary outlined by CoCT (2021) defines the extent of the Steenbras-Nuweberg GRU. The boundaries of the GRU include the TMG outcrop in the Steenbras and Theewaterskloof areas. The northern recharge area is demarcated by the La Motte Fault (DWAF, 2008a; CoCT, 2004), while the eastern margin is defined by the Kogelberg and Stettyns anticlines, encompassing sections of the G40A surface water catchment boundary. To the north, the GRU's extent is determined by interpolated basement lithologies, specifically the Malmesbury Group and the CGS Suite outcrop, extending to the False Bay coastline in the west. (refer to Figure 3-8 and DWS, 2022d and 2023a).
Quaternary Catchments	G40C, G40A, G40D, G22J, G22K, H60A and G40B (Figure 3-8)
Resource Unit	Fractured Table Mountain Group Aquifer
Description	The TMG Super aquifer in this region comprises the larger Peninsula Aquifer, ranging in apparent thickness from approximately 600 to 700 meters, and the smaller Nardouw Aquifer, which includes its sub-aquifers with an estimated thickness ranging from approximately 700 to 800 meters (Figure 3-9). The TMG has undergone folding, forming a syncline that exposes the Peninsula Fm in the limbs and along the steep mountainsides in the valley. On the elevated synclinal/anticlinal limbs us area, the Peninsula, Pakhuis, Cadarberg, and Goudini Fms are visible (refer to DWS, 2022d and 2023a). Within the syncline valley, the Nardouw Aquifer formed by the Skuwerberg and Rietvlei Fms. (See Figure 3-8 and the cross section below). The confining unit separating the Peninsula Aquifer from the overlying Nardouw Aquifer is characterized by a conformable package of three aquitard units: Goudini. Cedarberg, and Pakhuis. Collectively, these aquifart units: are referred to as the Winnerhoek Mega-aquifard. Hydrogoologically, the eninter Pakhuis-Goudini sequence effectively functions as an aquifard. despite are identified as the primary deep aquifer targets (refer to DWS, 2022d and 2023a). Within this aquifer system, the Peninsula Aquifer and the Skurweberg Sub-aquifer are identified as the primary deep aquifer targets (refer to DWS, 2022d and 2023a).



	GRU Name: Steenbras-Nuweberg						
GRU	Main Towns: Grabouw						
	Total Area (km ²): 150.24						
Surface Water System	The surface water bodies within this GRU er (see Figure 3-8). Surface water runoff aligns w						
Water Resource Classes & RQOs	Only a portion of the GRU is located within the segments of the GRU within the D7 IUA (catch however, it does host 1 priority biophysical site	ments G40A and G22K) have a \	Nater Resource	e Class of II and no Groundwate	er Resource Class. This (
	IUA Water Resource Class	Quaternary Catchment	RU	Resource Name	Biophysical Node	TEC	nMAR
	D7 Sir Lowry's II	G40A	D7-R20	Steenbras	Bvii22	B/C	23
Recharge	An estimated recharge of 58.76 M m ³ /a was det Stress assessments. The average recharge ra DWS (2022e) for further details. Method After (CoCT, 2022) hydrogeological technical assessment for IWULA	ermined from GRAII based on th te is 391.11 mm/a based on the Area (km ²) 150.24	e hydrogeologiu total GRU area	cal technical assessment (CoC a. Additional recharge estimatio Recharge Volume (M m ³ /a) 58.76 ²¹	ons are available in the lit	alue was incorpor- erature. Refer to Average Rechar (mm/a) 391.11	the table below and
Groundwater Use	In this GRU, Water Supply Services stand as total annual groundwater use of 8 M m ³ /a. How the Peninsula Aquifer and 6.5 M m ³ /a in the Na	vever, this usage is divided into		Water Use Sector Water Supply Service Water Supply Service Total	No. of Users Fractured TMG Aquifer (Per 0.5 Fractured TMG Aquifer (Na 0.5 1	ninsula)	/olume (M m ³ /a) 1.5 6.5 8
Water Quality	The primary water types in the Peninsula Aquife CI waters are a result of the deposition of m rainfall. Ca-HCO3 type waters arise from the d HCO3 type waters are due to ion exchange be in the lithology. Exceedances of baseline concentrations were arsenic, chromium, lead, and mercury, with 50° and EC. The adjusted water quality category is quality conditions prevail. However, there are acidic pH, elevated iron, and manganese in the for detail).	arine aerosols and recharge th issolution of carbonate minerals tween Ca+ ions from Ca-HCO3 observed for all parameters exit % of samples exceeding baseline B, indicating that predominantly concerns related to natural fac	The primary water types in th HCO ₃ and Ca-Mg-Cl types. T and recharge through coasta are lower than in the Penins of humic compounds from c acid) in recharge water, and Aquifer) to buffer acidic wate Exceedances of baseline co orthophosphate, dissolved cl B, indicating that predominar persist regarding natural fac water (refer to DWS 2022d, 2	The Na-Cl waters result fr I rainfall. Comparatively, t ula Aquifer. The more ac overlying plants, the disso the limited presence of b ers. ncentrations were observe hromium, and mercury. T ntly natural water quality of ctors such as acidic pH, of	om the deposition the EC and pH in t idic pH is attribute olution of CO ₂ (will asic ions (compar- ted for all parame the adjusted wate conditions prevail.	of marine aerosols he Nardouw Aquifer ad to the dissolution nich forms carbonic ed to the Peninsula ters except fluoride, r quality category is However, concerns	

²¹ Rainfall recharge value is from the first order GRAII Spatial Distribution (modified after CoCT, 2022).





		eenbras-Nuweberg											
GRU	Main Towns: Gr												
	Total Area (km ²)): 150.24											
	Groundwater Quality Component The groundwater quality component of the Reserve, detailed in the table below and described in Section 2.3 & 2.4, is determined as two components 1) the Groundwater Quality Reserv and 2) the Groundwater Quality Requirement for BHN.												
	Aquifer Unit	Parameter	Unit	No. BHs	No. Samples	Baseline Conc.	Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshold		
		pН		16	54	7.18	4.87	9.35	6.80	7.48	5 – 9		
		Electrical Conductivity	mS/m	16	58	14.00	2.47	38.00	13.00	14.30	150		
		Sodium as Na	mg/l	16	27	6.60	3.70	79.20	8.15	8.97	200		
	Fractured	Calcium as Ca	mg/l	16	57	2.78	0.50	50.10	5.20	5.72	150		
	Table	Magnesium as Mg	mg/l	16	38	1.83	0.20	7.60	1.30	1.83	70		
	Mountain	Chloride as Cl	mg/l	16	27	18.01	1.40	31.00	13.25	18.01	200		
	Group	Sulphate as SO4	mg/l	16	53	1.49	0.20	61.00	4.20	4.62	400		
	Aquifer	Nitrate + Nitrite	mg/l	16	38	1.05	0.00	1.20	0.10	1.05	10		
	(Peninsula)	Fluoride as F	mg/l	16	54	0.28	0.10	0.76	0.50	0.55	1.5		
		Ammonia as NH3	mg/l	16	58	0.12	0.00	12.00	0.10	0.12	-		
		Orthophosphate as PO4	mg/l	16	27	0.32	0.00	0.97	0.10	0.32	-		
		Potassium as K	mg/l	16	34	0.64	0.20	15.30	2.50	2.75	-		
						Baseline			Median	Groundwater	BHN		
Groundwater Reserve	Aquifer Unit	Parameter	Unit	No. BHs	No. Samples	Conc.	Min Conc.	Max Conc.	Conc.	Quality Reserve	Threshold		
Groundwater Reserve	Aquifer Unit	Parameter	Unit	No. BHs 16	No. Samples		Min Conc. 4.63	Max Conc. 8.61					
Groundwater Reserve	Aquifer Unit		Unit mS/m			Conc.			Conc.	Reserve	Threshold 5 – 9 150		
Groundwater Reserve	Aquifer Unit	pH		16	27	Conc. 5.91	4.63	8.61	Conc. 5.57	Reserve 6.13	Threshold 5 – 9		
Groundwater Reserve	Aquifer Unit	pH Electrical Conductivity	mS/m	<u> </u>	27 38 38 38 38	Conc. 5.91 10.00 11.13 5.10	4.63 2.00	8.61 24.20	Conc. 5.57 9.00	Reserve 6.13 10.00	Threshold 5 – 9 150 200 150		
Groundwater Reserve		pH Electrical Conductivity Sodium as Na	mS/m mg/l	16 16 16	27 38 38 38 38 27	Conc. 5.91 10.00 11.13	4.63 2.00 2.10	8.61 24.20 21.90	Conc. 5.57 9.00 9.30	Reserve 6.13 10.00 11.13	Threshold 5 - 9 150 200 150 70		
Groundwater Reserve	Fractured	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl	mS/m mg/l mg/l	16 16 16 16 16 16 16	27 38 38 38 27 34	Conc. 5.91 10.00 11.13 5.10 5.35 19.95	4.63 2.00 2.10 0.32 0.20 1.00	8.61 24.20 21.90 7.41 6.60 37.80	Conc. 5.57 9.00 9.30 1.00 1.10 17.00	Reserve 6.13 10.00 11.13 5.10 5.35 19.95	Threshold 5 - 9 150 200 150 70 200		
Groundwater Reserve	Fractured Table Mountain Group	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4	mS/m mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16	27 38 38 38 27 34 54	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50	4.63 2.00 2.10 0.32 0.20 1.00 0.40	8.61 24.20 21.90 7.41 6.60 37.80 17.70	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50	Threshold 5 - 9 150 200 150 200 400		
Groundwater Reserve	Fractured Table Mountain Group Aquifer	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite	mS/m mg/l mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16 16	27 38 38 38 27 34 54 61	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22	Threshold 5 - 9 150 200 150 200 400 10		
Groundwater Reserve	Fractured Table Mountain Group	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F	mS/m mg/l mg/l mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16 16 16 16	27 38 38 38 27 34 54 61 54	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20 0.50	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00 0.05	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66 0.50	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20 0.10	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22 0.50	Threshold 5 - 9 150 200 150 200 400 10 1.5		
Groundwater Reserve	Fractured Table Mountain Group Aquifer	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3	mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16 16 16 16 16	27 38 38 38 27 34 54 61 54 54 54 55	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20 0.50 2.88	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00 0.05 0.01	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66 0.50 12.22	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20 0.10 0.10	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22 0.50 2.88	Threshold 5 - 9 150 200 150 200 400 10		
Groundwater Reserve	Fractured Table Mountain Group Aquifer	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4	mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16 16 16 16 16 16	27 38 38 27 34 54 61 54 56 56 56	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20 0.50 2.88 0.20	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00 0.05 0.01 0.00	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66 0.50 12.22 0.20	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20 0.10 0.10	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22 0.50 2.88 0.20	Threshold 5 - 9 150 200 150 200 400 10 1.5 -		
Groundwater Reserve	Fractured Table Mountain Group Aquifer	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite	mS/m mg/l mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16 16	27 38 38 38 27 34 54 61	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22	Threshold 5 - 9 150 200 150 200 400 10		
Groundwater Reserve	Fractured Table Mountain Group Aquifer (Nardouw)	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K	mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l	16 16 16 16 16 16 16 16 16 16 16 16	27 38 38 38 27 34 54 61 54 54 54 55	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20 0.50 2.88	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00 0.05 0.01	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66 0.50 12.22	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20 0.10 0.10	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22 0.50 2.88	Threshold 5 - 9 150 200 150 200 400 10 1.5		
Groundwater Reserve	Fractured Table Mountain Group Aquifer (Nardouw) Groundwater Qu	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K uantity Component er quantity component of the	mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg	16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16	27 38 38 27 34 54 61 54 56 56 56 27	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20 0.50 2.88 0.20 1.00	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.00 0.05 0.01 0.00 0.09	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66 0.50 12.22 0.20 14.10	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20 0.10 0.10 0.10 0.93	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22 0.50 2.88 0.20 1.02	Threshold 5 - 9 150 200 150 200 400 10 1.5 - -		
Groundwater Reserve	Fractured Table Mountain Group Aquifer (Nardouw) Groundwater Qu	pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K uantity Component er quantity component of the HN Reserves.	mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg	16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16 16	27 38 38 38 27 34 54 61 54 54 56 56 27 below and descr	Conc. 5.91 10.00 11.13 5.10 5.35 19.95 6.50 0.20 0.50 2.88 0.20 1.00	4.63 2.00 2.10 0.32 0.20 1.00 0.40 0.40 0.00 0.05 0.01 0.00 0.09	8.61 24.20 21.90 7.41 6.60 37.80 17.70 3.66 0.50 12.22 0.20 14.10	Conc. 5.57 9.00 9.30 1.00 1.10 17.00 3.35 0.20 0.10 0.10 0.10 0.93	Reserve 6.13 10.00 11.13 5.10 5.35 19.95 6.50 0.22 0.50 2.88 0.20 1.02	Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - - -		

 ²² Rainfall recharge value is from the first order GRAII Spatial Distribution (modified after CoCT, 2022).
 ²³ Includes city municipal abstraction of 8 Mm³/a in development (phase 1) as per NWA Section 21(a).

	GRU Name: Ste	enhras-Nu	weberg				
GRU	Main Towns: Gr		weberg				
	Total Area (km ²)						
Future Scenario 2050 (Scenario 7b)	In Scenario 7b, factors directly in recharge from 5	which proje nfluenced t 8.76 to 57. mplementa	he parameters used 97 M m ³ /a, influence	to determine t ed by both clir development	he Groundwater F mate change and	Reserve, specificate the elimination o	(Mm*/a)
						BHN were strated	Indwater contribution to the EWR and a Management Option 1 for monitoring the groundwat tegically selected within the Steenbras-Nuweberg GRU (see Figure 3-8 and the table below Monitoring Description
1		1	-		1	EWR Manageme	
	H1A12	CoCT	Bvii22 & GRU	EWR (Nardouw Aquifer)	-34.15341755	18.93619208	Frequency: Quarterly 1) Groundwater level
	H2A1	CoCT	Bvii22 & GRU	EWR (Nardouw Aquifer)	-34.18480149	18.84681274	2) Groundwater Quality:
	H2A4	CoCT	Bvii22 & GRU	EWR (Peninsula Aquifer)	-34.18503396	18.84628454	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰:
Monitoring Programme	H3A2	CoCT	Bvii22 & GRU	EWR (Peninsula Aquifer)	-34.19704511	18.86919689	Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrica
	НЗАЗ	CoCT	Bvii22 & GRU	EWR (Nardouw Aquifer)	-34.19697736	18.86914539	
					-	BHN Manageme	
	H1A3b	CoCT	Bvii22 & GRU	BHN (Nardouw Aquifer)	-34.16604336	18.92808478	1) Groundwater level:
	H8A1_Ope	CoCT	Bvii22& GRU	BHN (Peninsula Aquifer)	-34.18547483	18.89892773	 Manual groundwater level measurements Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms
		•	•		•	•	



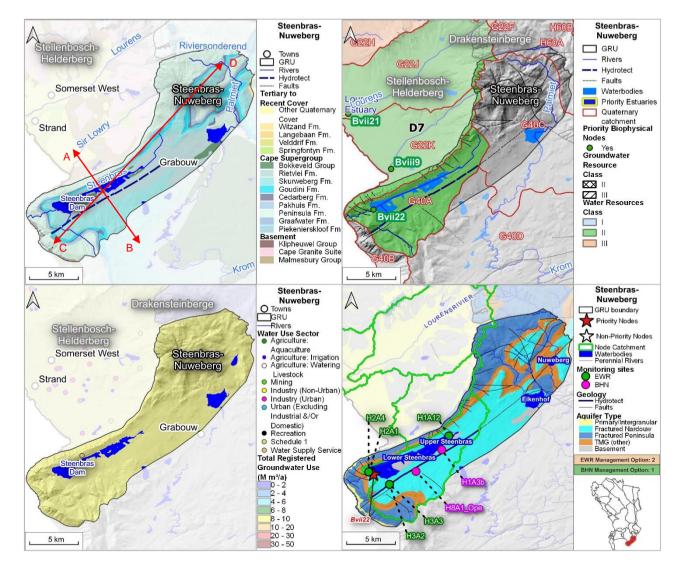


Figure 3-8 A series of maps for the Steenbras-Nuweberg GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2.3. Drakensteinberge GRU

	GRU Name: Drakensteinberge					
GRU	Main Towns: None					
	Total Area (km ²): 164.95					
GRU Boundary Description	The Drakensteinberge GRU is delimited by the T Lourens River in the southwest, contribute to the DWAF (2008a) and CoCT (2004) reports. Refer to	southern and southwestern boundaries	of the GRU. The southern extent is			
Quaternary Catchments	G10A, G10C, G22F, G22J, H60A and H60B (Fig	ure 3-9)				
Resource Unit		Fractured Table	Mountain Group Aquifer			
Description	The TMG Super aquifer in this area is composed Aquifer, which includes its component sub-aquife Sub-aquifer are recognized as the primary deep a In the southeastern part of this GRU, the Goudir situated as the western limb of a syncline. The N thickness of the Nardouw Aquifer can vary betwe	ers, measuring approximately 150 to 300 aquifer targets (refer to DWS, 2022d and ni, Skuwerberg, and minor sections of the ardouw Aquifer in this region is predomin	meters in thickness. Within this sup 2023a). • Rietvlei Fm, belonging to the Nar antly made up of the Skuwerberg F	douw Sub-group, are pre	eninsula Aquifer and the Skurwe	veberg ation is
Surface Water System	Tributaries of the Berg River, specifically the Wolv Berg River Dam, situated just east of the GRU, se				ms within this region. Additionall	lly, the
Water Resource Classes & RQOs	Only a portion of the GRU is located within the Ee area, specifically the former Berg WMA (2004). T The part of the GRU within the D6 IUA (catchmen Class of II. The GRU includes 1 priority biophysic	he segments of the GRU within the D6 and the G2F) is assigned a Groundwater Resolution Resolution and the second s	d D8 IUAs (catchments G10A and irce Class of III, and the portion with	G22F) have a Water Res	source Class of III and II, respec	ctively.
	D8 Upper Bergs II	G10A D8-R0		Bvii13	A 98	
Recharge	An estimated recharge of 27.6 M m ³ /a was detern the Aquifer Stress assessments. The average re- below and DWS (2022e) for further details. Method Map Centric Simulation Method					



	GRU Name: Drakensteinbe	erae							
GRU	Main Towns: None	orgo							
	Total Area (km ²): 164.95								
							N. (11		T . 111 (11 21)
					Water	r Use Sector	No. of Users		Total Volume (M m ³ /a)
Groundwater Use	In this GRU, there are 2				Agriculture: \	Watering Livestock	Fractured TMG Aquife	er	0.05
	Livestock) sector, collectiv	ely utilizing 0.05 M m ³ /a (see Figure 3-9 and the ta	ble on the		Total	2		0.05
	right).						_		0.00
Water Quality			Ν	lo water qual	ity data availal	<u>ble</u>			
Aquifer Stress	The GRU is considered to Category cannot be determ Recharge Volume	nined due to limited data av		-			tressed aquifer, and th		vater Quality Present Status water Quality Present Status
	(M m ³ /a)		M m ³ /a)	Stres	s Index		itus Category	Cround	Category
	27.6	X	0.05	(.00		A		-
Groundwater Reserve	Quality Component Groundwater Quantity Con The groundwater quantity of the EWR and BHN Reserv Recharge (Mm³/a) 27.6	component of the Reserve	_	v and describ GW Rese	it <u>y data availai</u> bed in Section rve (Mm³/a) .88			(Mm³/a)	ndwater contribution to both Still Allocable (Mm³/a) 24.67
Future Scenario 2050 (Scenario 7b)	factors directly influenced t recharge from 27.86 to 26.	the parameters used to det 86 M m ³ /a, influenced by be groundwater development	ermine the Groundwater Rooth climate change and the schemes in the area. Furth	eserve, spec elimination o ermore, the change from GW Rese	ifically the gro f IAPs. Additic groundwater c	undwater contributio onally, groundwater u contribution to the BH	n to the BHN and EWF ise increased from 0.05 N Reserve rose from 0 and the table below).	R. The scer 5 to 1.21 M 0.00 to 0.01 (Mm³/a)	arge and Water Use. These nario involved a decrease in m ³ /a due to sectoral growth M m ³ /a, primarily attributed Still Allocable (Mm ³ /a) 22.77



GRU	GRU Name: Dra Main Towns: No Total Area (km ²)	ne					
GRU Monitoring Programme	Main Towns: No Total Area (km ²) The Drakensteir	ne : 164.95 nberge GRU was	assigned a Ma f 3 monitoring si Monitoring Area Bvii13 Bviii1 Bviii1	nagement Option tes for the EWR Monitoring Objective EWR EWR	and 1 for the BH Latitude -33.95688 -33.90105 -33.9371	g the groundwat N were strategica Longitude EWR Management 19.07258 19.0503 19.0198 BHN Management	 Frequency: Quarterly 1) Groundwater level Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. 2) Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for EWR: NO2, NO3, NH4 Site specific additions as per RQO ²⁰: Bviii1: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN])); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen) Bvii13: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN])); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen) Option 1
	G1N0499	HYDSTRA	Bviii1	EWR			Bvii13: Nutrients (Phosphate [PO ₄ -P] and Total Inorganic Nitrogen [TIN])); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen)
	G1N0499	HYDSTRA	Bviii1	BHN	-33.9371	19.0198	 Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms

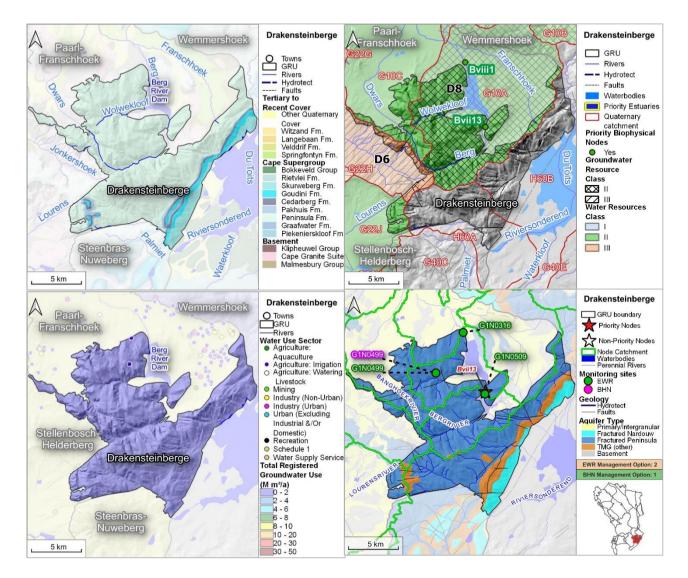


Figure 3-9 A series of maps for the Drakensteinberge GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2.4. Wemmershoek GRU

	Interstidek GIVO			
	GRU Name: Wemmershoek			
GRU	Main Towns: None			
	Total Area (km ²): 229.13			
GRU Boundary Description	The Wemmershoek GRU is defined by the exten along the Stettyns anticline to the east. To the n the La Motte fault and the basement aquitard (re	orth, the GRU is bounded by the Du Toits/Wel	lington fault, as indicated in the DWAF (2008a)	
Quaternary Catchments	G10B, G10A, G10C, H10J, H60B and H10K (Fig	ure 3-10)		
Resource Unit		Fractured Table Mour	ntain Group Aquifer	
Description	This GRU is predominantly defined by the Penins functions as an unconfined aquifer, transitioning metasediments. The contact between the Penin Cenozoic sediments extensively fill the valley, ov In the surrounding Wemmershoek valley, the G evident in the south-western section of the GRU, Within the valley, the basement rocks of the Malr the diverse and complex hydrogeological charact	to a confined aquifer at greater depths. The Pe sula Fm and the underlying basement is visi erlaying the basement geology (refer to Figure budini, Skuwerberg, and Rietvlei Formations, extending into portions of the north-east. The nesbury Group and the CGS are exposed, alo	eninsula Fm overlays the Malmesbury Group ar ble at the base of the mountain slopes and is e 3-10 and DWS, 2022d and 2023a). part of the Nardouw Sub-group, outcrop prom thickness of these formations ranges from appr ngside younger Cenozoic sediments that fill the	nd CGS basement, composed of granites and exposed in the valley. Additionally, younger ninently. This geological feature is particularly roximately 150 to 300 meters.
Surface Water System	Wemmershoek Dam, a component of the WCWS Drakenstein and Olifants rivers contribute to the			s, Holsloot, and Du Toits rivers. Moreover, the
Water Resource Classes & RQOs	Only a portion of the GRU is located within the segments of the RU within the D8 IUA (catchmer nor any priority biophysical nodes (Figure 3-10).	Upper Berg (D8) IUA, while the remaining pa ts G10A and G10B) have a Water Resource C	rt extends beyond the D8 IUA, as the GRU ex class of II and a Groundwater Resource Class o	apands outside of the Berg WMA (2004). The fII. The GRU does not include any EWR sites
Recharge	An estimated recharge of 26.83 M m ³ /a was det for the Aquifer Stress assessments. The average below and DWS (2022e) for further details. Method Map Centric Simulation Method			



	GRU Name: Wemmershoek			
GRU	Main Towns: None			
	Total Area (km ²): 229.13			
	In the Peninsula Aquifer RU, there are 11 registered groundwater users collectively utilizing	Water Use Secto		Total Volume (M m ³ /a)
	0.73 M m ³ /a of groundwater. The main sectors for groundwater use are Agriculture (Irrigation)	A grieviturev Irrigeti	Fractured TMG Aquifer (Pe	0.43
	and Agriculture (Aquaculture), contributing 58.9% and 41.1%, respectively, to the total annual	Agriculture: Irrigati	Fractured TMG Aquifer (N	
Groundwater Use	groundwater use volume.	Agriculture: Irrigati		0.01
	In the Nardouw Aquifer RU, there are 4 registered groundwater users collectively utilizing	Industry (Non-Urba		0.08
	0.09 M m ³ /a of groundwater. The predominant sector for groundwater use is Agriculture		Primary / Intergranular A	quifers
	(Irrigation), constituting 89% of the total annual groundwater use volume (see Figure 3-10	Agriculture: Aquacu		0.30
	and the table on the right).	Total	15	0.82
Water Quality	Key Wermershoek 1 C-4-KC0 type 2 Meet HC0 type 3 C-4-Ke-HC0 type 4 0 5 C-4-Ke-HC0 type 6 MeetHC0 type 7 MeetHC0 type 8 C 100 C </td <td>type waters arise from result from Na⁺ cation lithology. Exceedances of basel arsenic, lead, mangan that predominantly na</td> <td>n the dissolution of carbonate i exchange between Na-Cl type line concentrations were observ- uese, and mercury. The adjusted atural water quality conditions ors such as acidic pH and elev</td> <td>are Ca-HCO₃ and Ca-Mg-Cl. Ca- minerals, while Ca-Mg-Cl type w waters and Ca²⁺ and Mg²⁺ ions i ed for all parameters except diss water quality category is A, indic prevail. However, concerns p rated iron in the water (refer to D</td>	type waters arise from result from Na⁺ cation lithology. Exceedances of basel arsenic, lead, mangan that predominantly na	n the dissolution of carbonate i exchange between Na-Cl type line concentrations were observ- uese, and mercury. The adjusted atural water quality conditions ors such as acidic pH and elev	are Ca-HCO ₃ and Ca-Mg-Cl. Ca- minerals, while Ca-Mg-Cl type w waters and Ca ²⁺ and Mg ²⁺ ions i ed for all parameters except diss water quality category is A, indic prevail. However, concerns p rated iron in the water (refer to D
Aquifer Stress	Recharge Volume Groundwater Availability Present Status Category of 'A', inc Category of 'A' indicating unmodified, pristine conditions (see table below). Recharge Volume Groundwater Use Stress (M m³/a) (M m³/a) 0.82 0.00	Index	or slightly stressed aquifer, and Groundwater Availability Present Status Category	a Groundwater Quality Present St Adjusted Groundwater Quality Prese Status Category



	GRU Name: We	mmershoek										
GRU	Main Towns: No	ne										
	Total Area (km ²)	: 229.13										
	Groundwater Qu The groundwate and 2) the Grour	r quality compo	onent of the R	eserve, d t for BHN.	etailed in the table	below and descri	ped in Section 2	2.3 & 2.4, is dete	rmined as two	components 1) th	he Groundwater (Quality Reserve
	Aquifer Unit	Parame	eter	Unit	No. BHs	No. Samples	Baseline Conc.	Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshold
		pН			4	31	8.26	6.40	10.01	7.30	8.26	5 – 9
		Electrical Co		mS/m	4	31	9.27	4.66	16.00	8.10	9.27	150
		Sodium a	as Na	mg/l	4	26	10.44	2.20	11.00	5.75	10.44	200
	Fractured	Calcium a	as Ca	mg/l	4	28	4.39	0.20	10.83	3.15	4.39	150
	Table	Magnesium		mg/l	4	28	0.46	0.20	7.00	0.60	0.66	70
	Mountain	Chloride		mg/l	4	28	13.77	6.00	17.62	8.05	13.77	200
Groundwater Reserve	Group	Sulphate a		mg/l	4	19	3.45	0.20	20.90	0.72	3.45	400
Gloundwater Reserve	Aquifer	Nitrate + I		mg/l	4	24	0.53	0.00	1.27	0.02	0.53	10
	(Peninsula)	Fluoride		mg/l	4	4	0.16	0.05	0.39	0.11	0.16	1.5
		Ammonia a		mg/l	4	28	0.45	0.01	0.66	0.05	0.45	-
		Orthophospha Potassium		mg/l mg/l	4	22 20	0.05 8.20	0.00 0.10	0.43 8.43	0.02	0.05 8.20	-
	the EWR and BH Recharge (N		EWR Reserve (I	/lm³/a)	BHN Reserve (Mm	³ /a) GW Re	serve (Mm³/a)	Total Allocabl		Water Use (Mm ³ /a	a) Still Allo	cable (Mm ³ /a)
				init / d/	,		. ,	(Mm ³ /			· · · · · · · · · · · · · · · · · · ·	. ,
	26.83		3.59		0.00		3.59	23.24		0.82		22.43
Future Scenario 2050	factors directly in recharge from 26	nfluenced the p 5.83 to 25.60 M	barameters us 1 m³/a, influen	ed to dete	2050 and consider ermine the Groundw th climate change a cchemes in the area	ater Reserve, spend	ecifically the gro of IAPs. Addition	oundwater contril onally, groundwa	oution to the BH ter use increas	IN and EWR. Th ed from 0.81 to 1	e scenario involve .56 M m ³ /a due to	ed a decrease i sectoral growt

	GRU Name: We												
GRU	Main Towns: No												
	Total Area (km ²)	: 229.13											
	The Wemmershi contribution to th Site Name	oek GRU was e BHN. A tota Data Source	assigned a Ma of 3 monitoring Monitoring Area	anagement Opt sites for the EV Monitoring Objective	ion 2 for monitori WR and 1 for the Latitude	ing the groundv BHN were strat	vater contribution to the EWR and a Management Option 1 for monitoring the groundwater egically selected within the Wemmershoek GRU (see Figure 3-10 and the table below). Monitoring Description						
	EWR Management Option 2												
	Proposed BH		Biii2	EWR	-33.83659818	19.11174645	Frequency: Quarterly 1) Groundwater level:						
	G1N0500	HYDSTRA	Biii2	EWR	-33.8466	19.0493	 Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. Groundwater Quality: 						
Monitoring Programme	G1N0501	HYDSTRA	Biii2	EWR	-33.81001	19.07955	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, CI, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄ 						
		BHN Management Option 1											
	W7D1	CoCT	GRU	BHN	-33.81629	19.06087	 Frequency: Quarterly or Biannual (Summer & Winter): Groundwater level: Manual groundwater level measurements Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 						



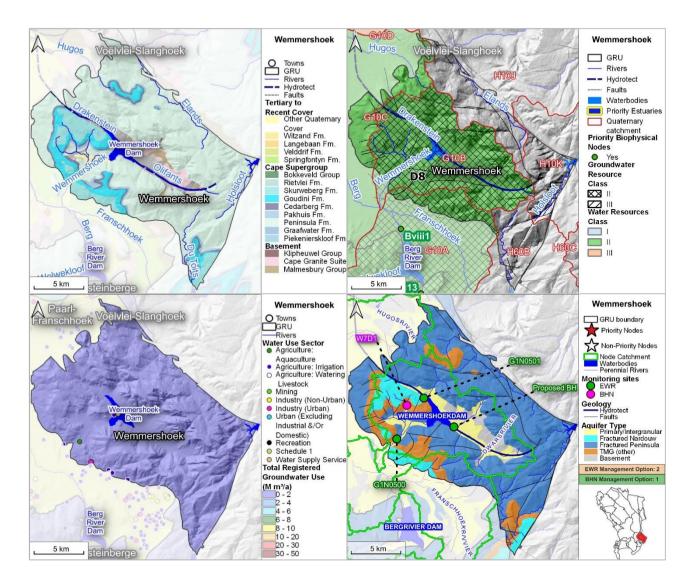


Figure 3-10 A series of maps for the Wemmershoek GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2.5. Voëlvlei-Slanghoek GRU

GRU	GRU Name: Voëlvlei-Slanghoek Main Towns: None					
	Total Area (km ²): 184.26					
GRU Boundary Description	The Voëlvlei-Slanghoek GRU is constrained by t the western and eastern/north-eastern edges of fringe is demarcated by the Stettyns and Koue B	the GRU. To the north, the GRU is sepa	rated from the Groot Winte	erhoek GRU by the Roode	zandspas Fault. The	e eastern/south-eastern
Quaternary Catchments	G10E, G10J, G10D, G10F, H10E, H10F and H1	0J (Figure 3-11)				
Resource Unit		Fractured Table N	Iountain Group Aquifer			
Description	The TMG Super aquifer within this GRU is prim within the GRU, with an average thickness rang between these formations is visible at the base of The Goudini, Skuwerberg, and Rietvlei Formati Skuwerberg and Rietvlei Formations, with an a hydrogeological characteristics of the GRU, influ	ging from approximately 600 to 1500 meter of the mountain slopes. This contact is furth ions, part of the Nardouw Sub-group, are average thickness of approximately 200 to	rs. The Peninsula Aquifer er exposed in the valley of also present along the s 300 meters and 150 to 2	overlies the Malmesbury on the eastern edge of the of lopes of this GRU. Within 200 meters, respectively.	Group and CGS bas GRU (Figure 3-11).	sement, and the contact
Surface Water System	The GRU is located immediately to the west of the from the reservoir, sourced from a weir located in	ne Voëlvlei Dam, which stands as the seco n the Nuewkloof Pass on the Klein Berg Ri	nd-largest reservoir in the ver (refer to Figure 3-11 a	WCWSS. This area encon nd DWS, 2022d and 2023	npasses a canal des a).	igned to distribute water
Water Resource Classes & RQOs	Only a portion of the GRU is located within the Mexpands outside of the Berg catchment area, sp Resource Class of III, and the portions within the Resource Class designation. This site includes 1	ecifically the former Berg WMA (2004). Th C5 IUA have a Water Resource Class of II,	e segments of the GRU wi with a corresponding Grou	thin the D9 and B4 IUAs (ndwater Resource Class o	catchments G10D a f II. The rest of the GI	nd G10F) have a Water
Recharge	An estimated recharge of 14.1 M m ³ /a was deter the Aquifer Stress assessments. The average re below and DWS (2022e) for further details. Method Map Centric Simulation Method			volume	available in the litera Average Re (mr	



	GRU Name: Voëlvlei-Slan	nhoek						
GRU	Main Towns: None	gnook						
ente	Total Area (km ²): 184.26							
	In the Peninsula Aquifer R	U. there are 3 registered	aroundwater users collecti	velv utilizina	Water Use Sector	No. of Users	Total Vo	olume (M m ³ /a)
	0.14 M m ³ /a of groundwa	ater (see Figure 3-11 and	the table on the right).	The primary		Fractured TMG Aquif		
Groundwater Use	groundwater use sectors i				Agriculture: Irrigation	2		0.04
	(Irrigation), contributing 73	.1% and 26.9%, respective	ely, to the total annual grou	ndwater use A	griculture: Watering Livestock			0.10
	volume.				Total	3		0.14
Water Quality			٨	lo water quality dat	a available			
Aquifer Stress	The GRU is considered to Category cannot be detern Recharge Volume (M m ³ /a)	nined due to limited data a	vailability (see table below) ndwater Use M m³/a)	Stress Inde	Groundw	y stressed aquifer, and the rater Availability Present Status Category	Groundwater Qual Cate	lity Present Status gory
	14.1		0.14	0.01		А	N/	/A
Groundwater Reserve	Quality Component Groundwater Quantity Cor The groundwater quantity the EWR and BHN Reserv Recharge (Mm³/a) 14.1	component of the Reserve		lo water quality dat v and described in GW Reserve (M 1.63	Section 2.3 & 2.4, is calcu	, ,		Contribution to both Allocable (Mm ³ /a) 12.34
Future Scenario 2050 (Scenario 7b)	In Scenario 7b, which proj factors directly influenced to recharge from 14.1 to 12.8 and the implementation of below). Recharge (Mm³/a) 12.87	the parameters used to det 7 M m 3 /a, influenced by bo	ermine the Groundwater R th climate change and the	eserve, specifically elimination of IAPs	y the groundwater contribu Additionally, groundwater the Allocation Category di	tion to the BHN and EWR ruse increased from 0.13 d not change from catego	t. The scenario invo to 0.31 M m³/a due ry B (refer to Sectio	olved a decrease in e to sectoral growth



GRU	GRU Name: Voël Main Towns: Non	e	ek				
Monitoring Programme	Total Area (km²): The Voëlvlei-Slar contribution to the Site Name 3319AC00039	nghoek GRU	was assigned a l of 1 monitoring <u>Monitoring</u> <u>Area</u> Biii4	Management C sites for the EV Monitoring Objective	Option 2 for monit VR and 1 for the Latitude	Oring the groun BHN were strat	dwater contribution to the EWR and a Management Option 1 for monitoring the groundwater egically selected within the Voëlvlei-Slanghoek GRU (see Figure 3-11 and the table below). <u>Monitoring Description</u> <u>ment Option 2</u> Frequency: Quarterly 1) Groundwater level: • Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. 2) Groundwater Quality: • Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 • Site specific additions for EWR: NO2, NO3, NH4 • Site specific additions as per RQO ²⁰ : Biil4: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical
							Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen); Toxins (Ammonia, Atrazine, Endusulfan)
				-		BHN Managen	
	3319AC00040	NGA	Biv3	BHN	-33.28911	19.06541	 Frequency: Quarterly or Biannual (Summer & Winter): Groundwater level: Manual groundwater level measurements Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms



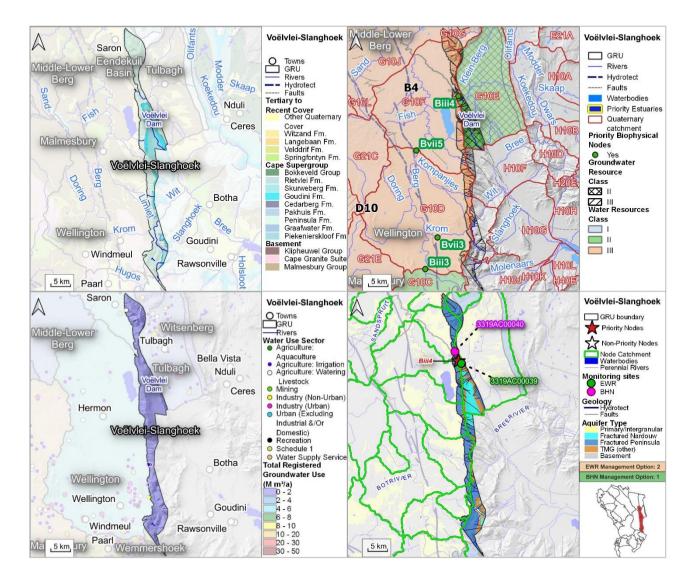


Figure 3-11 A series of maps for the Voëlvlei-Slanghoek GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2.6. Witzenberg GRU

•									
	GRU Name: Witzenberg								
GRU	Main Towns: None								
	Total Area (km ²): 39.95								
GRU Boundary Description	The Witzenberg GRU is defined by the wester	boundaries are determined by the extent of th		ntact with basement lithologies, specifically the on of the GRU is bounded by the G10G surface					
Quaternary Catchments	G10E (Figure 3-12)	G10E (Figure 3-12)							
Resource Unit		Fractured Table Mou	Intain Group Aquifer						
Description	The Peninsula Fm, characterized by thickly bedded quartzites, stands as the predominant geological feature in the mountains of the GRU. Functioning as an unconfined aquifer, the thickness of the Peninsula Fm varies within the range of approximately 550 to 1500 meters. The properties of the Peninsula Fm play a pivotal role in shaping the hydrogeology and groundwater dynamics of the GRU (refer to Figure 3-12 and DWS, 2022d and 2023a). Within this GRU, components of the Nardouw Sub-group, namely the Goudini, Skuwerberg, and Rietvlei Formations, are present. The aquifers within these formations include the Skuwerberg and Rietvlei Fm, with an average thickness of approximately 200 to 300 meters and 150 to 200 meters, respectively. These geological features contribute significantly to the hydrogeological characteristics of the GRU, impacting groundwater storage and flow dynamics (refer to DWS, 2022d and 2023a).								
Surface Water System	There are no major surface water systems in this RU except for a tributary of the Klein-Berg River (refer to Figure 3-12 and DWS, 2022d and 2023a).								
Water Resource Classes & RQOs	The GRU falls entirely within the Berg Tributaries (C5) IUA and is assigned a Water Resource Class of II and a Groundwater Resource Class of II. There are no EWR sites nor any priority biophysical nodes (Figure 3-12).								
Recharge	An estimated recharge of 2.78 M m ³ /a was determined from first-order recharge calculations using the Map-Centric Simulation method and was chosen as the estimated recharge value for the Aquifer Stress assessments. The average recharge rate is 69.59 mm/a based on the total GRU area. Additional recharge estimations are available in the literature. Refer to the tab below and DWS (2022e) for further details. Method Area (km ²) Recharge Volume (M m ³ /a) Average Recharge Rate (M m ³ /a) Map Centric Simulation Method 39.95 2.78 69.59								
Groundwater Use	In this GRU, there are 3 registered groundwate groundwater. The primary groundwater use sect (Irrigation), constituting 100% of the total annua and the table on the right).	ors are Agriculture (Watering) and Agriculture		of Users Total Volume (M m³/a) TMG Aquifer 3 0.08 3 0.08					



GRU	GRU Name: Witzenberg Main Towns: None											
GRU	Total Area (km ²): 39.95											
Motor Quality												
Water Quality			<u>^</u>	lo water quality data availal	<u>ble</u>							
	The CPI Lie considered to have a Croundwater Availability Present Status Category of 'A' indicating on unstragged or slightly stragged equifer, and the Croundwater Quality Present Status											
	The GRU is considered to have a Groundwater Availability Present Status Category of 'A', indicating an unstressed or slightly stressed aquifer, and the Groundwater Quality Present Status cannot be determined due to limited data availability (see table below).											
Aquifer Stress												
Aquiler Stress	Recharge Volume	Grou	ndwater Use	Stress Index	Groundwater Availa		dwater Quality Present Status					
	(M m ³ /a) 2.78	((M m ³ /a) 0.08	0.03	Status Cate	gory	Category N/A					
	2.78		0.08	0.03	A		N/A					
	Quality Component											
	No water quality data available											
	No water quality data available											
	Groundwater Quantity Con	nponent										
Groundwater Reserve	The groundwater quantity component of the Reserve, detailed in the table below and described in Section 2.3 & 2.4, is calculated by considering the total groundwater contribution to both											
	the EWR and BHN Reserve	es.										
			1		Total Allocable Volume							
	Recharge (Mm ³ /a)	EWR Reserve (Mm ³ /a)	BHN Reserve (Mm ³ /a)	GW Reserve (Mm ³ /a)	(Mm ³ /a)	Water Use (Mm ³ /a)	Still Allocable (Mm ³ /a)					
	2.78	0.18	0.00	0.18	2.60	0.08	2.52					
	In Sconaria 7h, which proje	acts conditions for the ves	ar 2050 and considers the	'Most Likely Cose' for the (CPUL the analysis focused (on two koy factors: Pack	narge and Water Use. These					
	factors directly influenced t	the parameters used to det	ermine the Groundwater R	eserve specifically the group	undwater contribution to the	BHN and FWR The sce	enario involved a decrease in					
	recharge from 2.78 to 2.60	$M \text{ m}^{3}/\text{a}$, influenced by bot	h climate change and the ϵ	elimination of IAPs. Addition	ally, groundwater use increa	ased from 0.08 to 0.16 N	$1 \text{ m}^3/\text{a}$ due to sectoral growth					
Future Scenario 2050							r to Section 2.5 and the table					
(Scenario 7b)	below).											
					Total Allocable Volume							
	Recharge (Mm ³ /a)	EWR Reserve (Mm ³ /a)	BHN Reserve (Mm ³ /a)	GW Reserve (Mm ³ /a)	(Mm ³ /a)	Water Use (Mm ³ /a)	Still Allocable (Mm ³ /a)					
	2.60	0.18	0.00	0.18	2.42	0.16	2.26					



	GRU Name: Witz	zenberg										
GRU	Main Towns: Nor	ne										
	Total Area (km ²):	39.95										
	The Witzenberg (to the BHN. A tot	GRU was assigr al of 1 monitorir	ng sites for the E	EWR and 1 for t	monitoring the he BHN were s	groundwater co trategically sele	ntribution to the EWR and a Management Option 1 for monitoring the groundwater contribution cted within the Witzenberg GRU (see Figure 3-12 and the table below).					
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description					
		EWR Management Option 1										
Monitoring Programme	3319AC00012	NGA	Biii4	EWR	-33.358	19.24152	 Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: Manual groundwater level measurements 2) Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for EWR: NO2, NO3, NH4 Site specific additions as per RQO ²⁰: Biii4: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature, pH, Dissolved Oxygen); Toxins (Atrazine and Endusulfan). 					
						BHN Managen						
	3319AC00012	NGA	Biii4	BHN	-33.358	19.24152	 Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: Manual groundwater level measurements 2) Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 					



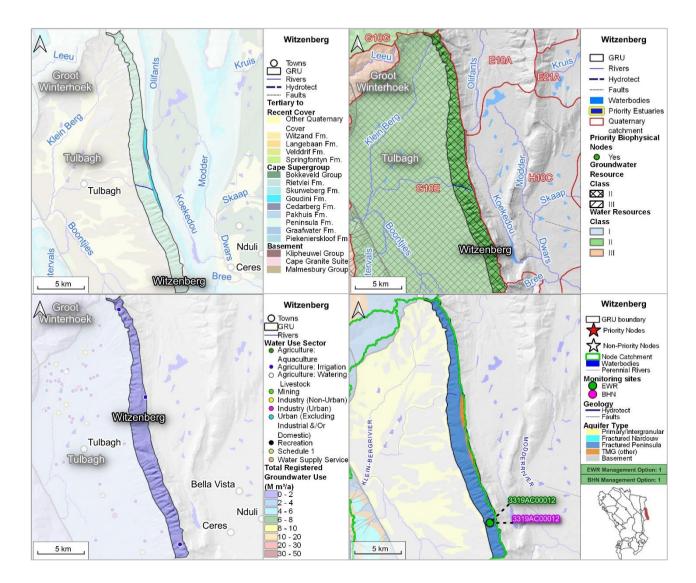


Figure 3-12 A series of maps for the Witzenberg GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2.7. Groot Winterhoek GRU

	GRU Name: Groot Winterhoek							
GRU	Main Towns: None							
	Total Area (km ²): 379.26							
GRU Boundary Description	The Groot Winterhoek GRU is delineated by the extent of the TMG and its contact with basement lithologies, specifically the Malmesbury Group on its western flank. The southern boundary, and its demarcation from the Voëlvlei-Slanghoek and Witzenberg GRUs, is defined by the Roodezandspas Fault line, the contact with the Malmesbury Group basement, and segments of the G10G surface water quaternary catchment divide. The north-eastern edge of the GRU is marked by sections of the E10C surface water quaternary catchment divide and the extent of the Berg catchment (refer to Figure 3-13 and DWS, 2022d and 2023a).							
Quaternary Catchments	G10J, G10E, G10H, E10C and G10G (Figure 3-13)							
Resource Unit	Fractured Table Mountain Group Aquifer							
Description	In the Groot Winterhoek region, the TMG has undergone folding, creating a syncline. This geological process has resulted in the exposure of the Peninsula Fm, comprising thickly bedded, super-mature quartzite, and quartz sandstones. The Peninsula Fm is prominently visible in the steep limbs to the east and west of the GRU. Within this specific area, the thickness of the Peninsula Fm ranges from approximately 600 to 1000 meters. The syncline structure and the distinct characteristics of the Peninsula Fm play a significant role in shaping the hydrogeological features of the Groot Winterhoek GRU (refer to DWS, 2022d and 2023a). Centrally located within the syncline are the Goudini, Skuwerberg, and Rietvlei Formations, belonging to the Nardouw Sub-group and having a thickness ranging from 150 to 300 meters. The Groot-Kliphuis River closely follows the axis of the syncline. Within these formations, the aquifers include the Skuwerberg, characterized by thickly bedded quartzite, and the Rietvlei, composed of feldspathic sandstone with minor shales. The geological features within the syncline, especially these aquifer formations, play a crucial role in influencing the hydrogeology and groundwater dynamics in the area (refer to DWS, 2022d and 2023a).							
Surface Water System	The Olifants River, originating from the northern extent of the Groot Winterhoek GRU, is composed of several tributaries such as the Klein Kliphuis River and the Vier-en-Twintig River. The principal surface water system in this GRU is the Olifants River itself, which flows directly through the northern and northeastern edges of the GRU. The course of most surface water features in the area follows the general topography of the Groot Drakenstein Mountains (refer to Figure 3-13 and DWS, 2022d and 2023a).							
Water Resource Classes & RQOs	Only a portion of the GRU is located within the Berg Tributaries (C5) and the Lower Berg (B4) IUAs, while the remaining part extends beyond the IUAs, as the GRU expands outside of Berg catchment area, specifically the former Berg WMA (2004). The segments of the RU within the B4 IUA (catchments G10H and G10J) have a Water Resource Class of II, and portions of the GRU within the C5 IUA (catchment G10G and G10E) have a Water Resource Class of II. The segments of the GRU within the B4 IUA (catchment G10H) have a Groundw Resource Class of II, and the portions within the C5 IUA (catchment G10E) have a Water Resource Class of II. This site includes 1 priority biophysical site – the Vier-en-twintig I node with a TEC of B/C (see Figure 3-13 and the table below). IUA Water Resource Class Quaternary Catchment RU Resource Name Biophysical Node TEC nMAR C5 Berg Tributaries's II G10G C5-R08 Vier-en-Twintig Bi1 B/C 23	nd the water						



	GRU Name: Groot Winterhoek								
GRU	Main Towns: None								
	Total Area (km ²): 379.26								
Recharge	An estimated recharge of 22.5 M m ³ /a was de the Aquifer Stress assessments (see table be Refer to DWS (2022e) for further details. Method Map Centric Simulation Method	termined from first-order recharg low). The average recharge rate Area (km ²) 379.26	e calculations usi e is 59.33 mm/a b	ased on the total	ric Simulation me I GRU area. Add harge Volume (M m ³ /a) 22.5	ethod and was chose litional recharge esti	mations a	e Recharge Rate (mm/a) 59.33	
Groundwater Use	In the Peninsula Aquifer RU, there are 4 regis 0.19 (M m ³ /a) of groundwater.	stered groundwater users, collec	ctively utilizing	Water Use : Agriculture: In Industry (Non	Frac	No. of Users ctured TMG Aquifer (Pe 3 1	Aquifer (Peninsula) 3 0.18		
	In the Nardouw Aquifer RU, there are 7 reg groundwater use of 0.21 M m ³ /a. The prima Agriculture (Irrigation). Refer to Figure 3-13 and	ary groundwater use sector in	h a combined this region is	Agriculture: In Total	Fra	actured TMG Aquifer (Na 7 11	ardouw)	1.21 1.39	
Water Quality	No water quality data available								
Aquifer Stress	The GRU is considered to have a Groundwate cannot be determined due to limited data avail Recharge Volume (M m³/a) 22.50	r Availability Present Status Catalability (see table below). Groundwater Use (M m³/a) 1.39	egory of 'B', indica Stress In 0.06	-	Groundwater	essed aquifer, and th Availability Present s Category B		vater Quality Present Status water Quality Present Status Category N/A	
Groundwater Reserve	Quality Component Groundwater Quantity Component The groundwater quantity component of the R the EWR and BHN Reserves. Recharge (Mm³/a) EWR Reserve (Mr 22.5 0.77	eserve, detailed in the table belo	<u>No water quality o</u> ow and described GW Reserve 0.79	in Section 2.3 &	2.4, is calculated tal Allocable Volum (Mm¾a) 21.71	· · ·	[Mm³/a)	ndwater contribution to both Still Allocable (Mm³/a) 20.32	



	GRU Name: Gro	at Winterbook									
GRU	Main Towns: Nor										
	Total Area (km ²):										
Future Scenario 2050 (Scenario 7b)	In Scenario 7b, v factors directly in recharge from 22 and the impleme	which projects fluenced the pa 2.5 to 20.11 M r ntation of grour wth. Under the	arameters used to n ³ /a, influenced b ndwater developm	a) BHN Res	Groundwater Re hange and the el the area. Furthe	serve, specifically imination of IAPs rmore, the groun	y the groun s. Additiona idwater con ry B (refer t	ndwater contribution to the ally, groundwater use incre	BHN and EWR. The scer eased from 1.39 to 3.27 M erve rose from 0.02 to 0.03	arge and Water Use. These nario involved a decrease in m ³ /a due to sectoral growth M m ³ /a, primarily attributed Still Allocable (Mm ³ /a) 16.04	
	The Groot Winte contribution to th	rhoek GRU wa e BHN. A total	of 2 monitoring si	tes for the EWR	on 1 for monitorin and 1 for the Bl	ng the groundwa HN were strategio	ter contribu cally selecte	ution to the EWR and a M ed within the Groot Winter	lanagement Option 1 for r rhoek GRU (see Figure 3 -	monitoring the groundwater 13 and the table below).	
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude		N	Ionitoring Description		
						EWR Management	t Option 1				
	Proposed BH		Bi1	EWR	-33.13404333	19.06101774	Frequency 1) 2)	 Manual groundwater level measurements 			
Monitoring Programme	3219CC00015	NGA	Bi1	EWR	-32.98054	19.07122	 Site specific additions as per RQO ²⁰: Bi1: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [T (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System (Temperature, pH, Dissolved Oxygen) 				
						BHN Management	t Option 1				
	3219CC00015	NGA	Bi1	BHN	-32.98054	19.07122	Frequency 1) 2)	Groundwater Quality (Back o Standard Parameters:	mer & Winter): r level measurements ground water quality and BHN pH, EC, Ca, Mg, Na, K, Palk, for BHN (microbiological): E ca	MAIK, F, CI, PO4, SO4	



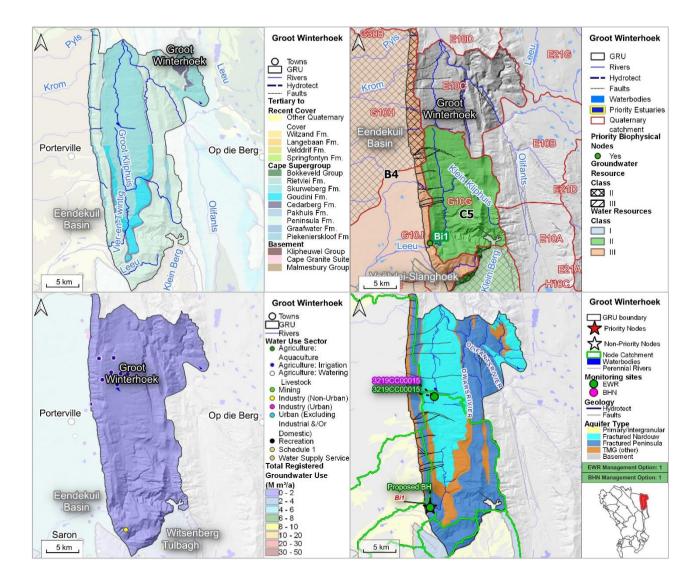


Figure 3-13 A series of maps for the Groot Winterhoek GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.2.8. Piketberg GRU

	GRU Name: Piketberg						
GRU	Main Towns: Goedwerwacht						
	Total Area (km ²): 298.29						
GRU Boundary Description	The Piketberg GRU is entirely defined by the e determined by the contact with the surrounding Piketberg fault zone (refer to Figure 3-14 and D	basement lithologies, specifically the Malmest	of the Peninsula, Rietvlei, Cederberg, Graafwat bury Group. The south/south-western edge of th				
Quaternary Catchments	G10M, G30D, G10K, G30A and G10H (Figure	3-14)					
Resource Unit		Fractured Table Mour	ntain Group Aquifer				
Description		asement itself is situated at the base of the mo st side of the Piketberg GRU, with only minor f on the mountain slopes, covering the TMG and d by the Rietvlei Fm, part of the Nardouw Sub-g ncline. In addition to the Rietvlei Fm, flat areas a	untain on the eastern side, outside the boundari- low occurring into screes and weathered zones basement to the northwest of the GRU (refer to roup. This Fm, consisting of feldspathic sandstor and screes on the mountain slopes are overlain b	es of this GRU. This basement acts as a no- s of the Malmesbury Group. Additionally, the DWS, 2022d and 2023a). ne with minor shales and approximately 150- by the Sandveld Group. The Sandveld Group			
Surface Water System	The primary surface water systems in this area are the Boesmans and Platkloof Rivers. Surface-water flow is observed originating from the elevated Piketberg Mountains of the TMG outcrop (refer to Figure 3-14 and DWS, 2022d and 2023a).						
Water Resource Classes & RQOs	Only a portion of the GRU is situated within the Lower Berg (B4) and the Berg Estuary (A1) IUAs, while the remaining part extends beyond the IUAs, as the GRU expands outside of the Berg catchment area. The segments of the RU within the B4 IUA (catchments G10K and G10H) have a Water Resource Class of III, and the portions within the A1 IUA (catchment G10M) have a Water Resource Class of II. The segments of the GRU within the B4 IUA (catchment G10H) lack a Groundwater Resource Class (except for the small portion within catchment G10H, which has a Groundwater Resource Class of II), and the portions within catchment G10M have a Groundwater Resource Class of II. This GRU does not contain any EWR sites nor any priority biophysical nodes (Figure 3-14).						
Recharge	An estimated recharge of 20.33 M m ³ /a was de for the Aquifer Stress assessments. The averag below and DWS (2022e) for further details. Method Map Centric Simulation Method						



	GRU Name: Piketberg								
GRU	Main Towns: Goedwerwacht								
	Total Area (km ²): 298.29								
	region is Agriculture (Irrigation) m ³ /a of groundwater (Figure 3), accounting for 97.5% -14). The primary grou	of the total annual grour	dwater use volume. In the Na s region is Agriculture (Irrigati	ardouw RU, there are 6 reg	istered groundwater us he total annual ground			
	Water U	Jse Sector		No. of Users Fractured TMG Aquifer (Peninsu		Total Volume (M m ³ /a)			
	Agricultur	re: Irrigation		41	lia)	5.0	12		
Groundwater Use		Non-Urban)		2		0.0			
		pply Service		3		0.0)7		
				Fractured TMG Aquifer (Nardour	w)				
	Agricultur	re: Irrigation		5		0.4	14		
	A grieviltur	re: Irrigotion		Primary / Intergranular Aquifers	S	0.0	02		
		re: Irrigation		46		5.5	-		
		Uldi		40		J.(00		
Water Quality		No water quality data available							
Aquifer Stress	The GRU is considered to have determined due to limited data Recharge Volume (M m ³ /a) 20.33	a availability (see table t		egory of 'C', indicating a mod Stress Index 0.27	derately stressed aquifer, an Groundwater Availa Status Cate C				
Groundwater Reserve	Quality Component Groundwater Quantity Compor The groundwater quantity com the EWR and BHN Reserves. Recharge (Mm³/a)		detailed in the table bel BHN Reserve (Mm³/a) 0.04	<u>No water quality data availal</u> ow and described in Section GW Reserve (Mm³/a) 2.11		considering the total g Water Use (Mm³/a) 5.58	roundwater contribution to both Still Allocable (Mm³/a) 12.64		



GRU	GRU Name: Pike Main Towns: Goe Total Area (km ²):	edwerwacht									
Future Scenario 2050 (Scenario 7b)	factors directly in recharge from 20 and the implement	fluenced the p .33 to 19.02 M ntation of grou	arameters used I m ³ /a, influence ndwater develo	I to determine t d by both clima pment schemes	he Groundwater I ite change and the s in the area. Furt	Reserve, specific e elimination of I hermore, the gro	cally the gro APs. Additi oundwater	GRU, the analysis focused o oundwater contribution to the ionally, groundwater use incre contribution to the BHN Reser on 2.5 and the table below).	BHN and EWR. The scenased from 5.58 to 9.80 M	nario involved a decrease in m ³ /a due to sectoral growth	
	Recharge (M	m³/a) E	WR Reserve (Mn	n³/a) BHN	Reserve (Mm ³ /a)	GW Reserv	e (Mm³/a)	Total Allocable Volume (Mm ³ /a)	Water Use (Mm ³ /a)	Still Allocable (Mm ³ /a)	
	19.02		2.07		0.06	2.1	3	16.89	9.80	7.09	
	to the BHN. A tot	al of 3 monitor	Monitoring Area Biv2	EWR and 1 fo Monitoring Objective	r the BHN were s	trategically select Longitude EWR Managen	nent Option 3	hin the Piketberg GRU (see Figure 3-14 and the table below). Monitoring Description on 3 ency: Monthly or Quarterly			
Marining	3218DC00011	NGA	Biv2 Biv2	EWR	-32.80305	18.68729	1) 2)	Groundwater level: • Manual water level measurements and continuous hourly r automatically recorded level loggers. Possible need for tele		ed for telemetry systems.	
Monitoring Programme	G1N0404	HYDSTRA	Biv2	EWR	-32.72257	18.5704				,,.,.,.,.,.,.,	
						BHN Managem	nent Option 1	1			
	3218DA00006	NGA	GRU	BHN	-32.6961	18.53395	 Frequency: Quarterly or Biannual (Summer & Winter) Groundwater level: Manual groundwater level measurements Groundwater Quality (Background water quality and BHN): 			alk, MAlk, F, Cl, PO4, SO4 E coli, Total Coliforms,	



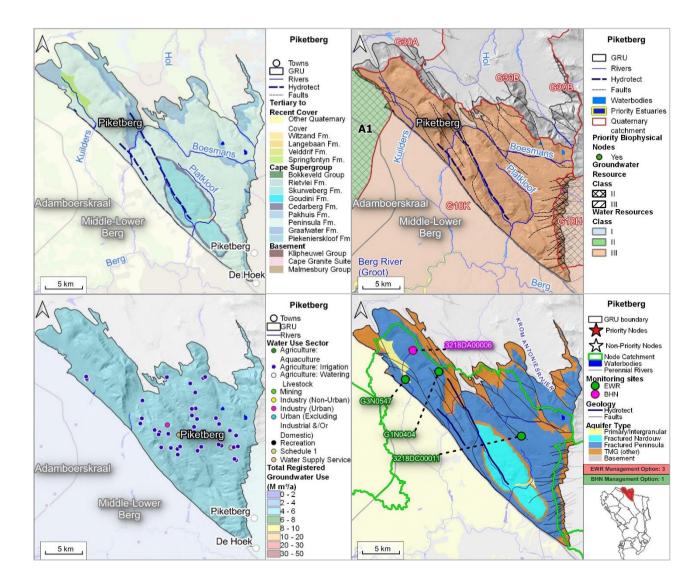


Figure 3-14 A series of maps for the Piketberg GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3. Fractured and Intergranular Basement GRUs

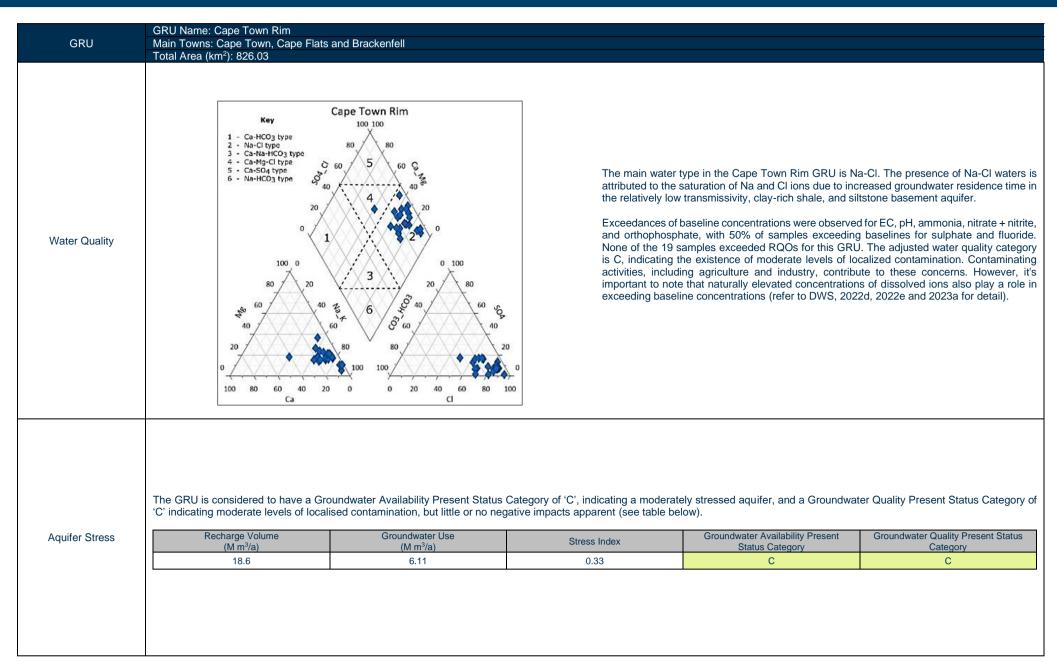
3.3.1. Cape Town Rim GRU

	GRU Name: Cape Town Rim
GRU	Main Towns: Cape Town, Cape Flats and Brackenfell
	Total Area (km ²): 826.03
GRU Boundary Description	The northern and eastern edges of the Cape Town Rim GRU are defined by portions of the G21F, G21E, G22H, and G22G surface water quaternary catchment divides. The boundary between the Cape Town Rim GRU and the Cape Peninsula GRU is established by the extent of basement lithologies, namely the CGS and the Malmesbury Group, along with their contact with the Table TMG rocks. Quaternary catchments were utilized due to the tendency of groundwater flow to align with topography. The western/north-western fringe of the GRU is bordered by the Table Bay and False Bay coastlines (refer to Figure 3-15 ; DWS, 2022d and 2023a).
Quaternary Catchments	G22C, G22E, G22B and G22D (Figure 3-15)
Resource Unit	Fractured and Intergranular Basement Aquifer
Description	The Cape Town Rim's Basement underlies, as illustrated in the cross-section of the CFA, and surrounds the Cape Flats GRU. The basement geology is composed of Neoproterozoic rocks belonging to the Tygerberg Fm (Malmesbury Group), intruded by the late Neoproterozoic to early Cambrian CGS. The Tygerberg Fm constitutes a relatively uniform succession of deepwater, turbiditic meta-sediments and shale that has undergone Fm into simple folds, typically displaying high weathering characteristics (refer to Figure 3-15 and DWS, 2022d and 2023a).
Surface Water System	The main rivers in the area include the Kuils, Lotus, Liesbeek, and Elsieskraal rivers. It's important to note that the majority of these rivers are situated on the CFA, which overlays the basement rocks in this area (refer to Figure 3-15 and DWS, 2022d and 2023a).



	GRU Name: Cape Town Rim										
GRU	Main Towns: Cape Town, Cape Flats and Brackenfell										
GRU	Total Area (km ²): 826.03	Centrell									
Water Resource Classes & RQOs	The GRU falls within the Peninsula (E1) and Cape Flats (E12) IUAs and has Water Resource Class II and III respectively. The portion of the GRU that fall within IUA E12 (catchments G22D and G22C) has a Groundwater Resource Class of II, and no Groundwater Resource Class for the portions that fall within IUA E11 (catchments G22A and G22B). There are no priority EWR sites within this IUA, although portions of 1 estuary node (Rietvlei/ Diep) with a TEC of C fall within the GRU (see table below).										
	IUA Water Resource Class Quaternary Catchment RU		Resource Name Bio	physical Node 7	TEC nMAR						
	D10 Diep III	G21F	D10-E03	Rietvlei/ Diep	Bxi7	C 78					
Recharge	An estimated recharge of 18.6 M m ³ /a was determined from first-order recharge calculations using the Map-Centric Simulation method and was chosen as the estimated recharge the Aquifer Stress assessments (see table below). The average recharge rate is 22.83 mm/a based on the total GRU area. Additional recharge estimations are available in the Refer to DWS (2022e) for further details. Method Area (km ²) Recharge Volume (M m ³ /a) Average Recharge Rate (mm/a)										
	Map Centric Simulation Method	Map Centric Simulation Method 298.29		18.6		22.83					
				Water Use Sector No. of Users Fractured And Intergranular Basement Agriculture: Irrigation 6 Industry (Non-Urban) 2 Industry (Urban) 9 Schedule 1 3 Urban (Excluding Industrial And/Or Domestic) 1 Water Supply Service 9 Fractured TMG Aquifer (Peninsu		0.07 0.02 0.26 0.004 0.01 0.36					
	In this GRU, 169 registered groundwater us	ers access various aquif	ers, including the	Agriculture: Irrigation	12	0.49					
	Fractured and Intergranular Basement Aquifer		Agriculture: Watering Livestock		0.03						
Groundwater Use	well as the Primary/Intergranular Aquifer. Toge		Industry (Urban) Water Supply Service	1	0.03						
	(see Figure 3-15 and the table on the right).	use sectors in this	Primary / Intergranular Aquifers (At surface but abstracting from the underlying basement)								
	region are Industry and Agriculture (Irrigation),	9.0%, respectively,	Agriculture: Aquaculture		0.004						
	to the total annual groundwater use volume.		Agriculture: Irrigation	22	1.82						
				Agriculture: Watering Livestock	3	0.06					
				Industry (Urban)	9	0.20					
			Industry (Non-Urban)	70	2.37						
			Schedule 1	7	0.02						
			Urban (Excluding Industrial And/Or Domestic)	3	0.02						
			Water Supply Service	9	0.31						
				Total	169	6.11					







GRU	GRU Name: Ca	pe Town Rim pe Town, Cape Flats and	Brackenfell									
	Total Area (km ²)		Diackenien									
Groundwater Reserve	Groundwater Qu The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer (Tygerberg) Groundwater Qu	uality Component rr quality component of the ndwater Quality Requirem Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K uantity Component rr quantity component of t	Unit Unit Unit Unit Unit Unit Unit Unit	No. BHs 21 21 21 21 21 21 21 21 21 21 21 21 21	No. Samples 21	Baseline Conc. 7.78 105.10 142.60 45.50 19.10 240.60 8.50 0.28 0.14 0.02 0.01 3.05	Min Conc. 7.00 21.00 28.20 2.30 1.70 44.00 5.50 0.02 0.12 0.02 0.00 0.87	Max Conc. 8.62 659.00 1048.00 259.80 119.10 2100.00 350.00 6.57 2.60 0.75 0.13 13.20 Culated by cor	Median Conc. 7.47 92.00 128.40 15.80 20.60 220.00 34.10 0.13 0.27 0.02 0.01 3.02	Groundwater Quality Reserve 8.22 105.10 142.60 45.50 22.66 242.00 37.51 0.28 0.30 0.02 0.01	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - -	
	Recharge (N	Im ³ /a) EWR Reserv	e (Mm³/a)	BHN Reserve (Mm ³ /	/a) GW Res	GW Reserve (Mm ³ /a)		a)	Water Use (Mm ³ /a	a) Still Allo	Still Allocable (Mm ³ /a)	
	18.6					· · · ·						
		0.87		0.20		1.07	17.54		6.21		11.33	



	GRU Name: Cap	e Town Rim					
GRU	Main Towns: Cap		Flats and Bracke	enfell			
	Total Area (km ²):	826.03					
			f 8 monitoring si	tes for the EWR			ter contribution to the EWR and a Management Option 3 for monitoring the groundwater cally selected within the Cape Town Rim GRU (see Figure 3-15 and the table below).
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description
					-	EWR Managemen	
	G2N0103	HYDSTRA	Biv9	EWR	-34.010081	18.709376	Frequency: Quarterly 1) Groundwater level:
	96058	WMS	Bviii6	EWR	-34.016389	18.382222	 Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger.
	96060	WMS	Bvii7	EWR	-34.028056	18.417222	 2) Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄
	96139	WMS	Bviii8	EWR	-33.855556	18.627222	• Site specific additions as per RQO ²⁰ :
Monitoring Programme	G2N0637	HYDSTRA	Biv9	EWR	-33.85839	18.66518	Bviii6: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables
Monitoning i Togramme	G2N0604	HYDSTRA	Bviii8	EWR	-33.90177	18.64386	(Temperature, pH, Dissolved Oxygen).
	3318DC00027	NGA	Biv9	EWR	-33.89189	18.73259	Bvii7: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical Conductivity [EC]); Pathogens (Escherichia Coli); System Variables
	G2N0112	HYDSTRA	GRU	EWR	-33.980081	18.479369	(Temperature, pH, Dissolved Oxygen).
						BHN Management	
	3318CD00036	NGA	GRU	BHN	-33.90301	18.41037	Frequency: Monthly or Quarterly 1) Groundwater level:
	3318DC00290	NGA	GRU	BHN	-33.88447	18.70283	 Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems. Groundwater Quality (Background water quality and BHN):
	96211	WMS	GRU	BHN	-33.838611	18.607222	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms
		•					



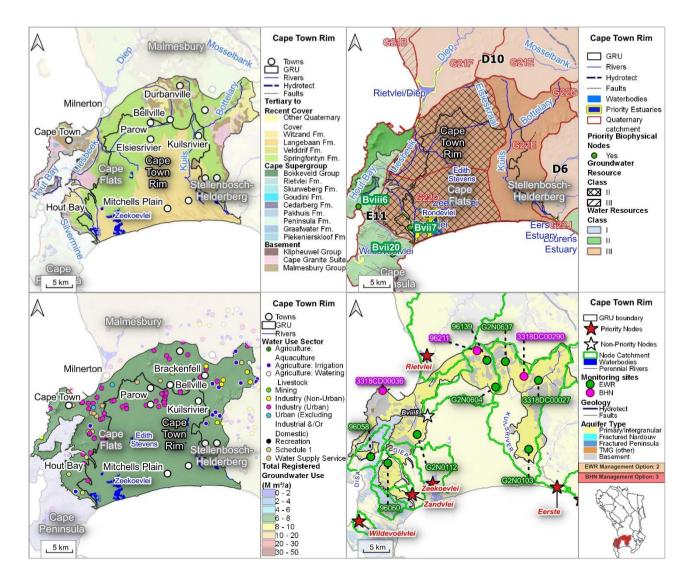


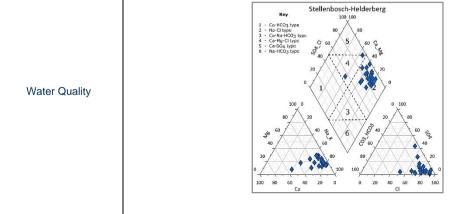
Figure 3-15 A series of maps for the Cape Town Rim GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.2. Stellenbosch-Helderberg GRU

	GRU Name: Stellenbos	Son nondonborg						
GRU	Main Towns: Stellenbo	sch and Somerset West						
	Total Area (km ²): 570.5	58						
GRU Boundary Description	model boundary outline of the basement litholog	ed in the CoCT (2018) repo gy (the CGS and the Malmo tern edge, where the cor	rt (i.e., the Cape Flats GRU). esbury Group) and the TMG,	The G10C surfamarks the south	ons of the G22E and G21E su ace water quaternary catching hern and eastern/south-easter direction towards the sout	ent divide, along with the co rn boundaries of the GRU, r	ntact between an espectively. The I	interpolated extent alse Bay coastline
Resource Unit			Fracture	ed and Intergran	ular Basement Aquifer			
Quaternary Catchments	G22G, G22H, G22F, G	22J and G22K (Figure 3-1	6)					
Description	lower rolling hills predo	minantly formed by the Ma	Imesbury Group (Figure 3-16	6). To the east, t	nd CGS. The CGS gives rise t the Peninsula Fm outcrops, sl nt aquifer (refer to DWS, 2022	naping the Stellenbosch and		
Surface Water System	Jonkershoek, and Klip		ers consistently follow the top		nd Sir Lowrys Pass rivers. T ming from the elevated mou			
Surface Water System	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour	pies tributaries. These rive nd DWS, 2022d and 2023a e Eerste (D6) and Sir Lowr rce Class of III, while the n	ers consistently follow the top). y's (D7) IUAs, with Water Re est of the RU lacks a Ground	source Class III		ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the	th to the coastal D6 (catchment G Eerste (Jonkershi	areas in the south
	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour	pies tributaries. These rive nd DWS, 2022d and 2023a e Eerste (D6) and Sir Lowr rce Class of III, while the n	ers consistently follow the top). y's (D7) IUAs, with Water Re est of the RU lacks a Ground	source Class III	ming from the elevated moun and II, respectively. The segu- ce Class designation. There is	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the	th to the coastal D6 (catchment G Eerste (Jonkershi	areas in the south
Water Resource	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr rce Class of III, while the m . Additionally, the Eerste an <u>Water Resource Class</u>	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Ground nd Lourens estuaries are pres Quaternary Catchment G22F	source Class III dwater Resource sent in this GRL RU D6-R16	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is I, both with a TEC of D (see F <u>Resource Name</u> <u>Eerste (Jonkershoek)</u>	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the igure 3-16 and the table be <u>Biophysical Node</u> Biii6	th to the coastal D6 (catchment G Eerste (Jonkershelow).	areas in the south (22F) is designated bek), and 3 priority nMAR 93
	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr rce Class of III, while the r . Additionally, the Eerste ar	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Groun nd Lourens estuaries are pres Quaternary Catchment G22F G22G	source Class III dwater Resource sent in this GRL <u>RU</u> <u>D6-R16</u> D6-R17	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is I, both with a TEC of D (see F <u>Resource Name</u> <u>Eerste (Jonkershoek)</u> Klippies	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the 'igure 3-16 and the table be <u>Biophysical Node</u> Biil6 Biv8	th to the coastal D6 (catchment G Eerste (Jonkershelow).	areas in the south (22F) is designated bek), and 3 priority <u>nMAR</u> 93 77
Water Resource	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr rce Class of III, while the m . Additionally, the Eerste an <u>Water Resource Class</u>	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Groum nd Lourens estuaries are pres Quaternary Catchment G22F G22G G22H	source Class III dwater Resource sent in this GRU D6-R16 D6-R17 D6-E06	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is I, both with a TEC of D (see F <u>Resource Name</u> <u>Eerste (Jonkershoek)</u> <u>Klippies</u> <u>Eerste Estuary</u>	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the 'igure 3-16 and the table be <u>Biophysical Node</u> <u>Biii6</u> <u>Biv8</u> <u>Bix3</u>	th to the coastal D6 (catchment G Eerste (Jonkershelow).	22F) is designated bek), and 3 priority nMAR 93 77 90
Water Resource	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes IUA D6 Eerste	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr roce Class of III, while the r . Additionally, the Eerste ar Water Resource Class III	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Ground nd Lourens estuaries are pres Quaternary Catchment G22F G22G G22H G22J	source Class III dwater Resource sent in this GRU D6-R16 D6-R17 D6-E06 D7-R18	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is b, both with a TEC of D (see F <u>Resource Name</u> <u>Eerste (Jonkershoek)</u> <u>Klippies</u> <u>Eerste Estuary</u> <u>Lourens</u>	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the Figure 3-16 and the table be <u>Biophysical Node</u> <u>Bii6</u> <u>Biv8</u> <u>Bxi3</u> Bvii21	th to the coastal D6 (catchment G Eerste (Jonkershelow). TEC C D D D D	areas in the south 22F) is designated bek), and 3 priority <u>nMAR</u> 93 77 90 114
Water Resource	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr rce Class of III, while the m . Additionally, the Eerste an <u>Water Resource Class</u>	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Groum nd Lourens estuaries are pres Quaternary Catchment G22F G22G G22H	source Class III dwater Resource sent in this GRU D6-R16 D6-R17 D6-E06	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is I, both with a TEC of D (see F <u>Resource Name</u> <u>Eerste (Jonkershoek)</u> <u>Klippies</u> <u>Eerste Estuary</u>	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the 'igure 3-16 and the table be <u>Biophysical Node</u> <u>Biii6</u> <u>Biv8</u> <u>Bix3</u>	th to the coastal D6 (catchment G Eerste (Jonkershelow).	areas in the south 22F) is designated bek), and 3 priority <u>nMAR</u> 93 77 90
Water Resource	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes IUA D6 Eerste D7 Sir Lower's An estimated recharge	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr rce Class of III, while the ri- . Additionally, the Eerste ar Water Resource Class III II II of 41.52 M m ³ /a was detern essments. The average rec	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Ground nd Lourens estuaries are pres Quaternary Catchment G22F G22G G22H G22J G22K G22J G22K G22J G22J	source Class III dwater Resource sent in this GRU D6-R16 D6-R17 D6-E06 D7-R18 D7-R19 D7-E07 ge calculations u	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is by both with a TEC of D (see F Resource Name Eerste (Jonkershoek) Klippies Eerste Estuary Lourens Sir Lowry's Pass*	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the igure 3-16 and the table be <u>Biophysical Node</u> <u>Biii6</u> <u>Biv8</u> <u>Bxi3</u> <u>Bvii21</u> <u>Bvii19</u> <u>Bxi4</u> ion method and was choser	th to the coastal D6 (catchment G Eerste (Jonkershe low). TEC C D D D C D D C D	areas in the south 222F) is designated bek), and 3 priority <u>nMAR</u> 93 77 90 114 84 85
Water Resource Classes & RQOs	Jonkershoek, and Klipp (refer to Figure 3-16 ar The GRU falls within th a Groundwater Resour biophysical river nodes IUA D6 Eerste D7 Sir Lower's An estimated recharge the Aquifer Stress assess below and DWS (2022)	pies tributaries. These rive and DWS, 2022d and 2023a the Eerste (D6) and Sir Lowr rce Class of III, while the ri- . Additionally, the Eerste ar Water Resource Class III II II of 41.52 M m ³ /a was detern essments. The average rec	ers consistently follow the top). ry's (D7) IUAs, with Water Re est of the RU lacks a Ground nd Lourens estuaries are pres Quaternary Catchment G22F G22G G22H G22J G22K G22J G22K G22J G22J	source Class III dwater Resource sent in this GRU D6-R16 D6-R17 D6-E06 D7-R18 D7-R19 D7-E07 ge calculations u	ming from the elevated mount and II, respectively. The segu- ce Class designation. There is b, both with a TEC of D (see F Resource Name Eerste (Jonkershoek) Klippies Eerste Estuary Lourens Sir Lowry's Pass* Lourens Estuary sing the Map-Centric Simulat	ntainous regions in the nor ment of the GRU within IUA s 1 priority EWR site - the igure 3-16 and the table be <u>Biophysical Node</u> <u>Biii6</u> <u>Biv8</u> <u>Bxi3</u> <u>Bvii21</u> <u>Bviii9</u> <u>Bxi4</u> ion method and was choser rge estimations are availabl	th to the coastal D6 (catchment G Eerste (Jonkershe low). TEC C D D D C D D C D	areas in the south (22F) is designated bek), and 3 priority (MAR 93 77 90 114 84 85 (recharge value for . Refer to the table

	GRU Name: Stellenbosch-Helderberg			
GRU	Main Towns: Stellenbosch and Somerset West			
	Total Area (km ²): 570.58			
		Water Use Sector	No. of Users	Total Volume (M m ³ /a)
		Fractu	red And Intergranular Basement	Aquifer
		Agriculture: Aquaculture	3	0.001
		Agriculture: Irrigation	35	0.87
		Industry (Non-Urban)	8	0.05
		Industry (Urban)	11	0.27
	In this GRU, there are 163 registered groundwater users utilizing a total of 8.79 M m ³ /a,	Schedule 1	3	0.003
	drawing from both the Fractured and Intergranular Basement Aquifer and the	Water Supply Service	2	3.50
Groundwater Use	Primary/Intergranular Aquifer. The primary groundwater use sectors are Water Supply		Primary / Intergranular Aquifer	
		Agriculture: Irrigation	38	1.06
	Services and Agriculture (Irrigation), accounting for 64.3% and 21.9%, respectively, of the	Agriculture: Watering Livestock	1	0.01
	total annual groundwater use volume (see Figure 3-16 and the table on the right).	Industry (Non-Urban)	11	0.11
		Industry (Urban)	41	0.71
		Recreation	1	0.02
		Schedule 1	4	0.03
		Water Supply Service	5	2.16
		Total	163	8.79



dissolution and saturation of Na and Cl ions due to increased groundwater residence time in the relatively low transmissivity granitic and clay-rich shale and siltstone basement aquifer.

No RQOs have been established for the drainage regions in which this GRU falls. In boreholes targeting the Tygerberg Fm, at least 50% of samples exceeded baseline concentrations for sulphate, EC, ammonia, nitrate + nitrite, and orthophosphate. For this lithology, the adjusted water quality category is C, indicating the presence of some localized contamination that may impact the purpose for which groundwater is used. Anthropogenic impacts, likely from agriculture and industry, contribute to these concerns, but exceedances are also influenced by naturally elevated salinity, posing water quality concerns.

In boreholes targeting the CGS, at least 50% of samples exceeded baseline concentrations for pH, ammonia, nitrate + nitrite, and orthophosphate. For this lithology, the final water quality category is also C, indicating the presence of some localized contamination that may impact the purpose for which groundwater is used. (reefer to DWS 2022d, 2022e and 2023a for detail).

	The GRU is considered to have a Gro	undwater Availability Present Status	Category of 'C', indicating a moderate	ely stressed aquifer, and a Groundwat	er Quality Present Status Category of	
	'C' indicating moderate levels of locali	sed contamination, but little or no neg	pative impacts apparent (see table bel	ow).		
Aquifer Stress	-					
Aquilei Ottess	Recharge Volume	Groundwater Use	Stress Index	Groundwater Availability Present	Groundwater Quality Present Status	

Recharge Volume (M m ³ /a)	Groundwater Use (M m ³ /a)	Stress Index	Groundwater Availability Present Status Category	Groundwater Quality Present Status Category
41.52	8.79	0.21	С	С



	GRU Name: Ste	llenbosch-Helderberg									
GRU	Main Towns: Ste	ellenbosch and Somerset V	Vest								
Unto .	Total Area (km ²)										
		. 070.00									
	The groundwate	uality Component r quality component of the ndwater Quality Requireme	Reserve, detail ent for BHN.	ed in the table t	pelow and describ	ed in Section 2	2.3 & 2.4, is dete	rmined as two co	omponents 1) t	he Groundwater C	Quality Rese
	Aquifer Unit	Parameter	Unit	No. BHs	No. Samples	Baseline Conc.	Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshold
		рН		15	15	7.08	6.72	7.18	6.98	7.18	5 – 9
		Electrical Conductivity	mS/m	15	15	197.00	32.70	885.00	203.00	223.30	150
		Sodium as Na	mg/l	15	15	297.30	54.10	1510.20	307.85	338.64	200
	Fractured	Calcium as Ca	mg/l	15	15	54.50	4.30	200.80	43.40	54.50	150
	and	Magnesium as Mg	mg/l	15	15	28.90	5.90	376.90	56.85	62.54	70
	Intergranular	Chloride as Cl	mg/l	15	15	610.60	86.50	3495.00	586.65	645.32	200
	Basement	Sulphate as SO4	mg/l	15	15	10.20	7.70	338.40	73.05	80.36	400
	Aquifer	Nitrate + Nitrite	mg/l	15	15	0.02	0.02	5.61	0.21	0.23	10
	(Tygerberg)	Fluoride as F	mg/l	15	15	2.35	0.05	2.61	0.67	2.35	1.5
		Ammonia as NH3	mg/l	15	15	0.04	0.02	0.09	0.05	0.06	-
undwater Reserve		Orthophosphate as PO4	mg/l	15	15	0.01	0.01	0.06	0.01	0.01	-
		Potassium as K	mg/l	15	15	6.38	2.98	8.80	3.78	6.38	-
	Aquifer Unit	Parameter	Unit	No. BHs	No. Samples	Baseline Conc.	Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshole
		рН		6	6	7.00	6.41	7.48	7.00	7.48	5 – 9
		Electrical Conductivity	mS/m	6	6	68.40	17.60	197.00	48.90	68.40	150
		Sodium as Na	mg/l	6	6	95.60	22.40	297.30	66.70	95.60	200
	Fractured	Calcium as Ca	mg/l	6	6	9.60	1.60	99.10	9.60	10.56	150
	and	Magnesium as Mg	mg/l	6	6	13.80	2.90	35.80	9.00	13.80	70
			mg/l	6	6 6	167.20	34.50	610.60	115.90	167.20	200
	Intergranular	Chloride as Cl				14.80	2.00	289.80	5.90	14.80	400
	Intergranular Basement	Sulphate as SO4	mg/l	6		0.04		0.04	0.04	1 00	
	Intergranular Basement Aquifer	Sulphate as SO4 Nitrate + Nitrite	mg/l	6	6	0.24	0.02	8.34	0.94	1.03	10
	Intergranular Basement	Sulphate as SO4 Nitrate + Nitrite Fluoride as F	mg/l mg/l	6 6	6 6	1.25	0.02 0.16	2.46	0.41	1.25	1.5
	Intergranular Basement Aquifer	Sulphate as SO4 Nitrate + Nitrite	mg/l	6	6		0.02				





	GRU Name: Stellenbosch-	Helderbera					
GRU	Main Towns: Stellenbosch	9					
	Total Area (km ²): 570.58						
	Groundwater Quantity Corr	nonent					
	The groundwater quantity of the EWR and BHN Reserve		, detailed in the table below	v and described in Section	2.3 & 2.4, is calculated by	considering the total grour	ndwater contribution to both
					Total Allocable Volume		
	Recharge (Mm ³ /a)	EWR Reserve (Mm ³ /a)	BHN Reserve (Mm ³ /a)	GW Reserve (Mm ³ /a)	(Mm³/a)	Water Use (Mm ³ /a)	Still Allocable (Mm ³ /a)
	41.52	2.34	0.24	2.58	38.94	8.79	30.13
	In Scopario 76, which proje	acts conditions for the yea	r 2050 and considers the '	Most Likoly Caso' for the (CPLL the analysis focused	on two koy factors: Pacha	rae and Water Lise. These
	factors directly influenced t	he parameters used to det	ermine the Groundwater R	eserve, specifically the gro	undwater contribution to the	BHN and EWR. The scen	rge and Water Use. These ario involved a decrease in
	factors directly influenced t recharge from 41.52 to 38	he parameters used to det .49 M m ³ /a, influenced by	ermine the Groundwater R both climate change and t	eserve, specifically the gro he elimination of IAPs. Add	undwater contribution to the ditionally, groundwater use	BHN and EWR. The scen increased from 8.81 to 11	nario involved a decrease in .30 M m ³ /a due to sectoral
Future Scepario 2050	factors directly influenced t recharge from 41.52 to 38. growth and the implementa	he parameters used to det .49 M m³/a, influenced by ation of groundwater develo	ermine the Groundwater R both climate change and t opment schemes in the are	eserve, specifically the gro he elimination of IAPs. Ado a. Furthermore, the groun	undwater contribution to the ditionally, groundwater use dwater contribution to the E	BHN and EWR. The scen increased from 8.81 to 11 BHN Reserve rose from 0.2	nario involved a decrease in
Future Scenario 2050 (Scenario 7b)	factors directly influenced t recharge from 41.52 to 38. growth and the implementa	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater devel- owth. In light of these chan	ermine the Groundwater R both climate change and t opment schemes in the are	eserve, specifically the gro he elimination of IAPs. Ado a. Furthermore, the groun	undwater contribution to the ditionally, groundwater use dwater contribution to the E	BHN and EWR. The scen increased from 8.81 to 11 BHN Reserve rose from 0.2	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily
	factors directly influenced t recharge from 41.52 to 38. growth and the implementa attributed to population gro	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater devel- owth. In light of these chan	ermine the Groundwater R both climate change and t opment schemes in the are	eserve, specifically the gro he elimination of IAPs. Ado a. Furthermore, the groun	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume	BHN and EWR. The scen increased from 8.81 to 11 BHN Reserve rose from 0.2	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow).	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego	eserve, specifically the gro he elimination of IAPs. Ad a. Furthermore, the groun ry shifted from. Under thes	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation	BHN and EWR. The scen increased from 8.81 to 11 BHN Reserve rose from 0.2 Category did not change	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)
	factors directly influenced t recharge from 41.52 to 38 growth and the implementa attributed to population gro Section 2.5 and the table b Recharge (Mm³/a)	he parameters used to det .49 M m ³ /a, influenced by ation of groundwater develo wth. In light of these chan elow). EWR Reserve (Mm ³ /a)	ermine the Groundwater R both climate change and t opment schemes in the are ges, the Allocation Catego BHN Reserve (Mm³/a)	eserve, specifically the gro he elimination of IAPs. Adv a. Furthermore, the groun ry shifted from. Under thes GW Reserve (Mm³/a)	undwater contribution to the ditionally, groundwater use dwater contribution to the E se conditions, the Allocation Total Allocable Volume (Mm ³ /a)	BHN and EWR. The scen increased from 8.81 to 11 HN Reserve rose from 0.2 Category did not change Water Use (Mm³/a)	ario involved a decrease in .30 M m ³ /a due to sectoral 24 to 0.46 M m ³ /a, primarily from a category C (refer to Still Allocable (Mm ³ /a)



	GRU Name: Stel	lenbosch-Held	erberg				
GRU	Main Towns: Ste	llenbosch and	Somerset Wes	t			
	Total Area (km ²):	570.58					
							undwater contribution to the EWR and a Management Option 3 for monitoring the groundw ategically selected within the Stellenbosch-Helderberg GRU (see Figure 3-16 and the t
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description
					Γ	EWR Manager	
	3418BB00038	NGA	Bviii9	EWR	-34.14602	18.87707	Frequency: Quarterly 1) Groundwater level: Manual groundwater level measurements, as well as average daily reading from
	3418BB00071	NGA	Bviii9	EWR	-34.11769	18.92707	 automatically recorded level logger. Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄
	G2N0672	HYDSTRA	Biv8	EWR	-33.83622	18.84286	 Site specific additions to EWN, NO2, NO3, NO4 Site specific additions as per RQO ²⁰: Bviii9: Nutrients (Phosphate [PO₄-P] and Total Inorganic Nitrogen [TIN]); Salts (Electric
	G2N0674	HYDSTRA	Eerste	EWR	-33.99185	18.80492	Conductivity [EC]); Pathogens (Escherichia Čoli); System Variables (Temperatu pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine, Endosulfan)
	G2N0684	HYDSTRA	Biii6	EWR	-33.93032	18.87903	Biv8: Nutrients (Phosphate [PO₄-P] and Total Inorganic Nitrogen [TIN]); Salts (Electri Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperatu pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine, Endosulfan)
Monitoring Programme	G2N0690	HYDSTRA	Biii6	EWR	-33.96561	18.92327	Bxi3 (Eerste): Nutrients (Dissolved Inorganic Nutrients [DIN] and Dissolved Inorganic Phospha [DIP]); Salts; Pathogens (Enterococci & Escherichia Coli); System Variab
	3418BB00016	NGA	Bvii21	EWR	-34.08269	18.86485	(Temperature, pH, Dissolved Oxygen). Biii6:
	3418BB00052	NGA	Bvii21	EWR	-34.06964	18.90762	Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electri Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperatu pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine, Endosulfan)
	BG00479	NGA	Biv8	EWR	-33.93513	18.8528	Bvii21: Nutrients (Phosphate [PO₄-P] and Total Inorganic Nitrogen [TIN]); Salts (Electri Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperatu pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine, Endosulfan)
						BHN Managen	
	96032	WMS	GRU	BHN	-34.052778	18.785556	Frequency: Monthly or Quarterly
	96036	WMS	GRU	BHN	-34.053333	18.840278	 Groundwater level: Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems.
	BG00364	NGA	GRU	BHN	-33.92159	18.85123	 Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄
	96033	WMS	GRU	BHN	-34.029444	18.806389	 Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms



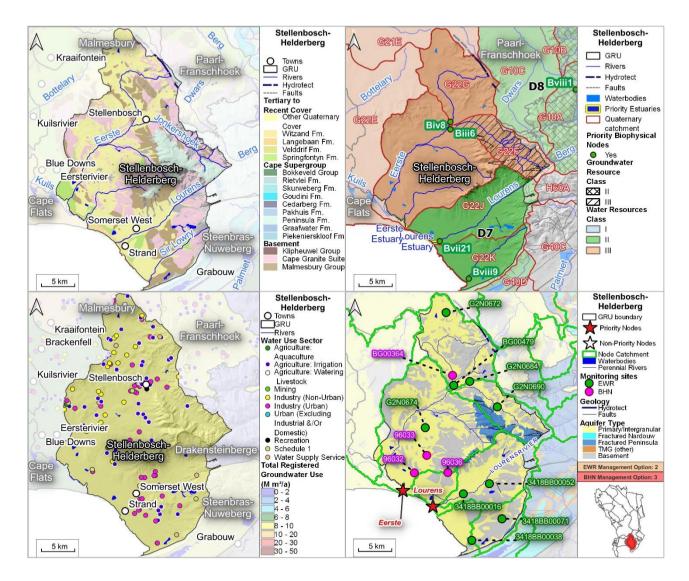


Figure 3-16 A series of maps for the Stellenbosch-Helderberg GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.3. Paarl-Franschhoek GRU

Paarl-Franschhoek Paarl, Franschhoek m2): 368.50 anschhoek GRU is enclosed by jes. The northern and western bo 22d and 2023a). and G10B (Figure 3-17) nsists of sequences of basemen e area. The Peninsula Fm of the Fm and other younger Quaterna surface water system in the area ay (refer to Figure 3-17 and DWS Is entirely within the Upper Berg here are no priority EWR sites w Water Resource Class	oundaries of the GRU are d F t rocks, primarily belonging a TMG is observed in the n ary sediments, extensively f a is the Berg River, which in S, 2022d and 2023a). (D8) and is assigned a Wa vithin this IUA; however, the	ractured and Intergra to the Malmesbury nountainous southea fill valleys, especially ncludes the Dwars ar	f the G10D, G21E, and G anular Basement Aquifer Group and the CGS. The ast and along the eastern along the Berg River (ref nd Franschhoek tributaries II. The segment of the Gi	21D surface water quater se rocks dominate the our boundary. Additionally, G er to DWS, 2022d and 20 s. This river flows in a nor RU within catchments G1	nary catchment divi tcrop in the undulat Quaternary cover, in 123a). thward direction fro 0A and G10B has the TEC table belo	ting northern and western noluding Fms such as the om the Berg River Dam to a Groundwater Resource
anschhoek GRU is enclosed by jes. The northern and western bo 22d and 2023a). and G10B (Figure 3-17) nsists of sequences of basemen e area. The Peninsula Fm of the Fm and other younger Quaterna surface water system in the area ay (refer to Figure 3-17 and DWS Is entirely within the Upper Berg here are no priority EWR sites w	oundaries of the GRU are d F t rocks, primarily belonging a TMG is observed in the n ary sediments, extensively f a is the Berg River, which in S, 2022d and 2023a). (D8) and is assigned a Wa vithin this IUA; however, the	ractured and Intergra to the Malmesbury nountainous southea fill valleys, especially ncludes the Dwars ar ater Resource Class are are 2 priority biop	f the G10D, G21E, and G anular Basement Aquifer Group and the CGS. The ast and along the eastern along the Berg River (ref nd Franschhoek tributaries II. The segment of the Gi	21D surface water quater se rocks dominate the our boundary. Additionally, G er to DWS, 2022d and 20 s. This river flows in a nor RU within catchments G1	nary catchment divi tcrop in the undulat Quaternary cover, in 123a). thward direction fro 0A and G10B has the TEC table belo	ting northern and western noluding Fms such as the om the Berg River Dam to a Groundwater Resource w and to Figure 3-17).
nsists of sequences of basemen e area. The Peninsula Fm of the Fm and other younger Quaterna surface water system in the area ay (refer to Figure 3-17 and DWS Is entirely within the Upper Berg here are no priority EWR sites w	t rocks, primarily belonging e TMG is observed in the n ary sediments, extensively f a is the Berg River, which in S, 2022d and 2023a). (D8) and is assigned a Wa vithin this IUA; however, the	to the Malmesbury nountainous southea fill valleys, especially ncludes the Dwars ar ater Resource Class are are 2 priority biop	Group and the CGS. The ast and along the eastern along the Berg River (ref nd Franschhoek tributaries II. The segment of the G hysical river nodes with a	boundary. Additionally, G er to DWS, 2022d and 20 s. This river flows in a nor RU within catchments G1	Quaternary cover, in 123a). thward direction fro 0A and G10B has the TEC table belo	om the Berg River Dam to a Groundwater Resource w and to Figure 3-17).
e area. The Peninsula Fm of the Fm and other younger Quaterna surface water system in the area ay (refer to Figure 3-17 and DWS Is entirely within the Upper Berg here are no priority EWR sites w	t rocks, primarily belonging e TMG is observed in the n ary sediments, extensively f a is the Berg River, which in S, 2022d and 2023a). (D8) and is assigned a Wa vithin this IUA; however, the	to the Malmesbury nountainous southea fill valleys, especially ncludes the Dwars ar ater Resource Class are are 2 priority biop	Group and the CGS. The ast and along the eastern along the Berg River (ref nd Franschhoek tributaries II. The segment of the G hysical river nodes with a	boundary. Additionally, G er to DWS, 2022d and 20 s. This river flows in a nor RU within catchments G1	Quaternary cover, in 123a). thward direction fro 0A and G10B has the TEC table belo	om the Berg River Dam to a Groundwater Resource w and to Figure 3-17).
e area. The Peninsula Fm of the Fm and other younger Quaterna surface water system in the area ay (refer to Figure 3-17 and DWS Is entirely within the Upper Berg here are no priority EWR sites w	e TMG is observed in the n ary sediments, extensively f a is the Berg River, which in S, 2022d and 2023a). (D8) and is assigned a Wa vithin this IUA; however, the	nountainous southea fill valleys, especially ncludes the Dwars ar ater Resource Class are are 2 priority biop	ast and along the eastern v along the Berg River (ref and Franschhoek tributaries II. The segment of the Gi hysical river nodes with a	boundary. Additionally, G er to DWS, 2022d and 20 s. This river flows in a nor RU within catchments G1	Quaternary cover, in 123a). thward direction fro 0A and G10B has the TEC table belo	om the Berg River Dam to a Groundwater Resource w and to Figure 3-17).
ay (refer to Figure 3-17 and DWS Is entirely within the Upper Berg here are no priority EWR sites w	S, 2022d and 2023a). (D8) and is assigned a Wa vithin this IUA; however, the	ater Resource Class are are 2 priority biop	II. The segment of the Gi	RU within catchments G1	0A and G10B has the TEC table belo	a Groundwater Resource w and to Figure 3-17).
here are no priority EWR sites w	vithin this IUA; however, the	ere are 2 priority biop	hysical river nodes with a		the TEC table belo	w and to Figure 3-17).
Water Resource Class	Quaternary Catchment	DII				DMAD
			Resource Name	Biophysical Node	TEC	
r Berg II	G10A G10C	D8-R02 D8-R03	Berg Berg	Bviii1 Biii3	C D	27 53
l recharge of 26.61 M m³/a was er Stress assessments. The aver WS (2022e) for further details.	determined from first-order age recharge rate is 72.21	r recharge calculation mm/a based on the t	ns using the Map-Centric total GRU area. Additiona	Simulation method and v I recharge estimations are	vas chosen as the e e available in the lite	estimated recharge value erature. Refer to the table
Method	Area (k	:m²)				Recharge Rate mm/a)
Centric Simulation Method	368.5	50				72.21
er W	Stress assessments. The aver /S (2022e) for further details. Method	Stress assessments. The average recharge rate is 72.21 /S (2022e) for further details. Method Area (k	Stress assessments. The average recharge rate is 72.21 mm/a based on the /S (2022e) for further details. Method Area (km²)	Stress assessments. The average recharge rate is 72.21 mm/a based on the total GRU area. Additional /S (2022e) for further details. Method Area (km²) Recharge (M m	Stress assessments. The average recharge rate is 72.21 mm/a based on the total GRU area. Additional recharge estimations are /S (2022e) for further details. Method Area (km²) Recharge Volume (M m³/a)	Method Area (km²) Recharge Volume (M m³/a) Average R



	GRU Name: Paarl-Franschhoek			
GRU	Main Towns: Paarl, Franschhoek			
ONO	Total Area (km2): 368.50			
		Water Use Sector	No. of Users	Total Volume (M m ³ /a)
			red and Intergranular Basement	
		Agriculture: Aquaculture	1	0.22
		Agriculture: Irrigation	33	0.90
		Agriculture: Watering livestock	3	0.10
		Industry (Non-urban)	16	0.32
		Industry (Urban)	7	0.17
		Schedule 1	1	0.01
	In this GRU, there are 268 registered groundwater users utilizing a combined groundwater		Primary / Intergranular Aquifer	
	volume of 9.84 M m ³ /a, drawing from the Fractured and Intergranular Basement Aquifer, the	Water Supply service	1	0.004
Groundwater Use	Primary/Intergranular Aquifer, and the Fractured TMG Aquifer (Peninsula). The major	Agriculture: Irrigation	1	0.07
	groundwater use sectors include Agriculture (Irrigation), Industry (Urban), and Water Supply		ractured TMG Aquifer (Peninsu	
	Services, contributing 61.1%, 15.1%, and 14.7%, respectively, to the total annual	Agriculture: Irrigation	140	5.04
	groundwater use volume (see Figure 3-17 and the table on the right).	Agriculture: Watering Livestock	7	0.08
		Industry (Non-urban)	5	0.11
		Industry (Urban)	34	1.31
		Schedule 1	9	0.06
		Urban (Excluding industrial	1	0.01
		and/or domestic) Water Supply service	9	1.44
		Total	268	9.84
		TOLAI	200	9.04
Water Quality	1 - Ca-HCG 1 VPR 2 - Ho-HCG 1 VPR 3 - Ca-HAH-HCG 1 VPR 5 - Ca-So HAH-HCG 1 VPR 6 - No-HCG 1 VPR 6 - No-HCG 1 VPR 6 - No-HCG 1 VPR 6 - No-HCG 1 VPR 7 - Ca-So HAH 6 - No-HCG 1 VPR 7 - Ca-So HAH 7 - Ca-HCG 1 VPR 7 - Ca-	The primary water type in Paar is attributed to the saturation residence time in the relatively siltstone basement aquifer. Only 1 sample exists for this GF exists for comparison, and con Despite agriculture being prev indicate that pristine water quali status would require additional detail).	of Na and Cl ions, resulti / low transmissivity of the RU. While this sample can e sequently, no water quality ralent within the GRU, the ty conditions are likely. How	ng from increased groundwate granite and clay-rich shale an stablish a baseline, no other dat category has been established e low parameter concentration vever, a more conclusive preser
Aquifer Stress	The GRU is considered to have a Groundwater Availability Present Status Category of 'C', indidetermined due to limited data availability (see table below). Recharge Volume Groundwater Use Stress	Groundwate		Quality Present Status cannot b roundwater Quality Present Status

	GRU Name: Paa	arl Francobback									
GRU		arl, Franschhoek									
GRU	Total Area (km2										
	Total Area (Kmz). 366.50									
Groundwater Reserve	Groundwater Qu The groundwater and 2) the Ground Aquifer Unit Fractured and Intergranular Basement Aquifer (CGS) Groundwater Qu	Parameter Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K Jantity Component	Unit Unit Unit Unit Unit Unit Unit Mg/I mg/I mg/I mg/I mg/I mg/I mg/I	No. BHs	No. Samples	Baseline Conc. 7.04 14.40 18.20 2.80 1.70 27.50 2.00 0.76 0.25 0.06 0.10 1.75	Min Conc. 7.04 14.40 18.20 2.80 1.70 27.50 2.00 0.76 0.25 0.06 0.10 1.75	Max Conc. 7.04 14.40 18.20 2.80 1.70 27.50 2.00 0.76 0.25 0.06 0.10 1.75	Median Conc. 7.04 14.40 18.20 2.80 1.70 27.50 2.00 0.76 0.25 0.06 0.10 1.75	Groundwater Quality Reserve 7.04 14.40 18.20 2.80 1.70 27.50 2.00 0.76 0.25 0.06 0.10 1.75	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - -
	Recharge (M	/Im³/a) EWR Reserv	ve (Mm³/a)	BHN Reserve (Mm	³/a) GW Re	serve (Mm³/a)	Total Allocable		Water Use (Mm ³ /a) Still Allo	ocable (Mm³/a)
	26.61	3.0	· · ·	0.13		3.14	(Mm³/a 23.47		9.84	·	13.65
	20.01	3.0	1	0.13		3.14	23.47		9.04		13.03
Future Scenario 2050 (Scenario 7b)	factors directly in recharge from 2 growth and the i		s used to dete fluenced by b lwater develo these chang ve (Mm ³ /a)	ermine the Groundwa both climate change opment schemes in t	ater Reserve, spe and the eliminat the area. Furtherr ategory shifted fro	cifically the gro ion of IAPs. Ad nore, the groun	undwater contrib ditionally, ground dwater contribut	bution to the BH dwater use incr ion to the BHN and the table be e Volume a)	IN and EWR. The eased from 9.82 Reserve rose fro	e scenario involve to 15.50 M m ³ /a om 0.13 to 0.21 N	ed a decrease in a due to sectoral



GRU	GRU Name: Paa Main Towns: Paa Total Area (km2):	arl, Franschhoe					
						BHN were strate	Indwater contribution to the EWR and a Management Option 2 for monitoring the groundwa rategically selected within the Paarl-Franschhoek GRU (see Figure 3-17 and the table below Monitoring Description
	G1N0439	HYDSTRA	Bvii2	EWR	-33,89888889	18.99027778	
		-					
	G1N0440	HYDSTRA	Biv5	EWR	-33.92332	19.11257	1) Groundwater level:
	G1N0502	HYDSTRA	Biii3	EWR	-33.76862	19.01813	 Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems.
	G1N0320	HYDSTRA	Biv5	EWR	-33.88316	19.04709	2) Groundwater Quality:
	G1N0322	HYDSTRA	Bvii2	EWR	-33.87951	19.03125	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄
	3319CC00104	NGA	Biii2	EWR	-33.85883	19.0303	 Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰:
A distant Deserves	G1N0428	HYDSTRA	Biv5	EWR	-33.92333333	19.08166667	7
Monitoring Programme	G1N0446	HYDSTRA	Biii3	EWR	-33.82835	18.94113	Biii3: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electr
	BG00450	NGA	Bvii14	EWR	-33.91134	18.94703	
	3318DD00243	NGA	Bvii2	EWR	-33.86135	18.99509	pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine, Endusulfan)
	3318DD00235	NGA	Bvii2	EWR	-33.84467	18.99092	
						BHN Managem	gement Option 2
	96019	WMS	GRU	BHN	-33.915556	18.920833	Frequency: Quarterly 1) Groundwater level:
	3318DD00221	NGA	GRU	BHN	-33.82247	18.96593	 Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. Groundwater Quality (Background water quality and BHN):
	3318DB00090	NGA	GRU	BHN	-33.7197	18.99509	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms

HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT



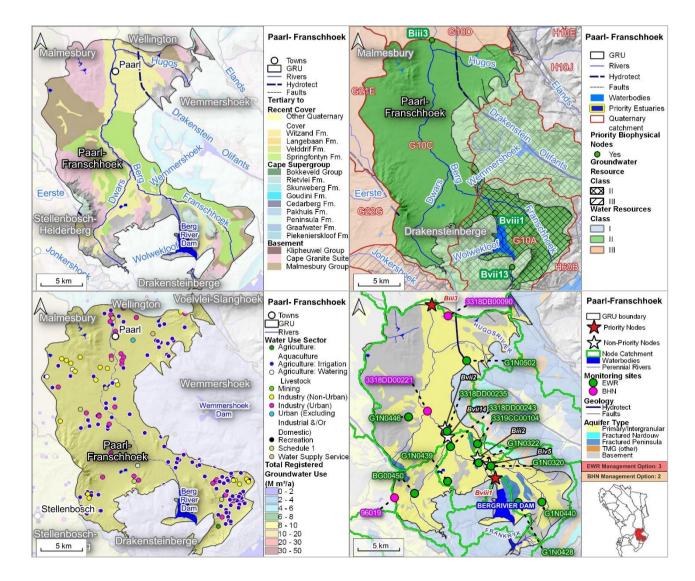


Figure 3-17 A series of maps for the Paarl-Franschoek GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.4. Malmesbury GRU

	GRU Name: Malmes							
GRU		bury and Melkbosstrand						
	Total Area (km2): 160	00.36						
	The Malmesbury GR	U is defined by a combination	n of an interpolated baseme	nt aeoloav extent	encompassing the Klipheu	wel Group, CGS, and M	lalmesbury Group, alc	ong with the G22G
GRU Boundary		G10C, G10J, G10L, G10F,						
Description		f the CoCT (2020) aquifer mo						
	00045 0040 0045		40)					
Quaternary Catchments	G201E, G21C, G21D	, G21F and G21B (Figure 3-	18)					
Resource Unit			Fracture	ed and Intergranu	ular Basement Aquifer			
	The GRU is primarily	underlain by the Malmesbur	y Group, intruded by CGS p	olutons. The CGS	plutons give rise to elevate	d rocky hills, in contrast	to the generally weat	hered lower rolling
Description		he Malmesbury Group. Group	ndwater flow is predominantl	y restricted to we	athered zones or granite scr	ee slopes on the flanks	of the plutons, and littl	e regional flow can
	be anticipated (refer	to DWS, 2022d and 2023a).						
Surface Water System	The major surface w:	ater systems in the area cons	ist of the Dien, Sout, and Mo	osselbank rivers (i	refer to Figure 3-18 and DW	(S. 2022d and 2023a)		
Oundee Water Oystern	The major surface we					70, 20220 and 2020a).		
		the West Coast (A3) and Die						
		G21B) both have a Ground						VR sites within this
Water Resource	IUA; however, there a	are 3 priority biophysical node	es: 1 estuary node (Rietviei/L	Diep) with a TEC	of C and 2 river nodes (refei	to the TEC table and F	igure 3-18 below).	
Classes & RQOs	IUA	Water Resource Class	Quaternary Catchment	RU	Resource Name	Biophysical Node	TEC	nMAR
			G21D	D10-R11	Diep	Bv1	D	66
	D10 Diep	III	G21D	D10-R12	Diep	Biv6	D	68
			G21F	D10-E03	Rietvlei/ Diep	Bxi7	С	78
		ge of 52.65 M m ³ /a was dete						
	(2022e) for further de	s assessments. The average	recharge rate is 32.90 mm/a	a based on the to	otal GRU area. Additional re	charge estimations are	available in the literat	ure. Refer to DWS
Dooborgo		italis.						
Recharge					Recharge Volun	ne	Average Recharg	e Rate
Recharge	Ν	Acthod						onuto
Recharge		Aethod	Area (km ²)		(M m³/a)		(mm/a)	o ruto
Reularge		Nethod Simulation Method	Area (km²) 1600.36		(M m³/a) 52.65		(mm/a) 32.90	
Recitalge					(M m³/a)			
Recharge					(M m³/a)			
Reutarge					(M m³/a)			



	GRU Name: Malmesbury			
GRU	Main Towns: Malmesbury and Melkbosstrand			
	Total Area (km2): 1600.36			
		Water Use Sector	No. of Users	Total Volume (M m ³ /a)
			actured And Intergranular Baser	
		Agriculture: Irrigation	<u>78</u> 18	5.44
		Agriculture: Watering Livestock Industry (Non-Urban)	2	0.002
		Industry (Non-Orban)	19	1.44
		Mining	19	0.003
		Schedule 1	4	0.003
	In this GRU, there are 245 registered groundwater users collectively utilizing 14.8 M m ³ /a of	Schedule 1	Primary / Intergranular Aquifers	
	groundwater. The primary groundwater use sectors are Agriculture (Irrigation), Agriculture	Water Supply Service	1	0.01
Groundwater Use	(Watering Livestock), and Industry (Urban), contributing 67.5%, 17.0%, and 12.4%,	Agriculture: Aguaculture	63	4.51
	respectively, to the total annual groundwater use volume (see Figure 3-18 and the table on	Agriculture: Irrigation	28	1.84
	the right).	Agriculture: Watering Livestock	2	0.13
		Industry (Non-Urban)	20	0.39
		Industry (Urban)	1	0.02
		Urban (Excluding Industrial	6	
		And/Or Domestic)	6	0.27
		Water Supply Service	1	0.01
		Total	245	14.75
	Malmesbury Key 100,100	The primary water type in Ma	almesbury GRU is Na-CL T	The presence of Na-Cl wat
Water Quality		The primary water type in Ma attributed to the saturation of Na time in the relatively low transm Exceedances of baseline conc mercury, with 50% of sample collected, 5 samples exceeded exceedances are attributed to naturally elevated concentratio indicating that low levels of co DWS 2022d, 2022e and 2023a	a and Cl ions, resulting from hissivity clay-rich shale and s entrations were observed for s exceeding the baseline f the RQO for EC, 1 for pH, o contamination from agric ns of dissolved ions. The adj ontamination exist, but large	increased groundwater resid siltstone basement aquifer. In all parameters except diss for pH. Out of the 149 sar and 34 for nitrate + nitrite. culture and industry, as we justed water quality category
Water Quality Aquifer Stress	The GRU is considered to have a Groundwater Availability Present Status Category of 'C', indicating localised, low levels of contamination, but no negative impacts apparent (see table I	attributed to the saturation of Natime in the relatively low transm Exceedances of baseline conc mercury, with 50% of sample collected, 5 samples exceeded exceedances are attributed to naturally elevated concentratio indicating that low levels of co DWS 2022d, 2022e and 2023a indicating a moderately stresse below).	a and Cl ions, resulting from hissivity clay-rich shale and s entrations were observed fo- is exceeding the baseline f the RQO for EC, 1 for pH, o contamination from agric ns of dissolved ions. The adj intamination exist, but large for detail).	increased groundwater res siltstone basement aquifer. r all parameters except dis for pH. Out of the 149 sa and 34 for nitrate + nitrite. sulture and industry, as v justed water quality catego ly natural conditions preva



	GRU Name: Malm	esburv									
GRU	Main Towns: Malm		chosstrand								
CINO			0033114114								
Groundwater Reserve	Aquifer Unit Aquifer Unit Fractured and Intergranular Basement Aquifer (Tygerberg) Groundwater Quar	ity Component Juality component water Quality Re Parameter PH Electrical Conduc Sodium as N: Calcium as C Magnesium as Chloride as C Sulphate as So Sulphate as So Sulphate as So Nitrate + Nitrit Fluoride as N Orthophosphate a Potassium as ntity Component Juantity component	quirement for BHI Unit tivity mS/m a mg/l a mg/l Mg mg/l Ja mg/l Q4 mg/l H3 mg/l K mg/l	No. BHs 66 66 66 66 66 66 66 66 66 66	No. Samples 197 197 191 194 193 197 196 194 193 197 196 194 195 195 192	Baseline Conc. 7.15 1549.90 282.03 178.18 66.07 655.78 172.57 503.08 0.26 0.10 18.77	Min Conc. 1.00 29.66 25.00 3.50 4.30 50.00 1.50 0.02 0.03 0.00 1.10	Max Conc. 8.60 2110.00 1726.90 219.30 205.00 2879.60 360.70 589.68 2.94 1.27 14.00 50.31	Median Conc. 7.64 107.90 156.40 16.98 18.68 257.01 33.30 0.56 0.38 0.03 0.02 3.67	Groundwater Quality Reserve 8.40 1549.90 282.03 178.18 66.07 655.78 172.57 503.08 0.42 0.10 0.10 18.77	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - -
	Recharge (Mm ²	³ /a) EWR	Reserve (Mm ³ /a)	BHN Reserve (Mm	³/a) GW Re	serve (Mm³/a)	Total Allocable Volume (Mm ³ /a)		Water Use (Mm ³ /a) Still Allo	cable (Mm ³ /a)
	52.65		1.18	0.34		1.52	51.13		14.75		36.38
Future Scenario 2050 (Scenario 7b)	factors directly influ recharge from 52.6 growth and the imp	uenced the para 55 to 44.42 M m plementation of g	neters used to de ³ /a, influenced by groundwater devel	ar 2050 and consider termine the Groundwa both climate change lopment schemes in t ges, the Allocation Ca	ater Reserve, spe and the eliminati the area. Further	ecifically the gro on of IAPs. Add more, the groun	oundwater contrib ditionally, ground idwater contribut r to Section 2.5 a	bution to the BH water use incre ion to the BHN and the table bel	N and EWR. The ased from 14.75 Reserve rose fro	scenario involve to 25.12 M m ³ /a	ed a decrease in due to sectoral
	Recharge (Mm ²	³/a) EWR	Reserve (Mm ³ /a)	BHN Reserve (Mm	3/a) GW Re	serve (Mm³/a)	Total Allocable (Mm ³ /a	a)	Water Use (Mm ³ /a	·	cable (Mm³/a)
	44.42		1.18	0.64		1.82	42.61		25.12		17.49



GRU	GRU Name: Malr Main Towns: Mal Total Area (km2):	mesbury and	Melkbosstrand				
						strategically sel	ontribution to the EWR and a Management Option 3 for monitoring the groundwater contribution ected within the Malmesbury GRU (see Figure 3-18 and the table below). Monitoring Description
				1		EWR Manager	
	G1N0439	HYDSTRA	Bvii2	EWR	-33.89888889	18.99027778	Frequency: Monthly or Quarterly
	G1N0440	HYDSTRA	Biv5	EWR	-33.92332	19.11257	3) Groundwater level:
	G1N0502	HYDSTRA	Biii3	EWR	-33.76862	19.01813	 Manual water level measurements and continuous hourly readings from
	G1N0320	HYDSTRA	Biv5	EWR	-33.88316	19.04709	automatically recorded level loggers. Possible need for telemetry systems.4) Groundwater Quality:
	G1N0322	HYDSTRA	Bvii2	EWR	-33.87951	19.03125	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, CI, PO₄, SO₄
	3319CC00104	NGA	Biii2	EWR	-33.85883	19.0303	 Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰:
	G1N0428	HYDSTRA	Biv5	EWR	-33.92333333	19.08166667	
Monitoring Programme	G1N0446	HYDSTRA	Biii3	EWR	-33.82835	18.94113	Biii3: Nutrients (Phosphate [PO4-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical
	BG00450	NGA	Bvii14	EWR	-33.91134	18.94703	Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature,
	3318DD00243	NGA	Bvii2	EWR	-33.86135	18.99509	pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine, Endusulfan)
	3318DD00235	NGA	Bvii2	EWR	-33.84467	18.99092	
				-		BHN Managen	
	96019	WMS	GRU	BHN	-33.915556	18.920833	Frequency: Quarterly 3) Groundwater level:
	3318DD00221	NGA	GRU	BHN	-33.82247	18.96593	 Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. Groundwater Quality (Background water quality and BHN):
	3318DB00090	NGA	GRU	BHN	-33.7197	18.99509	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms



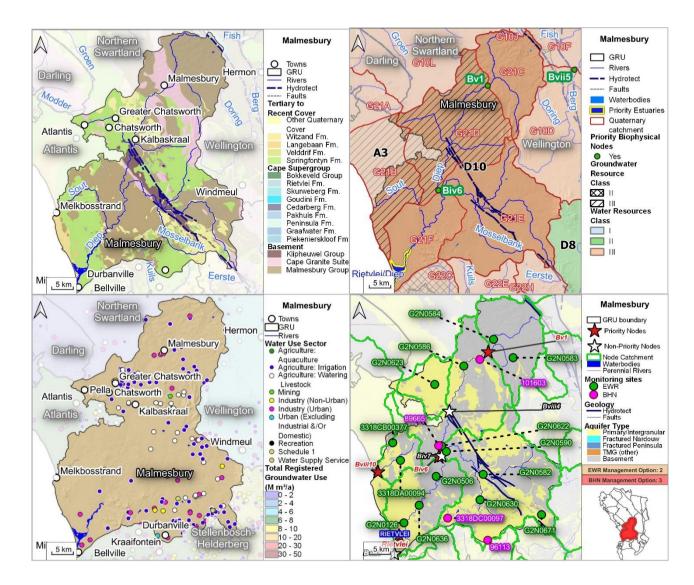


Figure 3-18 A series of maps for the Malmesbury GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.5. Wellington GRU

	GRU Name: Wellington	n						
GRU	Main Towns: Wellingto							
ONO	Total Area (km ²): 1068							
GRU Boundary Description	The Wellington GRU is bounded by the G21	s delineated by a combin E, G21C, G10C, and G1	ation of an interpolated ba 0J surface water quaterna as portions of the G10D s	ary catchment divid	es, incorporating sections	of the Berg River. The ea	astern edge is defined	by the contact between
Quaternary Catchments	G10D and G10F (Figu	ıre 3-19)						
Resource Unit			Fr	actured and Interg	anular Basement Aquifer	•		
Description	with the Malmesbury C Within the GRU, relativ	Group. Groundwater flow rely thin and laterally disc	bury Group, intruded by Co v is mainly restricted to we ontinuous outcrops of the riculture (refer to DWS, 20	eathered zones, de Sandveld Group are	eper structures, or grani	te scree slopes on the pl	uton flanks, with little	regional flow expected.
Surface Water System	The primary surface wa is home to the second- DWS, 2022d and 2023	-largest reservoir of the \	s the Berg River, which er VCWSS, the Voëlvlei Dan	ncompasses various n. Several smaller o	tributaries such as the F lams, including the Kersf	ish, Kompanjies, Limiet, C ontien Dam, are also loca	Doring, and Krom river ted within this GRU (i	s. Additionally, the GRU refer to Figure 3-19 and
Water Resource			Middle Berg (D9) IUAs, bo however, there are 2 pric					ource Class designation.
Classes & RQOs	IUA	Water Resource Class	Quaternary Catchment	RU	Resource Name	Biophysical Node	TEC	nMAR
	D9 Middle Berg	Ш	G10D	D9-R05	Kromme	Bvii3	D	89
			G10D	D9-R06	Berg	Bvii5	D	49
Recharge	for the Aquifer Stress (2022e) for further deta	assessments. The avera	etermined from first-order ge recharge rate is 36.95 Area (kr 1068.8	mm/a based on th	e total GRU area. Additio		are available in the l Average Re (mi	





	GRU Name: Wellington			
GRU	Main Towns: Wellington			
Cite	Total Area (km ²): 1068.81			
		Water Use Sector	No. of Users	Total Volume (M m ³ /a)
		Fract	ured And Intergranular Baseme	ent Aquifer
		Agriculture: Aquaculture	1	0.16
		Agriculture: Irrigation	70	3.08
		Agriculture: Watering Livestock	5	0.26
		Industry (Non-Urban)	2	0.00
	In this GRU, there are 117 registered groundwater users, collectively utilizing 4.48 M m ³ /a of	Industry (Urban)	11	0.12
Groundwater Use	groundwater. The primary groundwater use sectors are Agriculture (Irrigation) and Agriculture	Recreation	1	0.00
Ciounawater 03e	(Livestock Watering), contributing a combined 89.8% to the total annual groundwater use	Schedule 1	6	0.01
	volume (see Figure 3-19 and the table to the right).	Water Supply Service	3	0.04
			Primary Intergranular Aquife	
		Agriculture: Watering Livestock	14	0.63
		Industry (Non-Urban)	1 3	0.06
		Industry (Urban) Total	117	0.12
		I Utal	117	4.40
Water Quality	1 - Ca-HCQ3 type 2 - Na-HCQ3 type 3 - Ca-Ha-HCQ3 type 4 - Ca-HCQ1 type 5 - Ca-Ha-HCQ3 type 6 - Ma+HCQ3 type 6 - Ma+HCQ3 type 6 - Ma+HCQ3 type 7 - Ca-Ha-HCQ3 type 7 - Ca	attributed to the saturation of N time in the relatively low transm Exceedances of baseline cond No RQOs have been establish contamination from agriculture	la and Cl ions, resulting from nissivity clay-rich shale and centrations were observed hed for this GRU. The nutri e. The adjusted water quality	The presence of Na-CI waters is n increased groundwater residence I siltstone basement aquifer. for ammonia and orthophosphate. ient exceedances are attributed to y category is B, indicating that low ons prevail (refer to DWS, 2022d,
Aquifer Stress	Recharge Volume Groundwater Availability Present Status Category of 'B', indicating localised, low levels of contamination, but no negative impacts apparent (see Recharge Volume Groundwater Use Stress (M m³/a) (M m³/a) 0.1 39.49 4.48 0.1	table below). Index Groundwa	·	roundwater Quality Present Status Groundwater Quality Present Status Category B



	GRU Name: Wel	lington									
GRU	Main Towns: We										
	Total Area (km ²):	1068.81									
Groundwater Reserve		ality Component r quality component of the dwater Quality Requireme Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4			No. Samples No. Samples 3 3 3 3 3 3 3 3 3	Baseline Conc. 7.56 202.00 290.80 42.30 78.10 551.60 118.00 1.39 1.09 0.14 0.01	Min Conc. 7.03 25.60 33.90 1.90 4.20 51.90 4.30 1.26 0.22 0.05 0.01	Max Conc. 7.56 202.00 290.80 42.30 78.10 551.60 118.00 1.39 1.09 0.21 0.21 0.14	Median Conc. 7.40 29.70 36.50 9.70 7.30 64.50 4.30 1.28 0.26 0.14 0.01	Groundwater Quality Reserve 7.56 202.00 290.80 42.30 78.10 551.60 118.00 1.39 1.09 0.15 0.01	Quality Rese BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 -
		Potassium as K antity Component	mg/l	3	3	4.09	1.39	4.09	2.68	4.09	-
	The groundwater	Potassium as K antity Component quantity component of the IN Reserves.	mg/l	3	3 below and descr	4.09	1.39 2.3 & 2.4, is cal Total Allocable	4.09 culated by cons	2.68	4.09 groundwater cor	-
	The groundwater the EWR and BH	Potassium as K antity Component quantity component of the IN Reserves.	mg/l	3 detailed in the table	3 below and descr	4.09 ribed in Section	1.39 2.3 & 2.4, is cal	4.09 culated by cons	2.68	4.09 groundwater cor a) Still Allo	-
Future Scenario 2050 (Scenario 7b)	The groundwater the EWR and BH Recharge (M 39.49	Potassium as K antity Component quantity component of the IN Reserves. m³/a) EWR Reserve	(Mm³/a)	3 detailed in the table BHN Reserve (Mm ³ 0.24 2050 and considers mine the Groundwa h climate change an chemes in the area.	3 below and descr /a) GW Res s the 'Most-Likely ater Reserve, spe d the elimination Furthermore, the	4.09 ribed in Section serve (Mm³/a) 6.99 c Case' for the f ccifically the gro of IAPs. Additio	1.39 2.3 & 2.4, is cal Total Allocable (Mm ³ / 32.51 GRU, the analys undwater contrib onally, groundwa ontribution to the	4.09 culated by cons e Volume a) is focused on the pution to the BH ter use increase e BHN Reserve	2.68 sidering the total Water Use (Mm³/a 4.48 wo key factors: F N and EWR. The cd from 4.48 to 8. rose from 0.24 to	4.09 groundwater cor a) Still Allo Recharge and W e scenario involvo .79 M m ³ /a due to	- ntribution to b peable (Mm³/a) 28.03 28.03 ater Use. Th ed a decreas
	The groundwater the EWR and BH Recharge (M 39.49	Potassium as K antity Component r quantity component of the IN Reserves. m ³ /a) EWR Reserve 6.75 6.75 which projects conditions for fluenced the parameters us 1.49 to 33.07 M m ³ /a, influen ntation of groundwater dev wth. Under these condition	(Mm ³ /a)	3 detailed in the table BHN Reserve (Mm ³ 0.24 2050 and considers mine the Groundwa h climate change an chemes in the area.	3 below and descr /a) GW Res /a) GW Res //a) GW Res //a) GW Res //a) GW Res //a) for the set of the	4.09 ribed in Section serve (Mm³/a) 6.99 c Case' for the f ccifically the gro of IAPs. Additio	1.39 2.3 & 2.4, is cal Total Allocable (Mm ³ / 32.51 GRU, the analys undwater contrib onally, groundwa ontribution to the	4.09 culated by cons e Volume a) is focused on the bution to the BH ter use increase e BHN Reserve 5 and the table	2.68 sidering the total Water Use (Mm³/a 4.48 wo key factors: F N and EWR. The cd from 4.48 to 8. rose from 0.24 to	4.09 groundwater cor a) Still Allo Recharge and W e scenario involvo .79 M m ³ /a due to o 0.39 M m ³ /a, pr	- ntribution to b peable (Mm³/a) 28.03 28.03 ater Use. Th ed a decreas



HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDW,	ATER RESERVE DETERMINATION REPORT
HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STODT IN THE DERG CATCHMENT. GROUNDWI	ATER RESERVE DETERMINATION REPORT

GRU	GRU Name: Well Main Towns: Wel Total Area (km ²):	llington					
						strategically sele	tribution to the EWR and a Management Option 2 for monitoring the groundwater contribution ected within the Wellington GRU (see Figure 3-19 and the table below). Monitoring Description
						EWR Manager	ent Option 3
	3319CA00018	NGA	Bvii10	EWR	-33.69466	19.00487	Frequency: Monthly or Quarterly
	3319CA00056	NGA	Bvii3	EWR	-33.62661	19.02652	requency. Monthly of Quarterly
	Proposed BH		Bvii4	EWR	-33.49244285	19.08339959	1) Groundwater level:
	G1N0432	HYDSTRA	Bvii4	EWR	-33.5285	19.04005	 Manual water level measurements and continuous hourly readings from
	G1N0434	HYDSTRA	Bvii5	EWR	-33.44024	18.93324	automatically recorded level loggers. Possible need for telemetry systems. 2) Groundwater Quality:
	G1N0429	HYDSTRA	Bvii11	EWR	-33.37518	18.88481	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄
	G1N0447	HYDSTRA	Bvii11	EWR	-33.39082	18.99627	 Site specific additions for EWR: NO2, NO3, NH4
	G1N0448	HYDSTRA	Bvii15	EWR	-33.52897	18.85041	 Site specific additions as per RQO ²⁰:
	G1N0453 G1N0454	HYDSTRA HYDSTRA	Bvii5 Bvii10	EWR EWR	-33.59839 -33.6605	18.97863 18.95209	Bvii3:
Monitoring Programme	3318BD00196	NGA	Biv1	EWR	-33.0605	18.9912	Nutrients (Phosphate [PO ₄ -P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical
Monitoring r Togramme	3318BD00196	NGA	Bivi Bvii4	EWR	-33.28495	18.9912	Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature,
	3318BD00182	NGA	Bvii5	EWR	-33.49301	18.92232	pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine and Endusulfan).
	Proposed BH	NGA	Bviii11	EWR	-33.62228308	19.08690413	Bvii5:
	3318DB00329	NGA	Bvii10	EWR	-33.63912	18.99648	Nutrients (Phosphate [PO ₄ -P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical
	3318DB00328	NGA	Bvii10	EWR	-33.6369	18.96593	Conductivity [EC]); Pathogens (Escherichia Coli); System Variables (Temperature,
	G1N0551	HYDSTRA	Biv1	EWR	-33.29367	18.87805	pH, Dissolved Oxygen), Toxins (Ammonia, Atrazine and Endusulfan).
	C III CO I	mbonit	Bivi	Link	00.20007	BHN Managem	ent Option 2
	3318DB00358	NGA	GRU	BHN	-33.67853	18.95396	Frequency: Quarterly
	3318DB00083	NGA	GRU	BHN	-33.68082	18.99092	 Groundwater level: Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger.
	3318BD00169	NGA	GRU	BHN	-33.34884	18.87482	 automatically recorded level logget. Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4
	96016	WMS	GRU	BHN	-33.691944	18.901667	 Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms



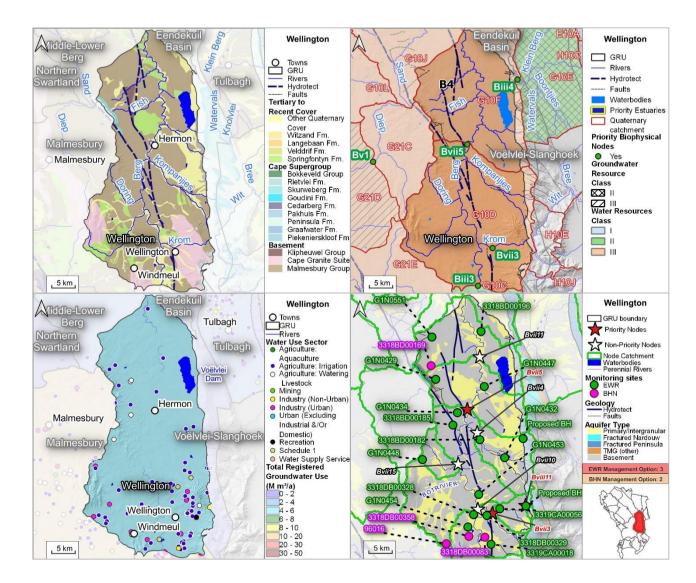


Figure 3-19 A series of maps for the Wellington GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.6. Tulbagh GRU

	GRU Name: Tulbagh								
GRU	Main Towns: Tulbagh								
	Total Area (km ²): 291.38								
GRU Boundary Description	The Tulbagh GRU is confined by the extent of the basement lithology, specifically the Malmesbury Group, and its contact with the TMG on its northern, eastern, and western edges. The southern boundary is defined by the Berg catchment, specifically the H10F surface water quaternary catchment divide (refer to Figure 3-20 and DWS, 2022d and 2023a).								
Quaternary Catchments	G10E and G10G (Figure 3-20)								
Resource Unit		Fractured and Intergram	nular Basement Aquifer						
Description	The Tulbagh GRU is primarily underlain by the Ma the Klein Berg catchment. In the east of the GRU, t of the Tulbagh Valley, represented by the Waterva 2023a).	he Tulbagh Valley is bounded on the east, v	vest, and north by slopes of the T	MG, predominantly the Peni	insula Fm. The western boundary				
Surface Water System	The primary surface water system in this GRU is Figure 3-20 and DWS, 2022d and 2023a).	the Klein-Berg River, which is complement	ed by its tributaries including the	e Boontjies, Waterval, Brakk	cloof, and Knolvlei rivers (refer to				
Water Resource Classes & RQOs	The GRU falls entirely within the Berg Tributaries (C5) IUA and is assigned a Water Resource Class II. The segments of the GRU within catchment G10E have a Groundwater Resource Class of II, while the remainder of the GRU has no Groundwater Resource Class assigned. There are no EWR sites or priority biophysical nodes in this GRU (see Figure 3-20).								
	An articular data from a (40.07 Mar ³ /succession)								
Recharge	for the Aquifer Stress assessments. The average r below and DWS (2022e) for further details.	mined from first-order recharge calculations echarge rate is 37.31 mm/a based on the to	using the Map-Centric Simulation tal GRU area. Additional recharc	on method, and was chosen le estimations are available i	as the estimated recharge value in the literature. Refer to the table				
Recharge	for the Aquifer Stress assessments. The average r below and DWS (2022e) for further details.	echarge rate is 37.31 mm/a based on the to	using the Map-Centric Simulation tal GRU area. Additional recharg Recharge Volume	e estimations are available i	as the estimated recharge value in the literature. Refer to the table				
Recharge	for the Aquifer Stress assessments. The average r below and DWS (2022e) for further details.	echarge rate is 37.31 mm/a based on the to Area (km²)	tal GRU area. Additional recharg Recharge Volume (M m³/a)	e estimations are available i	in the literature. Refer to the table werage Recharge Rate (mm/a)				
Recharge	for the Aquifer Stress assessments. The average r below and DWS (2022e) for further details.	echarge rate is 37.31 mm/a based on the to	tal GRU area. Additional recharg	e estimations are available i	in the literature. Refer to the table				



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	GRU Name: Tulbagh						
GRU	Main Towns: Tulbagh						
ONO	Total Area (km ²): 291.38						
Water Quality				No water quality data			
Aquifer Stress	The GRU is considered to be determined due to limite Recharge Volume (M m ³ /a) 10.87	ed data availability (see tab	ability Present Status Cate le below). ndwater Use M m ³ /a) 3.78	egory of 'C', indicating a mo Stress Index 0.35	derately stressed aquifer, a Groundwater Availa Status Cate C	bility Present Groundv	ity Present Status could not vater Quality Present Status Category N/A
Groundwater Reserve	Groundwater Quality Comp Groundwater Quantity Com The groundwater quantity of the EWR and BHN Reserv Recharge (Mm³/a) 10.87	nponent component of the Reserve	, detailed in the table below BHN Reserve (Mm³/a) 0.02	No water quality data w and described in Section GW Reserve (Mm³/a) 1.30	2.3 & 2.4, is calculated by Total Allocable Volume (Mm ³ /a) 9.57	considering the total grour Water Use (Mm³/a) 3.78	ndwater contribution to both Still Allocable (Mm³/a) 5.79
Future Scenario 2050 (Scenario 7b)	factors directly influenced t recharge from 10.87 to 9.3	he parameters used to det 4 M m ³ /a, influenced by bo groundwater development	ermine the Groundwater R th climate change and the schemes in the area. Furth	elimination of IAPs. Addition elimination of IAPs. Addition nermore, the groundwater co	undwater contribution to the nally, groundwater use incre ontribution to the BHN Rese	BHN and EWR. The scer eased from 3.78 to 6.66 M	arge and Water Use. These nario involved a decrease in m ³ /a due to sectoral growth M m ³ /a, primarily attributed Still Allocable (Mm ³ /a) 1.35



GRU	GRU Name: Tulba Main Towns: Tulba Total Area (km ²): 2	agh					
		l of 5 monito	ring sites for the	EWR and 2 for			tribution to the EWR and a Management Option 1 for monitoring the groundwater contribution cted within the Tulbagh GRU (see Figure 3-20 and the table below).
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Monitoring Description
						EWR Manager	
	3319AA00001	NGA	Biii4	EWR	-33.23078	19.13263	Frequency: Monthly or Quarterly 1) Groundwater level:
	3319AC00001	NGA	Biii4	EWR	-33.38355	19.21597	 Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems. Groundwater Quality:
	3319AC00043	NGA	Biii4	EWR	-33.32106	19.11874	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄ Site specific additions as per RQO ²⁰:
Monitoring Programme	3319AA00005	NGA	Biii4	EWR	-33.24188	19.15487	Biii4: Nutrients (Phosphate [PO₄-P] and Total Inorganic Nitrogen [TIN]); Salts (Electrical Conductivity [EC]): Pathogens (Escherichia Coli); System Variables
	3319AA00009	NGA	Biii4	EWR	-33.23356	19.10763	(Temperature, pH, Dissolved Oxygen); Toxins (Ammonia, Atrazine, Endusulfan)
						BHN Managen	
	3319AC00028	NGA	GRU	BHN	-33.28355	19.14096	Frequency: Quarterly or Biannual (Summer & Winter): 1) Groundwater level: Manual groundwater level measurements 2) Groundwater Quality (Background water quality and BHN):
	89812	WMS	GRU	BNH	-33.376667	19.168889	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms



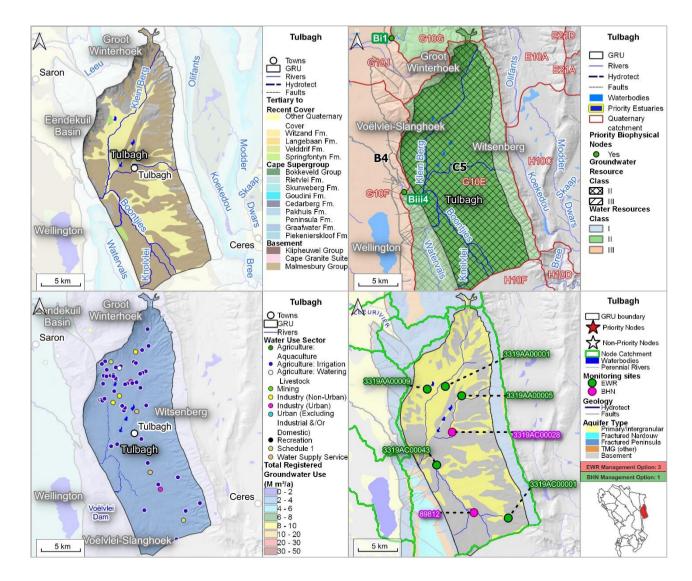


Figure 3-20 A series of maps for the Tulbagh GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.7. Eendekuil Basin GRU

	GRU Name: Eendekuil Basin							
GRU	Main Towns: Porterville and Piketberg							
	Total Area (km ²): 939.94							
GRU Boundary Description	The Eendekuil Basin GRU is defined by the extent of the basement lithologies, specifically the Malmesbury Group, and its contact with the TMG outcrop on the eastern flank of the GRU. In the north, portions of the Aurora-Piketberg fault zone contribute to the boundary. The Berg and Klein Berg rivers serve as the south/south-western boundaries. The definition of the GRU also takes into account the preferential groundwater flow direction and inferred discharge directions toward both the north and south (refer to Figure 3-21 and DWS, 2022d and 2023a).							
Quaternary Catchments	G10H, G10J, G10F and G10K (Figure 3-21)							
Resource Unit	Eractured and Intergra	nular Basement Aquifer						
Description	The Eendekuil Basin GRU is primarily composed of the Malmesbury Group, with some outcrops recent sediment deposits resulting from the weathering of the TMG mountains to the east of the areas (refer to DWS, 2022d and 2023a).	s of the Klipheuwel Group making up	the basement lithology. A Vier-en-Twintig River and	dditionally, there are Quaternary- d overlay the basement in certain				
Surface Water System	The western boundary of the GRU is defined by the Berg River, serving as the primary surfa Dam, supplied by several rivers originating from the mountainous areas of the Groot Winter Twintig rivers (refer to Figure 3-21 and DWS, 2022d and 2023a).	ce water system in this region. Addi hoek, including the Krom, Pyls, Ass	itional surface water syste egaaibosspruit, Jakkalskl	ems encompass the Misverstand loof, Bothmankloof, and Vier-en-				
Water Resource Classes & RQOs	The GRU falls entirely within the Lower Berg (B4) and is assigned a Water Resource Class III III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E							
Classes & RQOs		EWR sites within this IUA, nor are the susing the Map-Centric Simulation n	ere any priority biophysica	al nodes (Figure 3-21).				
	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m ³ /a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details.	EWR sites within this IUA, nor are the susing the Map-Centric Simulation n otal GRU area. Additional recharge e Recharge Volume	ere any priority biophysica nethod and was selected estimations are available in	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m ³ /a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to	EWR sites within this IUA, nor are the susing the Map-Centric Simulation n otal GRU area. Additional recharge e Recharge Volume	ere any priority biophysica nethod and was selected estimations are available in	al nodes (Figure 3-21).				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m ³ /a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details.	EWR sites within this IUA, nor are the susing the Map-Centric Simulation n otal GRU area. Additional recharge e	ere any priority biophysica nethod and was selected estimations are available in	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²)	EWR sites within this IUA, nor are the susing the Map-Centric Simulation n otal GRU area. Additional recharge e Recharge Volume (M m³/a)	ere any priority biophysica nethod and was selected estimations are available in	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a)				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²)	EWR sites within this IUA, nor are the susing the Map-Centric Simulation in the stal GRU area. Additional recharge e Recharge Volume (M m³/a) 21.88	ere any priority biophysica nethod and was selected estimations are available in Av	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²)	EWR sites within this IUA, nor are the susing the Map-Centric Simulation notal GRU area. Additional recharge e Recharge Volume (M m³/a) 21.88 Water Use Sector	ere any priority biophysica nethod and was selected estimations are available in Av	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a)				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²)	EWR sites within this IUA, nor are the susing the Map-Centric Simulation motal GRU area. Additional recharge end (M m³/a) 21.88	ere any priority biophysica nethod and was selected estimations are available in Av No. of Users ured And Intergranular Basem	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) ment				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²) Map Centric Simulation Method 936.94	WR sites within this IUA, nor are the susing the Map-Centric Simulation notal GRU area. Additional recharge end (M m³/a) 21.88	ere any priority biophysica nethod and was selected estimations are available in Av No. of Users ured And Intergranular Basen 19	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) nent 1.52				
Classes & RQOs Recharge	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²) Map Centric Simulation Method 936.94 In this GRU, there are 33 registered groundwater users, collectively utilizing 4.85 M m³/a of	WR sites within this IUA, nor are the susing the Map-Centric Simulation motal GRU area. Additional recharge e Recharge Volume (M m³/a) 21.88	ere any priority biophysica method and was selected estimations are available in Available in No. of Users ured And Intergranular Basen 19 3	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table /erage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) nent 1.52 0.06				
Classes & RQOs	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²) Map Centric Simulation Method 936.94 In this GRU, there are 33 registered groundwater users, collectively utilizing 4.85 M m³/a of groundwater. The primary groundwater use sectors are Water Supply Services and	WR sites within this IUA, nor are the susing the Map-Centric Simulation motal GRU area. Additional recharge e Recharge Volume (M m³/a) 21.88 Recharge Volume (M m³/a) 21.88 Water Use Sector Fracture: Agriculture: Watering Livestock Industry (Urban)	ere any priority biophysica method and was selected estimations are available in Available No. of Users ured And Intergranular Basen 19 3 3	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table /erage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) nent 1.52 0.06 0.01				
Classes & RQOs Recharge	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²) Map Centric Simulation Method 936.94 In this GRU, there are 33 registered groundwater users, collectively utilizing 4.85 M m³/a of groundwater. The primary groundwater use sectors are Water Supply Services and Agriculture (Irrigation), contributing 61.9% and 36.7%, respectively, to the total annual	WR sites within this IUA, nor are the susing the Map-Centric Simulation motal GRU area. Additional recharge end (M m³/a) 21.88	ere any priority biophysica nethod and was selected estimations are available in No. of Users ured And Intergranular Basen 19 3 3 3 imary / Intergranular Aquifers	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) nent 1.52 0.06 0.01 3				
Classes & RQOs Recharge	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²) Map Centric Simulation Method 936.94 In this GRU, there are 33 registered groundwater users, collectively utilizing 4.85 M m³/a of groundwater. The primary groundwater use sectors are Water Supply Services and	WR sites within this IUA, nor are the susing the Map-Centric Simulation motal GRU area. Additional recharge end (M m³/a) 21.88 Recharge Volume (M m³/a) 21.88 Water Use Sector Fractulture: Irrigation Agriculture: Watering Livestock Industry (Urban) Pr	ere any priority biophysica method and was selected estimations are available in Available No. of Users ured And Intergranular Basen 19 3 3	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) ment 1.52 0.06 0.01 5 0.26				
Classes & RQOs Recharge	III, while the rest of the GRU has no Groundwater Resource Class designated. There are no E An estimated recharge of 21.88 M m³/a was determined from first-order recharge calculations for the Aquifer Stress assessments. The average recharge rate is 23.35 mm/a based on the to below and DWS (2022e) for further details. Method Area (km²) Map Centric Simulation Method 936.94 In this GRU, there are 33 registered groundwater users, collectively utilizing 4.85 M m³/a of groundwater. The primary groundwater use sectors are Water Supply Services and Agriculture (Irrigation), contributing 61.9% and 36.7%, respectively, to the total annual	WR sites within this IUA, nor are the susing the Map-Centric Simulation motal GRU area. Additional recharge end (M m³/a) 21.88	ere any priority biophysica nethod and was selected estimations are available in No. of Users ured And Intergranular Basen 19 3 3 3 imary / Intergranular Aquifers	al nodes (Figure 3-21). as the estimated recharge value n the literature. Refer to the table verage Recharge Rate (mm/a) 23.35 Total Volume (M m³/a) nent 1.52 0.06 0.01 3				



	GRU Name: Eendekuil Basin											
GRU	Main Towns: Porterville and Piketberg											
	Total Area (km ²)	: 939.94										
Water Quality		Key Een 1 - C-H4C0 type 8 2 - H4C0 type 6 3 - C-H4-H00 type 6 4 - C-H4-C0 type 6 5 - AH-C1 type 6 6 - No-HC0 type 6 20 0 1 100 0 0 20 0 0 6 40 20 100 0 6 6 80 0 0 6 6 40 20	dekuil Basin 100 100 5 60 G 4 4 4 7 20 6 5 6 5 6 5 6 7 20 7 7 7 7 7 7 7 7 7 7 7 7 7	0 80 60 40 40 20 0 50 80 100	The primary water type in Eendekuil Basin GRU is Na-Cl. The presence of Na-Cl waters attributed to the saturation of Na and Cl ions, resulting from increased groundwater residenc time in the relatively low transmissivity clay-rich shale and siltstone basement aquifer. Exceedances of baseline concentrations were observed for multiple parameters, with mou than 50% of samples exceeding baselines for sulphate, EC, nitrate + nitrite, and fluoride. Tw of the four samples collected exceed the RQO for pH. The adjusted water quality category C, indicating that moderate levels of contamination exist in the Eendekuil Basin GRU (se DWS, 2022d, 2022e and 2023a for detail).							
			watar Availabi	lity Present Stat	us Category of '0	C', indicating a	moderately stre	ssed aquifer, an	d a Groundwa	ater Quality Prese	nt Status of	
Aquifer Stress	indicating moder Recha	sidered to have a Ground ate levels of localised conta rge Volume 4 m ³ /a) 21.88	Groundwater Availabil Groundwate (M m ³) 4.85	little or no negat er Use ⁄a)	ive impacts apparent	rent (see table l ess Index 0.22	below).	dwater Availability I Status Category C		Groundwater Quality Categor C	Present Status	
Aquifer Stress	indicating moder	ate levels of localised conta rge Volume 1 m ³ /a) 21.88	amination, but Groundwat (M m³, 4.85 Reserve, detai	little or no negat er Use (a)	ive impacts apparent street	rent (see table l ess Index 0.22	Groun	dwater Availability I Status Category C	Present (Catego C	Present Status y	
Aquifer Stress	Groundwater Qu The groundwate and 2) the Groun	ate levels of localised conta rge Volume 1 m ³ /a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter pH	amination, but Groundwat (M m³, 4.85 4.85 Reserve, detai nt for BHN. Unit	little or no negat	ve impacts apparent street str	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20	2.3 & 2.4, is dete Min Conc. 7.86	dwater Availability I Status Category C rmined as two co Max Conc. 8.45	Present (pomponents 1) : Median Conc. 8.14	Categor C the Groundwater (Groundwater Quality Reserve 8.45	Present Status y Quality Reser BHN Threshold 5 – 9	
Aquifer Stress	Groundwater Qu The groundwate and 2) the Groun	ate levels of localised containing Volume I m³/a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter pH Electrical Conductivity	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit	little or no negat	below and describ	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00	2.3 & 2.4, is dete Min Conc. 7.86 42.10	dwater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00	Present (pomponents 1) + Median Conc. 8.14 233.00	Categor C the Groundwater C Groundwater Quality Reserve 8.45 256.30	Present Status y Quality Rese BHN Threshold 5 – 9 150	
	indicating moder Recha (N Groundwater Qu The groundwate and 2) the Groun Aquifer Unit	ate levels of localised conta rge Volume 1 m ³ /a) 21.88 ality Component r quality component of the idwater Quality Requireme Parameter pH Electrical Conductivity Sodium as Na	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit Unit mS/m mg/l	little or no negat	ve impacts apparent street str	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20	Conc. Co	dwater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10	Present (pomponents 1) * Median Conc. 8.14 233.00 444.10	Categor C C the Groundwater (Groundwater Quality Reserve 8.45 256.30 488.51	Present Statu y Quality Rese BHN Threshold 5 – 9 150 200	
	indicating moder Recha (N Groundwater Qu The groundwate and 2) the Groun Aquifer Unit Fractured	ate levels of localised conta rge Volume 1 m ³ /a) 21.88 ality Component r quality component of the idwater Quality Requireme Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca	amination, but Groundwat (M m³, 4.85 A.85 Reserve, detai nt for BHN. Unit Unit mS/m mg/l	little or no negat	No. Samples	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50	Contemporation Contemporatio Contemporation Contemporation Contemporation Contemp	dwater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00	Present 0 pmponents 1) 1 Median Conc. 1 8.14 233.00 444.10 20.85	Categor C C the Groundwater C Groundwater Quality Reserve 8.45 256.30 488.51 25.50	Present Statu y Quality Rese BHN Threshold 5 – 9 150 200 150	
	indicating moder Recha (N Groundwater Qu The groundwater and 2) the Grour Aquifer Unit Fractured and	ate levels of localised containing Volume A m³/a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit Unit mg/l mg/l	little or no negat (a) led in the table b No. BHs 10 10 10 10 10	No. Samples	eest Index 0.22 0.22 0eed in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20	Contemporation Contemporatio Contemporation Contemporation Contemporation Contemp	dwater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00	Present (pomponents 1) * Median Conc. 8.14 233.00 444.10 20.85 55.05	Categor C C the Groundwater C Groundwater Quality Reserve 8.45 256.30 488.51 25.50 60.56	Present Statu y Quality Rese BHN Threshold 5 – 9 150 200 150 70	
	indicating moder Recha (N Groundwater Qu The groundwater and 2) the Groun Aquifer Unit Fractured and Intergranular	ate levels of localised containing Volume I m³/a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl	amination, but Groundwat (M m³) 4.85 Reserve, detai nt for BHN. Unit Unit mg/l mg/l mg/l	little or no negat ier Use (a) led in the table b No. BHs 10 10 10 10 10	No. Samples 10 10 10 10 10 10 10 10 10 10 10 10 10	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20 543.60	C.3 & 2.4, is dete Min Conc. 7.86 42.10 41.70 10.60 18.40 92.80	dwater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00 1873.40	Present (pomponents 1) * Median Conc. 8.14 233.00 444.10 20.85 55.05 664.90	Categor C C the Groundwater Quality Reserve 8.45 256.30 488.51 25.50 60.56 731.39	Present Status y Quality Rese BHN Threshold 5 – 9 150 200 150 70 200	
·	indicating moder Recha (N Groundwater Qu The groundwater and 2) the Groun Aquifer Unit Fractured and Intergranular Basement	ate levels of localised containing Volume I m³/a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4	amination, but Groundwat (M m³) 4.85 Reserve, detai nt for BHN. Unit Unit MS/m mg/l mg/l mg/l mg/l	little or no negat let Use (a) led in the table b No. BHs 10 10 10 10 10 10 10 10 10 10	No. Samples 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10 10	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20 58.20 58.20 543.60 52.60	C.3 & 2.4, is dete Min Conc. 7.86 42.10 41.70 10.60 18.40 92.80 7.30	Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00 1873.40 219.00	Present 0 pomponents 1) Median Conc. 8.14 233.00 444.10 444.10 20.85 55.05 664.90 79.55 79.55	Categor C C the Groundwater Quality Reserve 8.45 256.30 488.51 25.50 60.56 731.39 87.51	Present Status y Quality Rese BHN Threshold 5 - 9 150 200 150 70 200 400	
·	indicating moder Recha (N Groundwater Qu The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer	ate levels of localised containing Volume I m³/a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit Unit Unit MS/m mg/l mg/l mg/l mg/l mg/l	little or no negat let Use (a) led in the table b No. BHs 10 10 10 10 10 10 10 10 10 10	No. Samples 10	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20 543.60 52.60 0.84	C.3 & 2.4, is dete Min Conc. 7.86 42.10 41.70 10.60 18.40 92.80 7.30 0.04	Advater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00 1873.40 219.00 5.39	Present 0 omponents 1) 0 Median Conc. 0 8.14 233.00 444.10 20.85 55.05 664.90 79.55 0.85	Categor C C C C C C C C C C C C C C C C C C C	Present Status y Quality Rese BHN Threshold 5 – 9 150 200 150 70 200 400 10	
	indicating moder Recha (N Groundwater Qu The groundwater and 2) the Groun Aquifer Unit Fractured and Intergranular Basement	ate levels of localised conta rge Volume 1 m ³ /a) 21.88 ality Component r quality component of the advater Quality Requireme Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit Unit Unit mg/l mg/l mg/l mg/l mg/l mg/l	little or no negat let Use (a) led in the table b No. BHs 10 10 10 10 10 10 10 10 10 10	No. Samples 10	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20 543.60 52.60 0.84 0.94	Contemporation Contemporatio Contemporation Contemporation Contemporation Contemp	Advater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00 1873.40 219.00 5.39 1.87	Median Conc. 8.14 233.00 444.10 20.85 55.05 664.90 79.55 0.85 1.01	Categor C C C C C C C C C C C C C C C C C C C	Present Status y Quality Reserved BHN Threshold 5 - 9 150 200 150 200 400 10 1.5	
Aquifer Stress	indicating moder Recha (N Groundwater Qu The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer	ate levels of localised containing Volume I m³/a) 21.88 ality Component r quality component of the adwater Quality Requireme Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as CI Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit Unit Unit mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg/l	little or no negat let Use (a) led in the table b No. BHs 10 10 10 10 10 10 10 10 10 10	No. Samples 10	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20 543.60 52.60 0.84 0.94 0.02	Min Conc. 7.86 42.10 41.70 10.60 18.40 92.80 7.30 0.04 0.20 0.02	Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00 1873.40 219.00 5.39 1.87 0.05	Present O pmponents 1) Median Conc. 1) 8.14 233.00 444.10 20.85 55.05 664.90 79.55 0.85 1.01 0.02	Categor C C C C C C C C C C C C C C C C C C C	Present Status y Quality Reset BHN Threshold 5 - 9 150 200 150 70 200 10 10 1.5 -	
	indicating moder Recha (N Groundwater Qu The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer	ate levels of localised conta rge Volume 1 m ³ /a) 21.88 ality Component r quality component of the advater Quality Requireme Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F	amination, but Groundwat (M m³, 4.85 Reserve, detai nt for BHN. Unit Unit Unit mg/l mg/l mg/l mg/l mg/l mg/l	little or no negat let Use (a) led in the table b No. BHs 10 10 10 10 10 10 10 10 10 10	No. Samples 10	rent (see table l ess Index 0.22 Ded in Section 2 Baseline Conc. 8.20 205.00 323.20 25.50 58.20 543.60 52.60 0.84 0.94	Contemporation Contemporatio Contemporation Contemporation Contemporation Contemp	Advater Availability I Status Category C rmined as two co Max Conc. 8.45 583.00 967.10 151.00 342.00 1873.40 219.00 5.39 1.87	Median Conc. 8.14 233.00 444.10 20.85 55.05 664.90 79.55 0.85 1.01	Categor C C C C C C C C C C C C C C C C C C C	Present Status y Quality Reserved BHN Threshold 5 - 9 150 200 150 200 400 10 1.5	



HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT

GRU	GRU Name: Eendekuil Basin Main Towns: Porterville and Piketberg Total Area (km ²): 939.94									
	Groundwater Qua	antity Compone	ent							
	The groundwater the EWR and BH		onent of the Res	serve, detailed in	the table below	and described ir	Section 2	2.3 & 2.4, is calculated by	considering the total grou	ndwater contribution to b
	Recharge (M	m³/a) EV	VR Reserve (Mm ³ /	a) BHN Res	serve (Mm ³ /a)	GW Reserve (M	/lm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm ³ /a)	Still Allocable (Mm ³ /a)
	21.88		6.95		0.09	7.04		14.84	4.85	9.99
Future Scenario 2050 (Scenario 7b)	recharge from 21 and the implement to population grou	.88 to 17.31 M intation of groun wth. In light of t	m ³ /a, influenced dwater developm hese changes, th	by both climate c nent schemes in t he Allocation Cat	change and the e the area. Further tegory shifted fro	limination of IAP more, the ground m D to E (refer t	s. Additior dwater cor o Section	ally, groundwater use incr	e BHN and EWR. The sce reased from 4.85 to 6.57 M rve rose from 0.09 to 0.016	I m ³ /a due to sectoral gro 6 M m ³ /a, primarily attrib
	Recharge (Mi	m ³ /a) EV	VR Reserve (Mm ³ /	·	serve (Mm³/a) 0.16	GW Reserve (N 7.11	/lm³/a)	(Mm³/a) 10.21	Water Use (Mm ³ /a) 6.57	Still Allocable (Mm ³ /a) 3.64
									Anagement Option 2 for a sain GRU (see Figure 3-2	
								ted within the Eendekuil B		
	contribution to the Site Name	e BHN. A total o Data Source	of 9 monitoring s Monitoring Area	ites for the EWR Monitoring Objective	and 3 for the BH	IN were strategie Longitude EWR Managemen	cally selec	ted within the Eendekuil B	Basin GRU (see Figure 3-2	
	contribution to the	e BHN. A total o	of 9 monitoring s Monitoring Area Biii5	Monitoring Objective EWR	and 3 for the BH Latitude -32.960132	IN were strategie Longitude EWR Managemen 18.999392	t Option 3 Frequence	ted within the Eendekuil B N y: Monthly or Quarterly	Basin GRU (see Figure 3-2	
	contribution to the Site Name	e BHN. A total o Data Source	of 9 monitoring s Monitoring Area	ites for the EWR Monitoring Objective	and 3 for the BH	IN were strategie Longitude EWR Managemen	cally selec	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: O Manual water level rel	Basin GRU (see Figure 3-2 Monitoring Description	21 and the table below).
	Contribution to the Site Name G1N0193 Proposed BH G1N0059	e BHN. A total o Data Source HYDSTRA HYDSTRA	Monitoring s Monitoring Area Biii5 Biv3 Biii5	Monitoring Objective EWR EWR EWR EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013	Longitude EWR Managemen 18.999392 18.95370508 18.849388	t Option 3 Frequence 1)	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: o Manual water level r automatically record	Basin GRU (see Figure 3-2	21 and the table below). s hourly readings from
	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA	Monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4	Monitoring Objective EWR EWR EWR EWR EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023	N were strategin Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732	t Option 3 Frequence	y: Monthly or Quarterly Groundwater level: Manual water level r automatically record Groundwater Quality: Standard Parameter	Monitoring Description Monitoring Description measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa	21 and the table below). s hourly readings from ed for telemetry systems.
	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00038	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA	Monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16	Monitoring Objective EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.1444	Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009	t Option 3 Frequence 1)	y: Monthly or Quarterly Groundwater level: Manual water level r automatically record Groundwater Quality: Standard Parameter	Monitoring Description Monitoring Description measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄	21 and the table below). s hourly readings from ed for telemetry systems.
Monitoring Programme	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00038 3319AA00063	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA NGA	Monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16 Bvii6	Monitoring Objective EWR EWR EWR EWR EWR EWR EWR EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.1444 -33.05716	Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009 19.01653	t Option 3 Frequence 1)	y: Monthly or Quarterly Groundwater level: Manual water level r automatically record Groundwater Quality: Standard Parameter Site specific additior Site specific additior	Monitoring Description Monitoring Description measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄	21 and the table below). s hourly readings from ed for telemetry systems.
Monitoring Programme	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00038 3319AA00063 3318BB00066	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA NGA NGA	Monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16 Bvii16 Bvii8	Monitoring Objective EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.18023 -33.1444 -33.05716 -33.10245	Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009 19.01653 18.88343	t Option 3 Frequence 1)	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: o Manual water level r automatically record Groundwater Quality: o Standard Parameter o Site specific additior o Site specific additior Bvii6: Nutrients (Phosphat	Monitoring Description Monitoring Description Measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄ ns as per RQO ²⁰ : te [PO ₄ -P] and Total Inorganic	21 and the table below). s hourly readings from ed for telemetry systems. lk, MAlk, F, Cl, PO ₄ , SO ₄
Monitoring Programme	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00057 3318BB00066 3319AA00013	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA NGA NGA NGA	of 9 monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16 Bvii16 Bvii8 Biv3	Monitoring Objective EWR EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.18023 -33.1444 -33.05716 -33.10245 -33.1905	Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009 19.01653 18.88343 19.0243	t Option 3 Frequence 1)	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: • Manual water level r automatically record Groundwater Quality: • Standard Parameter • Site specific additior • Site specific additior Bvii6: Nutrients (Phosphat (Electrical Conductiv	Monitoring Description Monitoring Description measurements and continuous led level loggers. Possible nee rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄ ns as per RQO ²⁰ :	21 and the table below). s hourly readings from ed for telemetry systems. lk, MAlk, F, Cl, PO ₄ , SO ₄ Nitrogen [TIN]); Salts ichia Coli); System Variable
Monitoring Programme	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00038 3319AA00063 3318BB00066	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA NGA NGA	Monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16 Bvii16 Bvii8	Monitoring Objective EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.18023 -33.1444 -33.05716 -33.10245 -33.1905 -33.28355	Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009 19.01653 18.88343 19.0243 19.05208	t Option 3 Frequence 1) 2)	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: • Manual water level r automatically record Groundwater Quality: • Standard Parameter • Site specific additior • Site specific additior Bvii6: Nutrients (Phosphat (Electrical Conductiv	Monitoring Description Monitoring Description measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄ ns as per RQO ²⁰ : te [PO ₄ -P] and Total Inorganic vity [EC]); Pathogens (Escheri	21 and the table below). s hourly readings from ed for telemetry systems. lk, MAlk, F, Cl, PO ₄ , SO ₄ Nitrogen [TIN]); Salts ichia Coli); System Variable
Monitoring Programme	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00057 3318BB00066 3319AA00013	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA NGA NGA NGA	of 9 monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16 Bvii16 Bvii8 Biv3	Monitoring Objective EWR EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.18023 -33.1444 -33.05716 -33.10245 -33.1905 -33.28355	Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009 19.01653 18.88343 19.0243	t Option 3 Frequence 1) 2) COption 2	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: Manual water level r automatically record Groundwater Quality: Standard Parameter Site specific addition Bvii6: Nutrients (Phosphat (Electrical Conductiv (Temperature, pH, E y: Quarterly Groundwater level:	Asin GRU (see Figure 3-2 Monitoring Description measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄ ns as per RQO ²⁰ : te [PO ₄ -P] and Total Inorganic vity [EC]); Pathogens (Escheri Dissolved Oxygen); Toxins (At	21 and the table below). s hourly readings from ed for telemetry systems. lk, MAlk, F, Cl, PO ₄ , SO ₄ Nitrogen [TIN]); Salts ichia Coli); System Variable razine and Endusulfan).
Monitoring Programme	Contribution to the Site Name G1N0193 Proposed BH G1N0059 3318BB00057 3318BB00057 3318BB00066 3319AA00013 3319AC00042	e BHN. A total o Data Source HYDSTRA HYDSTRA NGA NGA NGA NGA NGA	Monitoring s Monitoring Area Biii5 Biv3 Biii5 Biv4 Bvii16 Bvii8 Biv3 Biv3 Biv3 Biv3	Monitoring Objective EWR EWR EWR EWR EWR EWR EWR EWR EWR EWR	and 3 for the BH Latitude -32.960132 -33.21410414 -32.99013 -33.18023 -33.18023 -33.1444 -33.05716 -33.10245 -33.10245 -33.1905 -33.28355	N were strategie Longitude EWR Managemen 18.999392 18.95370508 18.849388 18.95732 18.92009 19.01653 18.88343 19.0243 19.05208 BHN Management	t Option 3 Frequence 1) 2) t Option 2 Frequence	ted within the Eendekuil B y: Monthly or Quarterly Groundwater level: Manual water level r automatically record Groundwater Quality: Standard Parameter Site specific additior Bvii6: Nutrients (Phosphat (Electrical Conductiv (Temperature, pH, E) y: Quarterly Groundwater level: Manual groundwater from automatically re Groundwater Quality (Back	Monitoring Description Monitoring Description measurements and continuous ded level loggers. Possible new rs: pH, EC, Ca, Mg, Na, K, Pa ns for EWR: NO ₂ , NO ₃ , NH ₄ ns as per RQO ²⁰ : te [PO ₄ -P] and Total Inorganic vity [EC]); Pathogens (Escheri	21 and the table below). s hourly readings from ed for telemetry systems. Ik, MAIk, F, CI, PO4, SO4 Nitrogen [TIN]); Salts ichia Coli); System Variable razine and Endusulfan).

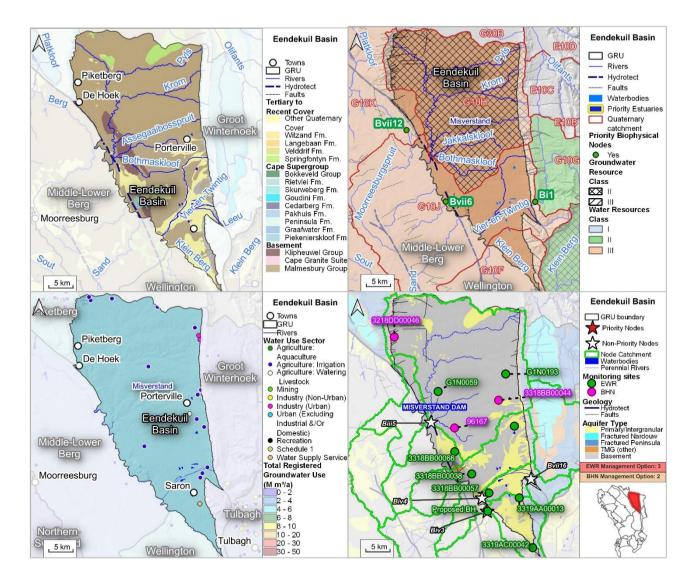


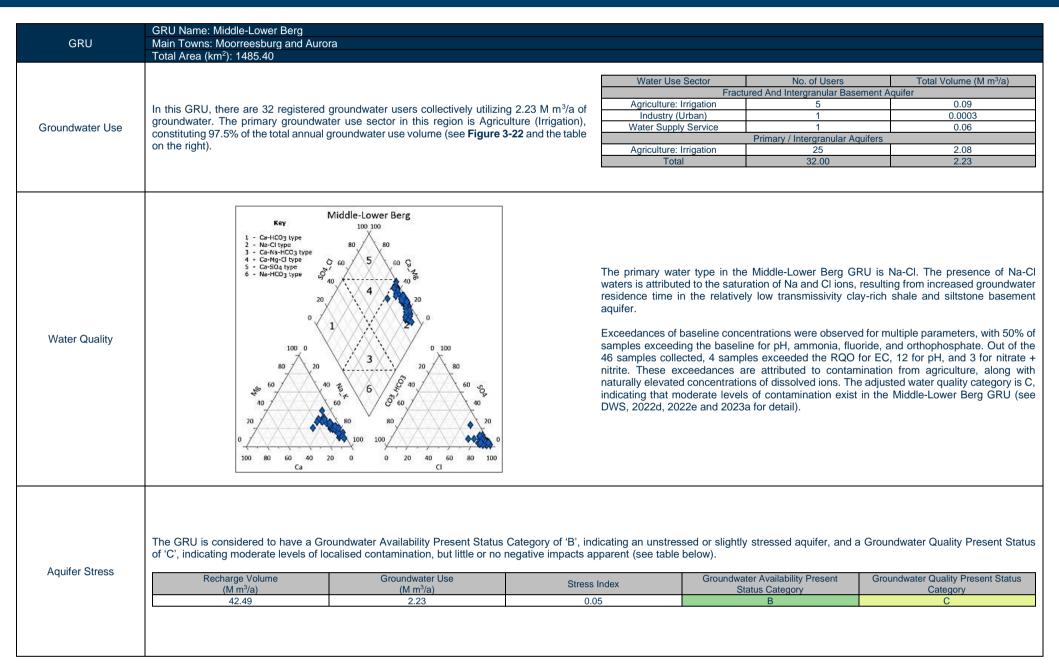
Figure 3-21 A series of maps for the Eendekuil Basin GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.8. Middle-Lower Berg GRU

5.5.6. WHU								
	GRU Name: Middle-Lo							
GRU	Main Towns: Moorreesburg and Aurora Total Area (km²): 1485.40							
	I otal Area (km ²): 1485.40							
GRU Boundary	The Middle-Lower Berg GRU is enclosed by portions of the G21C, G10L, and G10F surface water quaternary catchment divides on its south-western to south-eastern edge. The easter edge is defined by portions of the Aurora-Piketberg fault zone and the Berg and Klein Berg rivers. On the north-eastern border, the GRU is separated from the Piketberg GRU by the contact							
Description	edge is defined by portions of the Aurora-Piketberg fault zone and the Berg and Klein Berg rivers. On the north-eastern border, the GRU is separated from the Piketberg GRU by the cor between the TMG and interpolated basement lithologies of the Malmesbury Group, as well as portions of the Berg catchment boundary. The north/north-western boundary is formed by							
	Adamboerskraal aquifer model boundary (SRK, 2004) and the St Helena Bay coastline (refer to Figure 3-22 and DWS, 2022d and 2023a).							
	0401 0004 0401/	04014 (5:0000 0.00)						
Quaternary Catchments	G10J, G30A, G10K and	d G10M (Figure 3-22)						
Resource Unit			F	ractured and Interg	anular Basement Aquifer			
Description	The Middle-Lower Berg	g GRU is primarily comp	oosed of the Malmesbury	Group, which serve	s as the basement litholo	gy. Additionally, there are	Quaternary-recent s	ediment deposits in th
Description	area. Towards the nort	h-west, the GRU is dom	inated by laterally continu	uous Sandveld Grou	p sediments (refer to DW	S, 2022d and 2023a).		
	The Porg Estuany initia	too from the north wood	torn corner of this CPU o	and constitutor a sig	nificant aurface water av	stem. Contributing to the E	Pora Divor oro the K	uildora Booomona on
Surface Water System								
Surface Water System								iei to i iguie 3-22 ai
	DWS, 2022d and 2023a).							
Water Pesource	The GRU falls within th a Groundwater Resour	e Lower Berg (B4) and ce Class of II, while the		Groundwater Reso	urce Class designated. T	vely. Only portions of the A here are no priority EWR s -22 and the table below).		
Water Resource Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I	e rest of the GRU has no D, as well as portions of th	Groundwater Reson ne Berg (Groot) prior	urce Class designated. T ity estuary (see Figure 3	-22 and the table below).	sites within this IUA;	however, there are tw
Water Resource Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class	e rest of the GRU has no	Groundwater Reso	urce Class designated. T	nere are no priority EWR		
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K	Groundwater Resource ne Berg (Groot) prior RU B4-R09 B4-R10	rce Class designated. T rity estuary (see Figure 3 Resource Name Berg Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12	tes within this IUA;	however, there are tw nMAR 52 51
	The GRU falls within th a Groundwater Resour priority biophysical nod	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J	Groundwater Resolute ne Berg (Groot) priol RU B4-R09	arce Class designated. T ity estuary (see Figure 3 Resource Name Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6	sites within this IUA; TEC D	however, there are tw nMAR 52
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K	Groundwater Resource ne Berg (Groot) prior RU B4-R09 B4-R10	rce Class designated. T rity estuary (see Figure 3 Resource Name Berg Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12	tes within this IUA;	however, there are tw nMAR 52 51
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K	Groundwater Resource ne Berg (Groot) prior RU B4-R09 B4-R10	rce Class designated. T rity estuary (see Figure 3 Resource Name Berg Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12	tes within this IUA;	however, there are tw nMAR 52 51
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K	Groundwater Resource ne Berg (Groot) prior RU B4-R09 B4-R10	rce Class designated. T rity estuary (see Figure 3 Resource Name Berg Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12	tes within this IUA;	however, there are tw nMAR 52 51
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K	Groundwater Resource ne Berg (Groot) prior RU B4-R09 B4-R10	rce Class designated. T rity estuary (see Figure 3 Resource Name Berg Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12	tes within this IUA;	however, there are tw nMAR 52 51
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K	Groundwater Resource ne Berg (Groot) prior RU B4-R09 B4-R10	rce Class designated. T rity estuary (see Figure 3 Resource Name Berg Berg	ere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12	tes within this IUA;	however, there are tw nMAR 52 51
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II	e rest of the GRU has no D, as well as portions of th <u>Quaternary Catchment</u> <u>G10J</u> <u>G10K</u> <u>G10M</u>	Groundwater Reson ne Berg (Groot) prior B4-R09 B4-R10 A1-E01	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot)	Biophysical Node Biophysical Node Bvii6 Bvii12 Bxi1	TEC D D C	however, there are tw <u>nMAR</u> 52 51 52 52
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K G10M	Groundwater Reso ne Berg (Groot) prior RU B4-R09 B4-R10 A1-E01	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot)	Pere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and w	TEC D D C	however, there are tw <u>nMAR</u> 52 51 52 52 stimated recharge value
Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge for the Aquifer Stress a	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II 0 f 42.49 M m ³ /a was d ssessments. The average	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K G10M	Groundwater Reso ne Berg (Groot) prior RU B4-R09 B4-R10 A1-E01	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot)	Biophysical Node Biophysical Node Bvii6 Bvii12 Bxi1	TEC D D C	however, there are two nMAR 52 51 52 52 stimated recharge valu
	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II 0 f 42.49 M m ³ /a was d ssessments. The average	e rest of the GRU has no D, as well as portions of th Quaternary Catchment G10J G10K G10M	Groundwater Reso ne Berg (Groot) prior RU B4-R09 B4-R10 A1-E01	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot)	Pere are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and w	TEC D D C	however, there are two nMAR 52 51 52 52 52
Classes & RQOs	The GRU falls within the a Groundwater Resourd priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge for the Aquifer Stress a below and DWS (2022)	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II 0 f 42.49 M m ³ /a was d ssessments. The average) for further details.	e rest of the GRU has no D, as well as portions of the G10J G10K G10M etermined from first-order ge recharge rate is 28.61	Groundwater Reson ne Berg (Groot) prior B4-R09 B4-R10 A1-E01 r recharge calculatic mm/a based on the	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot) ns using the Map-Centric total GRU area. Addition	are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and wal recharge estimations are a Volume	TEC D D C vas chosen as the es available in the liter Average Re	however, there are tw <u>nMAR</u> <u>52</u> <u>51</u> <u>52</u> stimated recharge valu ature. Refer to the table charge Rate
Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge for the Aquifer Stress a below and DWS (2022)	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II II of 42.49 M m ³ /a was d ssessments. The average of for further details.	e rest of the GRU has no D, as well as portions of th <u>Quaternary Catchment</u> <u>G10J</u> <u>G10K</u> <u>G10M</u> etermined from first-order ge recharge rate is 28.61 <u>Area (k</u>	Groundwater Reson ne Berg (Groot) prior B4-R09 B4-R10 A1-E01 r recharge calculatio mm/a based on the	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot) ons using the Map-Centric total GRU area. Addition Recharg (Mr	are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and wal recharge estimations are avoid and so and so and so avoid avoid avoid and so avoid av	TEC D D C vas chosen as the es e available in the liter Average Re (mr	however, there are tw <u>nMAR</u> <u>52</u> <u>51</u> <u>52</u> stimated recharge valu ature. Refer to the tabl charge Rate n/a)
Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge for the Aquifer Stress a below and DWS (2022)	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II 0 f 42.49 M m ³ /a was d ssessments. The average) for further details.	e rest of the GRU has no D, as well as portions of the G10J G10K G10M etermined from first-order ge recharge rate is 28.61	Groundwater Reson ne Berg (Groot) prior B4-R09 B4-R10 A1-E01 r recharge calculatio mm/a based on the	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot) ons using the Map-Centric total GRU area. Addition Recharg (Mr	are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and wal recharge estimations are a Volume	TEC D D C vas chosen as the es available in the liter Average Re	however, there are tw <u>nMAR</u> <u>52</u> 51 <u>52</u> stimated recharge valu ature. Refer to the tabl charge Rate n/a)
Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge for the Aquifer Stress a below and DWS (2022)	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II II of 42.49 M m ³ /a was d ssessments. The average of for further details.	e rest of the GRU has no D, as well as portions of th <u>Quaternary Catchment</u> <u>G10J</u> <u>G10K</u> <u>G10M</u> etermined from first-order ge recharge rate is 28.61 <u>Area (k</u>	Groundwater Reson ne Berg (Groot) prior B4-R09 B4-R10 A1-E01 r recharge calculatio mm/a based on the	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot) ons using the Map-Centric total GRU area. Addition Recharg (Mr	are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and wal recharge estimations are avoid and so and so and so avoid avoid avoid and so avoid av	TEC D D C vas chosen as the es e available in the liter Average Re (mr	however, there are tw <u>nMAR</u> <u>52</u> <u>51</u> <u>52</u> stimated recharge valu ature. Refer to the tab charge Rate n/a)
Classes & RQOs	The GRU falls within th a Groundwater Resour priority biophysical nod IUA B4 Lower Berg A1 Berg Estuary An estimated recharge for the Aquifer Stress a below and DWS (2022)	e Lower Berg (B4) and ce Class of II, while the es, both with a TEC of I Water Resource Class III II II of 42.49 M m ³ /a was d ssessments. The average of for further details.	e rest of the GRU has no D, as well as portions of th <u>Quaternary Catchment</u> <u>G10J</u> <u>G10K</u> <u>G10M</u> etermined from first-order ge recharge rate is 28.61 <u>Area (k</u>	Groundwater Reson ne Berg (Groot) prior B4-R09 B4-R10 A1-E01 r recharge calculatio mm/a based on the	Arce Class designated. T ity estuary (see Figure 3 Resource Name Berg Berg Berg (Groot) ons using the Map-Centric total GRU area. Addition Recharg (Mr	are no priority EWR s -22 and the table below). Biophysical Node Bvii6 Bvii12 Bxi1 Simulation method and wal recharge estimations are avoid and so and so and so avoid avoid avoid and so avoid av	TEC D D C vas chosen as the es e available in the liter Average Re (mr	however, there are tw <u>nMAR</u> 52 51 52 stimated recharge valuature. Refer to the tab charge Rate n/a)







	GRU Name: Mid	dle-Lower Berg									
GRU		porreesburg and Aurora									
0.10	Total Area (km ²)										
	The groundwate	uality Component r quality component of the ndwater Quality Requireme	Reserve, de	etailed in the table b	elow and descrik	ed in Section 2	2.3 & 2.4, is dete	rmined as two	components 1) th	e Groundwater (Quality Reserve,
			THE IOF DEFINE.								
	Aquifer Unit	Parameter	Unit	No. BHs	No. Samples	Baseline Conc.	Min Conc.	Max Conc.	Median Conc.	Groundwater Quality Reserve	BHN Threshold
		рН		46	60	7.63	3.11	8.71	7.70	8.47	5 – 9
		Electrical Conductivity	mS/m	46	60	841.00	20.68	1212.00	636.00	841.00	150
		Sodium as Na	mg/l	46	57	1345.50	75.00	2376.10	930.60	1345.50	200
	Fractured	Calcium as Ca	mg/l	46	58	166.30	4.70	218.40	63.36	166.30	150
	and	Magnesium as Mg	mg/l	46	58	204.00	2.85	353.00	135.16	204.00	70
	Intergranular	Chloride as Cl	mg/l	46	58	2627.50	25.52	4393.30	1972.70	2627.50	200
Groundwater Reserve	Basement	Sulphate as SO4	mg/l	46	58	342.80	3.52	799.60	196.90	342.80	400
	Aquifer	Nitrate + Nitrite	mg/l	46	58	6.16	0.02	24.96	1.24	6.16	10
	(Tygerberg)	Fluoride as F	mg/l	46	58	0.57	0.17	2.22	0.67	0.74	1.5
		Ammonia as NH3	mg/l	46	58	0.02	0.02	1.37	0.04	0.04	-
		Orthophosphate as PO4	mg/l	46	58	0.01	0.00	0.13	0.01	0.01	-
		Potassium as K	mg/l	46	57	22.53	1.73	79.19	24.37	26.81	-
	The groundwate the EWR and BH Recharge (M			detailed in the table BHN Reserve (Mm ³ /		ibed in Section	2.3 & 2.4, is cal Total Allocable (Mm³/a	e Volume	sidering the total g Water Use (Mm³/a)		ntribution to both
	42.49	11.15		0.09		11.24	31.26		2.23		29.03
	42.43		I	0.09	I	11.24	51.20		2.23		23.03
Future Scenario 2050 (Scenario 7b)	factors directly in recharge from 42 and the implement		used to deter enced by both velopment sc ns, the Alloca (Mm ³ /a)	rmine the Groundwa h climate change and chemes in the area. I	ter Reserve, spe d the elimination Furthermore, the not change from of (a) GW Res	cifically the gro of IAPs. Additic groundwater c	undwater contrib onally, groundwat ontribution to the	ution to the BH ter use increas BHN Reserve and the table b Volume	IN and EWR. The ed from 2.23 to 5.0 rose from 0.09 to	scenario involvo 09 M m³/a due to 0.16 M m³/a, pri Still Allo	ed a decrease in o sectoral growth



GRU	GRU Name: Mide Main Towns: Moe Total Area (km ²):	orreesburg and					
	The Middle-Lowe	er Berg GRU wa e BHN. A total c			R and 1 for the B	HN were strateg	ater contribution to the EWR and a Management Option 2 for monitoring the groundwater gically selected within the Middle-Lower Berg GRU (see Figure 3-22 and the table below).
	Site Name	Data Source	Area	Objective	Latitude	Longitude	Monitoring Description
		1		1		EWR Management	Option 3
	G1N0203	HYDSTRA	Biv2	EWR	-32.97013	18.569379	-
	BG00369	NGA	Bvii8	EWR	-33.09141	18.8334	Frequency: Monthly or Quarterly
	96095	WMS	GRU	EWR	-33.0925	18.710833	
	96152	WMS HYDSTRA	Bvii8 Biv2	EWR EWR	-33.138889	18.805556	1) Groundwater level:
	G3N0546 G1N0548	HYDSTRA	Bvii17	EWR	-32.79555556 -33.18139	18.51277778 18.87706	 Manual water level measurements and continuous hourly readings from automatically recorded level loggers. Possible need for telemetry systems.
	G1N0548 G1N0531	HYDSTRA	Bvii17 Bvii17	EWR	-33.34023	18.80592	2) Groundwater Quality:
	3318BA00042	NGA	Bvii18	EWR	-33.14467	18.70759	 Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄
Monitoring Programme	3218CB00140	NGA	GRU	EWR	-32.68957	18.45493	 Site specific additions for EWR: NO₂, NO₃, NH₄
	G1N0195	HYDSTRA	Biv2	EWR	-32.96013	18.499377	
	G1N0534	HYDSTRA	Bvii17	EWR	-33.25757	18.80806	
	0110001		Dinii			BHN Management	Option 2
							Frequency: Quarterly
	3318BA00046	NGA	GRU	BHN	-33.13496	18.66871	 Groundwater level: Manual groundwater level measurements, as well as average daily reading from automatically recorded level logger. Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN: E coli, Total Coliforms, and Faecal Coliforms



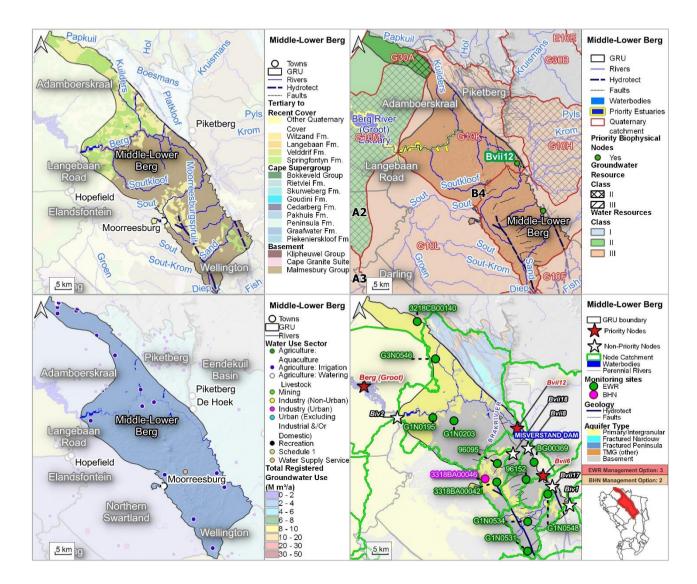


Figure 3-22 A series of maps for the Middle-Lower Berg GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.9. Northern Swartland GRU

	GRU Name: Northern Swartland										
GRU	Main Towns: None										
	Total Area (km ²): 1262.65										
GRU Boundary Description	The Northern Swartland GRU is defined by a combination of an interpolated basement lithology extent, including the CGS and the Malmesbury Group, and portions of the G21C, G21D, G10J, and G10K surface water quaternary catchment divides on its northern, eastern, and southern borders. Along the western edge of the GRU, the boundary is characterized by the Colenso Fault, portions of the Modder River, and the contact between the Springfontyn Fm and the basement lithologies, creating the south-western/western edge. The western/north-western border is marked by the Sout River (refer to Figure 3-23 and DWS, 2022d and 2023a).										
Quaternary Catchments	G10L (Figure 3-23)										
Resource Unit		Fractured and Inte	ergranular Basement Aquifer								
Description	This GRU is formed by a combination of baseme sediments from ephemeral streams, are predom	ent Malmesbury Group and various pluto inant in this GRU (refer to DWS, 2022d a	ns of the CGS. Additionally, and 2023a).	laterally continuous Sandve	eld Group sediments, as v	well as fluvial					
Surface Water System	The predominant surface water flow direction in this area is from the south-east to north-west. Multiple tributaries, including the Sout, Sout-Krom, and Groen rivers, converge into the Sout River, ultimately contributing to the Berg River (refer to Figure 3-23 and DWS, 2022d and 2023a).										
Water Resource Classes & RQOs	The GRU falls almost entirely within the Lower E the G21D catchment, which has a Groundwater a TEC of C (see Figure 3-23 and the table below	Resource Class of III. There are no prior	ass of III. For most of the GI ity EWR sites within this IU/	RU, there is no Groundwate A; however, it contains porti	er Class, except for the sr ions of the priority Berg (nall portions withir Groot) estuary with					
		Quaternary Catchment RU	Resource Name	Biophysical Node	TEC	nMAR					
	A1 Berg Estuary II	G10M A1-E01	Berg (Groot)	Bxi1	С						
Recharge	An estimated recharge of 31.85 M m ³ /a was det for the Aquifer Stress assessments. The average below and DWS (2022e) for further details.	ermined from first-order recharge calcula e recharge rate is 25.33 mm/a based on Area (km ²) 1257.65	he total GRU area. Addition	e Simulation method, and w al recharge estimations are e Volume n ³ /a) .85	/as chosen as the estima e available in the literature Average Recharg (mm/a) 25.33	. Refer to the table					



	GRU Name: Northern Swartland			
GRU	Main Towns: None			
	Total Area (km ²): 1262.65			
		Water Use Sector	No. of Users	Total Volume (M m ³ /a)
			ured And Intergranular Base	
	In this GRU, there are 19 registered groundwater users, collectively utilizing 1.8 M m ³ /a of	Agriculture: Irrigation	3	0.65
Groundwater Use	groundwater. The primary groundwater use sectors are Agriculture (Irrigation) and Industry		Primary / Intergranular Ac	
	(Urban), contributing 72.3% and 19%, respectively, to the total annual groundwater use	Agriculture: Irrigation	6	0.65
	volume (see Figure 3-23 and the table on the right).	Agriculture: Watering Livestock Industry (Urban)	5 5	0.16 0.34
		Total	19	1.80
		Total	13	1.00
Water Quality	Northern Swartland $1 - Ca+IICO_3$ type 2 - IA-CI type $3 - Ca+Me-IICO_3$ type $4 - Ca+IICO_3$ type 5 - Ca+SoCa type 5 - Ca+SoCa type $5 - Na+IICO_3$ type 5 - N	is attributed to the saturation residence time in the relative aquifer. Exceedances of baseline cond samples exceeding the baselin 5 samples exceeded the RQO are attributed to contamin concentrations of dissolved id	n of Na and Cl ions, re ly low transmissivity cla mentrations were observed he for pH and nitrate + nit for EC, 1 for pH, and 3 for ation from agriculture, nos. The adjusted water	Na-Cl. The presence of Na-Cl wasulting from increased groundw y-rich shale and siltstone baser d for multiple parameters, with 50° trite. Out of the 31 samples collect or nitrate + nitrite. These exceedar coupled with naturally eleve quality category is C, indicating Swartland GRU (refer to DWS, 20
Aquifer Stress	Recharge Volume Groundwater Availability Present Status Category of 'B', ind of 'C', indicating moderate levels of localised contamination, but little or no negative impacts ap Recharge Volume Groundwater Use Stress (M m³/a) (M m³/a) 0.0	Index Groundwa	y stressed aquifer, and a ter Availability Present tatus Category B	Groundwater Quality Present Statu Groundwater Quality Present Statu Category C
		0	D	U U



GRU Main Towns: None Table Area (km?): 1282-86 Groundwater Quality Component The groundwater quality component of the Reserve, detailed in the table below and described in Section 2.3 & 2.4, is determined as two components 1) the Groundwater Quality Reserve and 2) the Groundwater Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Image: Start Area (km?) Parameter Quality Requirement for BHN. Groundwater Reserve Image: Start Area (km?) Parameter Quality Requirement for BHN. Groundwater Reserve Image: Start Area (km?) Parameter Quality Requirement for BHN. Groundwater Quanity Component Parameter Area (km?) Parameter Quality Reserve. Image: Start Quality Component If the Reserve. Parameter Quanity Component Irre (km?)		GRU Name: Nor	thern Swartland									
Total Area (Km2): 1252 65 Groundwater Quality Component The groundwater Quality Component of the Reserve, detailed in the table below and described in Section 2.3 & 2.4, is determined as two components 1) the Groundwater Quality Reserve and 2) the Groundwater Quality Requirement for BHN. Auginer Unit Parameter Unit Non-optimized State S	GRU											
Groundwater Quality Component The groundwater quality component of the Reserve, detailed in the table below and described in Section 2.3 & 2.4, is determined as two components 1) the Groundwater Quality Reserved at 2 the Groundwater Quality Requirement for BHN. Groundwater Reserve Aquiter Unit Parameter Unit No. BHs No. Services Baseline Min Conc Min Conc Model Conc Model Conc BHN Groundwater Reserve Elevative Conductivity mS/m 31 31 31 555 61.3 77.0 16.13 77.0 20.23 10.9 20.23 10.9 20.23 10.9 20.23 10.9 20.2 10.9 20.2 10.2 <th>Cito</th> <th></th>	Cito											
31.85 0.20 0.05 0.25 31.60 1.79 29.81 In Scenario 7b, which projects conditions for the year 2050 and considers the 'Most-Likely Case' for the GRU, the analysis focused on two key factors: Recharge and Water Use. Th factors directly influenced the parameters used to determine the Groundwater Reserve, specifically the groundwater contribution to the BHN and EWR. The scenario involved a decreas recharge from 31.85 to 26.11 M m ³ /a, influenced by both climate change and the elimination of IAPs. Additionally, groundwater use increased from 1.79 to 2.29 M m ³ /a due to sectoral groundwater contribution to the BHN Reserve rose from 0.05 to 0.09 M m ³ /a, primarily attribution	Groundwater Reserve	Groundwater Qua The groundwater and 2) the Ground Aquifer Unit Fractured and Intergranular Basement Aquifer (Tygerberg) Groundwater Qua The groundwater the EWR and BH	ality Component r quality component of the adwater Quality Requirem Parameter pH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3 Orthophosphate as PO4 Potassium as K antity Component r quantity component of the N Reserves.	ent for BHN Unit mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l mg	No. BHs 31 31 31 31 31 31 31 31 31 31	No. Samples 31 31 31 31 31 31 31 31 31 31	Baseline Conc. 7.59 532.00 984.70 35.70 81.00 1643.10 114.70 0.87 0.72 0.02 0.01 23.46	Min Conc. 5.55 49.70 65.50 3.80 9.90 135.10 7.90 0.02 0.15 0.02 0.15 0.02 0.00 1.48	Max Conc. 8.13 1175.50 2133.50 286.50 437.30 4123.90 484.70 21.53 1.25 0.52 0.11 116.34 culated by cons	Median Conc. 7.70 400.00 614.00 52.40 76.50 1121.80 114.70 0.96 0.70 0.02 0.01 14.00	Groundwater Quality Reserve 8.13 532.00 984.70 57.64 84.15 1643.10 126.17 1.06 0.77 0.02 0.01 23.46 groundwater cor	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 - -
Future Scenario 2050 (Scenario 7b) to population growth. Under these conditions, the Allocation Category did not change from category B (refer to Section 2.5 and the table below). Recharge (Mm³/a) EWR Reserve (Mm³/a) BHN Reserve (Mm³/a) GW Reserve (Mm³/a) Total Allocable Volume (Mm³/a) Water Use (Mm³/a) Still Allocable (Mm³/a) 26.11 0.20 0.09 0.29 25.82 2.92 22.90	Future Scenario 2050 (Scenario 7b)	In Scenario 7b, v factors directly in recharge from 31 and the implement to population gro	which projects conditions ifluenced the parameters I.85 to 26.11 M m ³ /a, influ ntation of groundwater de wth. Under these conditio	for the year used to dete enced by bo velopment s ons, the Allo	r 2050 and considers ermine the Groundwa th climate change and schemes in the area. cation Category did n	ter Reserve, spe d the elimination Furthermore, the ot change from o	r Case' for the cifically the gro of IAPs. Additio groundwater c category B (refe	GRU, the analys bundwater contrib onally, groundwa contribution to the er to Section 2.5	is focused on t bution to the BH ter use increase BHN Reserve and the table b Volume	wo key factors: F N and EWR. The ed from 1.79 to 2. rose from 0.05 to elow).	Recharge and W scenario involve 29 M m ³ /a due to 0 0.09 M m ³ /a, pr	/ater Use. Thes ed a decrease o sectoral grow imarily attribute
<u>26.11</u> 0.20 0.09 0.29 25.82 2.92 22.90				,			· · · ·			0.00		



HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT

	GRU Name: No	orthern Swartland									
GRU	Main Towns: None										
	Total Area (km ²): 1262.65										
							undwater contribution to the EWR and a Management Option 1 for monitoring the groundwater ategically selected within the Northern Swartland GRU (see Figure 3-23 and the table below).				
	Site Name	Data Source	Area	Objective	Latitude	, in the second se					
	EWR Management Option 1										
Monitoring Programme	G2N0587	HYDSTRA	Bii1	EWR	-33.35619	18.64199	 Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: Manual groundwater level measurements 				
	G1N0376	HYDSTRA	Bii1	EWR	-33.21675	18.39426	 Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄ 				
	BHN Management Option 1										
	96144	WMS	GRU	BHN	-33.245556	18.635556	 Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: Manual groundwater level measurements 2) Groundwater Quality (Background water quality and BHN): Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO4, SO4 Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 				
		-					·				



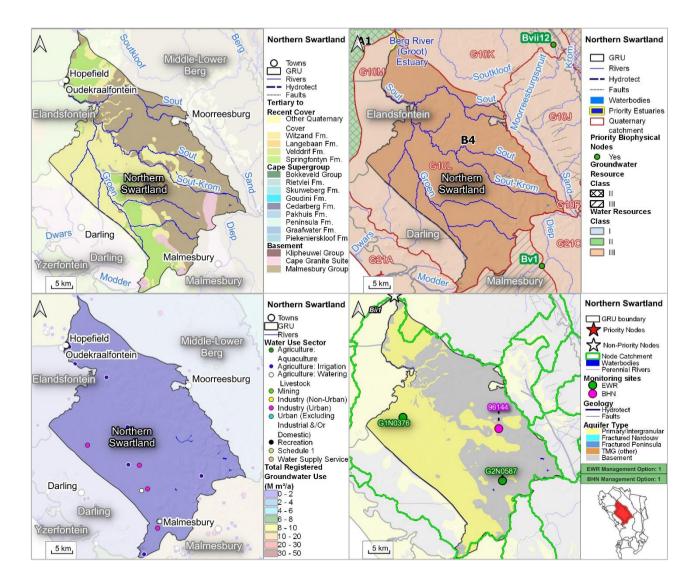


Figure 3-23 A series of maps for the Northern Swartland GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.10. Darling GRU

5.5.10. Dall											
	GRU Name: Darling										
GRU	Main Towns: Darling and Mamre										
	Total Area (km ²): 408.82										
GRU Boundary Description	The eastern flank of the Darling GRU is delimited by the Colenso Fault, Modder River, and Groen River, representing the extent of the Northern Swartland GRU. The boundary between the Elandsfontein and Yzerfontein GRUs is defined by the extent of the Springfontyn Fm and its contact with the CGS. In the south, the Darling GRU is demarcated by portions of the G21B surface water quaternary catchment divide and the CoCT (2020) aquifer model boundary for the Atlantis GRU (refer to Figure 3-24 and DWS, 2022d and 2023a).										
Quaternary Catchments	G10L and G21A (Figure 3-24)										
Resource Unit	Fractured and Intergranular Basement Aquifer										
Description	This GRU is dominantly composed of the CGS plu depositing fluvial sediments to the north-east of the	itons that have intruded the Malmesbury	•	manate from the granite hills after heavy rain,							
Surface Water System	The surface water systems in this area exhibit dual f the coast, while the tributaries in the northern part of										
Water Resource Classes & RQOs	The GRU falls within the Lower Berg (B4) and West Coast (A3) IUAs, both with a Water Resource Class of III and no Groundwater Class designated. There are no EWR sites within this IUA, nor are there any priority biophysical nodes (refer to Figure 3-24 and DWS, 2022d and 2023a).										
Recharge	An estimated recharge of 9.95 M m ³ /a was determin the Aquifer Stress assessments. The average recha below ands DWS (2022e) for further details.	ed from first-order recharge calculations u arge rate is 24.34 mm/a based on the tota	sing the Map-Centric Simulation method and v I GRU area. Additional recharge estimations a	was chosen as the estimated recharge value for are available in the literature. Refer to the table							
	Method	Area (km ²)	Recharge Volume (M m³/a)	Average Recharge Rate (mm/a)							
	Map Centric Simulation Method	408.82	9.95	24.34							
	Map Centric Sindiation Method	400.02	9.90	24.04							
Groundwater Use	In this GRU, there are 9 registered groundwater us groundwater. The predominant groundwater use (Irrigation), accounting for 93.0% of the total a Figure 3-24 and the table on the right).	e sector in this region is Agriculture		of Users Total Volume (M m³/a) anular Basement Aquifer 5 0.71 3 0.05 1 0.01 9 0.77							



	GRU Name: Dai	rling										
GRU	Main Towns: Darling and Mamre											
	Total Area (km ²)											
Water Quality		Key 1 - Ca+ICO3 type 2 - Re-Cl hype Dype 3 - Ca+ICO3 type 3 - Ca+ICO3 type 5 - Ca+ICO3 type 5 - Ca+ICO3 type 0 - IO 100 0 100 0 100 0 0 - IO 0 - I	Darling 100 100 0 5 60 C 4 4 20 4 20 0 100 0 20 00 0 20 000	0 80 60 80 20 0 80 80 100	The primary water type in Darling GRU is Na-Cl. The presence of Na-Cl waters is attribut to the saturation of Na and Cl ions, resulting from increased groundwater residence time the relatively low transmissivity granitic basement aquifer. Exceedances of baseline concentrations were observed for multiple parameters, with 50% samples exceeding the baseline for EC, pH, and fluoride. Out of the 9 samples collected sample exceeded the RQO for EC. These exceedances are attributed to contamination fro agriculture, along with naturally elevated concentrations of dissolved ions. The adjusted wa quality category is C, indicating that moderate levels of contamination exist in Darling (re to DWS, 2022d, 2022e and 2023a for detail).							
Aquifer Stress	of 'C', indicating	sidered to have a Groundw moderate levels of localise arge Volume M m ³ /a)	d contaminatio Groundwat (M m³/	n, but little or no er Use ′a)	o negative impacts	apparent (see	e table below).	dwater Availability F Status Category		Groundwater Quality Categor	Present Status	
		9.95	0.77			0.08				С		
						0.00		В		0		
	The groundwate	uality Component or quality component of the ndwater Quality Requireme Parameter		No. BHs	below and describ	ed in Section 2 Baseline Conc.	Min Conc.	rmined as two co Max Conc.	Median Conc.) the Groundwater (Groundwater Quality Reserve	BHN Threshold	
	The groundwate and 2) the Groun	Parameter	nt for BHN. Unit	No. BHs 9	below and describ	Baseline Conc. 6.80	Min Conc. 6.70	rmined as two co Max Conc. 7.86	Median Conc. 7.20) the Groundwater (Groundwater Quality Reserve 7.86	BHN Threshold 5 – 9	
roundurator Decence	The groundwate and 2) the Groun	Parameter PH Electrical Conductivity	nt for BHN. Unit mS/m	No. BHs 9 9	No. Samples	Baseline Conc. 6.80 192.00	Min Conc. 6.70 108.60	rmined as two co Max Conc. 7.86 1100.00	Median Conc. 7.20 281.60) the Groundwater (Groundwater Quality Reserve 7.86 309.76	BHN Threshold <u>5 – 9</u> 150	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit	Parameter pH Electrical Conductivity Sodium as Na	nt for BHN. Unit <u>mS/m</u> mg/l	No. BHs 9 9 9	No. Samples	Baseline Conc. 6.80 192.00 299.20	Min Conc. 6.70 108.60 151.90	rmined as two co Max Conc. 7.86 1100.00 1907.00	Median Conc. 7.20 281.60 416.30) the Groundwater (Groundwater Quality Reserve 7.86 309.76 457.93	BHN Threshold 5 – 9 150 200	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured	Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca	nt for BHN. Unit mS/m mg/l mg/l	No. BHs 9 9 9 9	No. Samples	Baseline Conc. 6.80 192.00 299.20 16.90	Min Conc. 6.70 108.60 151.90 9.30	rmined as two co Max Conc. 7.86 1100.00 1907.00 251.00	Median Conc. 7.20 281.60 416.30 46.60) the Groundwater Quality Reserve 7.86 309.76 457.93 51.26	BHN Threshold 5 – 9 150 200 150	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and	Parameter PH Electrical Conductivity Sodium as Na Calcium as Mg	nt for BHN. Unit mS/m mg/l mg/l	No. BHs 9 9 9 9 9 9	No. Samples	Baseline Conc. 6.80 192.00 299.20 16.90 38.80	Min Conc. 6.70 108.60 151.90 9.30 11.50	rmined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10	Median Conc. 7.20 281.60 416.30 46.60 57.60) the Groundwater (Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36	BHN Threshold 5 - 9 150 200 150 70	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular	Parameter PH Electrical Conductivity Sodium as Na Calcium as Ma Chloride as Cl	nt for BHN. Unit mS/m mg/l mg/l mg/l	No. BHs 9 9 9 9 9 9 9 9 9	No. Samples 9 9 9 9 9 9 9 9 9	Baseline Conc. 6.80 192.00 299.20 16.90 38.80 499.10	Min Conc. 6.70 108.60 151.90 9.30 11.50 332.70	mined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10 3413.80	Median Conc. 7.20 281.60 416.30 46.60 57.60 766.10) the Groundwater (Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36 842.71	BHN Threshold 5 - 9 150 200 150 70 200	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement	Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4	Unit Unit MS/m mg/l mg/l mg/l mg/l	No. BHs 9 9 9 9 9 9 9 9 9 9	No. Samples 9 9 9 9 9 9 9 9 9	Baseline Conc. 6.80 192.00 299.20 16.90 38.80 499.10 96.10	Min Conc. 6.70 108.60 151.90 9.30 11.50 332.70 10.70	mined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10 3413.80 542.20	Median Conc. 281.60 416.30 46.60 57.60 766.10 96.10) the Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36 842.71 105.71	BHN Threshold 5 – 9 150 200 150 70 200 400	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer	Parameter Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite	nt for BHN. Unit <u>mS/m</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u>	No. BHs 9 9 9 9 9 9 9 9 9 9 9 9	No. Samples 9 9 9 9 9 9 9 9 9	Baseline Conc. 6.80 192.00 299.20 16.90 38.80 499.10 96.10 0.83	Min Conc. 6.70 108.60 151.90 9.30 11.50 332.70 10.70 0.02	rmined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10 3413.80 542.20 4.16	Median Conc. 7.20 281.60 416.30 46.60 57.60 766.10 96.10 0.83) the Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36 842.71 105.71 0.91	BHN Threshold 5 - 9 150 200 150 70 200 400 10	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement	Parameter Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F	nt for BHN. Unit mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l	No. BHs 9 9 9 9 9 9 9 9 9 9 9 9 9 9	No. Samples 9 9 9 9 9 9 9 9 9	Baseline Conc. 6.80 192.00 299.20 16.90 38.80 499.10 96.10 0.83 0.15	Min Conc. 6.70 108.60 151.90 9.30 11.50 332.70 10.70 0.02 0.10	rmined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10 3413.80 542.20 4.16 1.50	Median Conc. 7.20 281.60 416.30 46.60 57.60 766.10 96.10 0.83 0.56) the Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36 842.71 105.71 0.91 0.62	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer	Parameter Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F Ammonia as NH3	nt for BHN. Unit <u>mS/m</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u> <u>mg/l</u>	No. BHs 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	No. Samples 9 9 9 9 9 9 9 9 9	Baseline Conc. 6.80 192.00 299.20 16.90 38.80 499.10 96.10 0.83 0.15 0.02	Min Conc. 6.70 108.60 151.90 9.30 11.50 332.70 10.70 0.02 0.10 0.02	mined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10 3413.80 542.20 4.16 1.50 0.08	Median Conc. 7.20 281.60 416.30 46.60 57.60 766.10 96.10 96.10 0.83 0.56 0.02) the Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36 842.71 105.71 0.91 0.62 0.02	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5 -	
roundwater Reserve	The groundwate and 2) the Groun Aquifer Unit Fractured and Intergranular Basement Aquifer	Parameter Parameter PH Electrical Conductivity Sodium as Na Calcium as Ca Magnesium as Mg Chloride as Cl Sulphate as SO4 Nitrate + Nitrite Fluoride as F	nt for BHN. Unit mS/m mg/l mg/l mg/l mg/l mg/l mg/l mg/l	No. BHs 9 9 9 9 9 9 9 9 9 9 9 9 9 9	No. Samples 9 9 9 9 9 9 9 9 9	Baseline Conc. 6.80 192.00 299.20 16.90 38.80 499.10 96.10 0.83 0.15	Min Conc. 6.70 108.60 151.90 9.30 11.50 332.70 10.70 0.02 0.10	rmined as two co Max Conc. 7.86 1100.00 1907.00 251.00 236.10 3413.80 542.20 4.16 1.50	Median Conc. 7.20 281.60 416.30 46.60 57.60 766.10 96.10 0.83 0.56) the Groundwater Quality Reserve 7.86 309.76 457.93 51.26 63.36 842.71 105.71 0.91 0.62	BHN Threshold 5 - 9 150 200 150 70 200 400 10 1.5	



HIGH CONFIDENCE GROUNDATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT: GROUNDWATER RESERVE DETERMINATION REPORT

	GRU Name: Da	rlina								
GRU	Main Towns: Da		mre							
0.10	Total Area (km ²)									
	Groundwater Qu	uantity Comp	onent							
	The groundwate the EWR and B			erve, detailed in	the table below	and described in	Section 2.3 & 2.4, is calculated by	considering the total groun	dwater contribution to both	
	Recharge (N	/lm³/a)	EWR Reserve (Mm ³ /a	a) BHN Res	serve (Mm³/a)	GW Reserve (N	Im ³ /a) Total Allocable Volume (Mm ³ /a)	Water Use (Mm³/a)	Still Allocable (Mm³/a)	
	9.95		0.03		0.02	0.05	9.91	0.76 ²⁴	9.15	
Future Scenario 2050 (Scenario 7b)	factors directly in recharge from 9 and the implement to population group Recharge (N 8.02	nfluenced the 9.95 to 8.02 M entation of gro owth. Under the Mm ³ /a)	e parameters used to I m ³ /a, influenced by bundwater developm hese conditions, the EWR Reserve (Mm ³ /a 0.03 ed a Management C	o determine the (both climate ch ient schemes in Allocation Cate i) BHN Res option 1 for mon	Groundwater Re ange and the el the area. Furthe gory did not cha serve (Mm ³ /a) 0.03 itoring the grour	eserve, specifically imination of IAPs. ermore, the ground ange from categor GW Reserve (M 0.06	for the GRU, the analysis focused / the groundwater contribution to the Additionally, groundwater use incred dwater contribution to the BHN Reserved y B (refer to Section 2.5 and the tab Im ³ /a) Total Allocable Volume (Mm ³ /a) 7.97 on to the EWR and a Management C ithin the Darling GRU (see Figure 3)	BHN and EWR. The scen eased from 0.76 to 1.40 M erve rose from 0.02 to 0.03 ele below). Water Use (Mm³/a) 1.40 Dption 1 for monitoring the	ario involved a decrease in m³/a due to sectoral growth M m³/a, primarily attributed Still Allocable (Mm³/a) 6.56	
	Site Name	Data Sourc	e Monitoring Area	Monitoring Objective	Latitude	Longitude	Ν	Ionitoring Description		
						EWR Management	t Option 1			
Monitoring Programme	G1N0555	HYDSTRA	A Bii1	EWR	-33.393056	18.463889	 Groundwater Quality: Standard Parameter 	nmer & Winter) r level measurements rs: pH, EC, Ca, Mg, Na, K, Pall is for EWR: NO ₂ , NO ₃ , NH ₄	<, MAIK, F, CI, PO4, SO4	
					-	BHN Management				
	94570	WMS	GRU	BHN	-33.4259	18.4212	 Groundwater Quality (Back Standard Parameter 	imer & Winter): r level measurements ground water quality and BHN rs: pH, EC, Ca, Mg, Na, K, Pal ns for BHN (microbiological): E	k, MAIk, F, CI, PO4, SO4	



²⁴ The WARMS dataset places Yzerfontein's municipal abstraction of 0.26 Mm³/a in the Darling GRU. It has been updated to reflect for the Yzerfontein GRU.

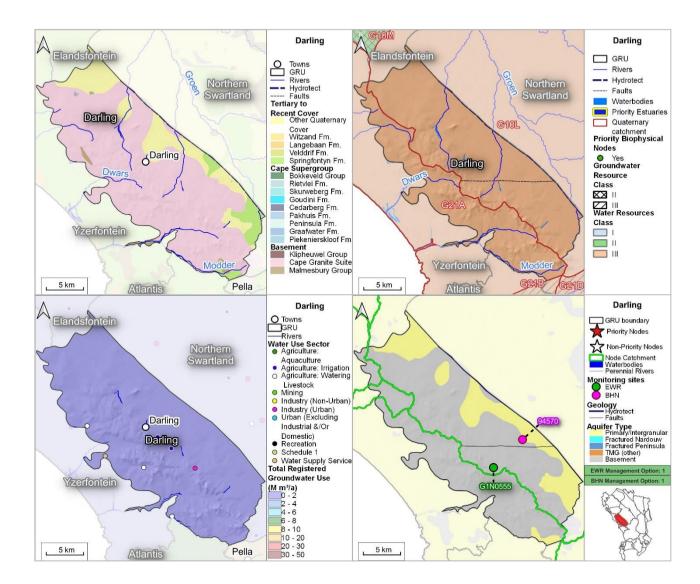


Figure 3-24 A series of maps for the Darling GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



3.3.11. Vredenburg GRU

	GRU Name: Vredenburg										
GRU	Main Towns: Vredenburg, Paternoster and Saldanha	1									
	Total Area (km ²): 376.18										
GRU Boundary Description	The Vredenburg GRU is defined by the CGS outcrop and its contact with the Springfontyn Fm on its eastern edge. The south-eastern border is established by a combination of an interpolated extent of CGS outcrops and the Bok River. The northern, western, and southern extents of the GRU are delineated by the Atlantic coastline, Saldanha Bay, and St Helena Bay coastlines, respectively (refer to Figure 3-25 and DWS, 2022d and 2023a).										
Quaternary Catchments	G10M (Figure 3-25)										
Resource Unit		Fractured and Intergram	ular Basement Aquifer								
Description	The West Coast region is formed by basement Malmesbury Group and various plutons of the CGS, overlain by the Sandveld Group, which is laterally continuous over large areas and also reaches significant thicknesses (refer to DWS, 2022d and 2023a).										
Surface Water System	Following heavy rain, numerous ephemeral streams originate from the hills of the CGS. The flow of these rivers adheres to the topography, moving from the elevated regions in the east towards the coastal areas in the west (refer to Figure 3-25 and DWS, 2022d and 2023a).										
Water Resource Classes & RQOs	The GRU falls within the Langebaan (A2) and Berg Estuary (A1) IUAs, both of which have a Water Resource Class of II and Groundwater Class II. There are no EWR sites within this IU nor are there any priority biophysical nodes (refer to Figure 3-25 and DWS, 2022d and 2023a).										
Recharge	An estimated recharge of 7.43 M m ³ /a was determin the Aquifer Stress assessments. The average recha below and DWS (2022e) for further details.	ed from first-order recharge calculations us rge rate is 19.75 mm/a based on the total	ing the Map-Centric Simulation GRU area. Additional recharge	method and was chosen as the estimations are available in t	ne estimated recharge value for he literature. Refer to the table						
5	Method	Area (km ²)	Recharge Volume	Ave	Average Recharge Rate						
	Man Cantria Simulatian Mathed	N 7	<u>(M m³/a)</u> 7.43		(mm/a)						
	Map Centric Simulation Method	376.18	7.43		19.75						



GRU	GRU Name: Vredenburg Main Towns: Vredenburg,	Petermoster and Soldanha								
GKU	Total Area (km ²): 376.18	Paternoster and Saldanna								
Water Quality	No water quality data									
Aquifer Stress	The GRU is considered to is unknown due to limited o Recharge Volume	data availability (see table l		egory of 'B', indicating an un Stress Index	stressed or slightly stressed	· · · · · · · · · · · · · · · · · · ·	Iwater Quality Present Status Groundwater Quality Present			
	(M m ³ /a) 7.43	((<u>M m³/a)</u> 1.16	0.16	(after WRC, B	2007)	Status Category N/A			
	1.45	I	1.10	0.10	0		N/A			
Groundwater Reserve	Quality Component Groundwater Quantity Con The groundwater quantity the EWR and BHN Reserv	component of the Reserve	a, detailed in the table belc	<u>No water quality data</u> ow and described in Section	2.3 & 2.4, is calculated by	considering the total grou	undwater contribution to both			
	Recharge (Mm ³ /a)	EWR Reserve (Mm ³ /a)	BHN Reserve (Mm³/a)	GW Reserve (Mm ³ /a)	Total Allocable Volume (Mm³/a)	Water Use (Mm ³ /a)	3/a) Still Allocable (Mm3/a)			
	7.43	0.00	0.01	0.01	7.42	1.16	6.26			
	In Scenario 7b. which proi	ects conditions for the vea	ar 2050 and considers the	• 'Most-Likely Case' for the	GRU, the analysis focused	on two key factors: Rech	narge and Water Use. These			
Future Scenario 2050	factors directly influenced t recharge from 7.43 to 6.63 and the implementation of	the parameters used to det 3 M m ³ /a, influenced by both groundwater development	termine the Groundwater F th climate change and the schemes in the area. Furt	Reserve, specifically the gro elimination of IAPs. Addition	oundwater contribution to the nally, groundwater use incre- contribution to the BHN Rese	BHN and EWR. The sce eased from 1.16 to 1.97 M	enario involved a decrease in /I m ³ /a due to sectoral growth)2 M m ³ /a, primarily attributed			
(Scenario 7b)	Recharge (Mm³/a)	EWR Reserve (Mm³/a)	BHN Reserve (Mm³/a)	GW Reserve (Mm³/a)	Total Allocable Volume (Mm³/a)	Water Use (Mm³/a)	Still Allocable (Mm ³ /a)			
	6.63	0.00	0.02	0.02	6.61	1.97	4.64			



GRU	GRU Name: Vre Main Towns: Vre Total Area (km ²):	denburg, Pate	ernoster and Sa	ldanha							
	The Vredenburg	GRU was assi	igned a Manage ring sites for the	ment Option 1 f EWR and 1 fo	or monitoring the r the BHN were s	groundwater co trategically sele	ontribution to the EWR and a Management Option 1 for monitoring the groundwater contribution octed within the Vredenburg GRU (see Figure 3-25 and the table below).				
	Site Name	Data Source	Monitoring Area	Monitoring Objective	Latitude	Longitude	Longitude Monitoring Description				
	EWR Management Option 1										
Monitoring Programme	3217DD00034	NGA	GRU	EWR	-32.76058	17.95753	Frequency: Quarterly or Biannual (Summer & Winter) 1) Groundwater level: o Manual groundwater level measurements				
	G1N0024	HYDSTRA	GRU	EWR	-32.950127	17.91936	 2) Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for EWR: NO₂, NO₃, NH₄ 				
	BHN Management Option 1										
	46113	NGA	GRU	BHN	-32.98103	17.96632	 Frequency: Quarterly or Biannual (Summer & Winter): Groundwater level: Manual groundwater level measurements Groundwater Quality: Standard Parameters: pH, EC, Ca, Mg, Na, K, Palk, MAlk, F, Cl, PO₄, SO₄ Site specific additions for BHN (microbiological): E coli, Total Coliforms, Faecal Coliforms 				
						-	·				



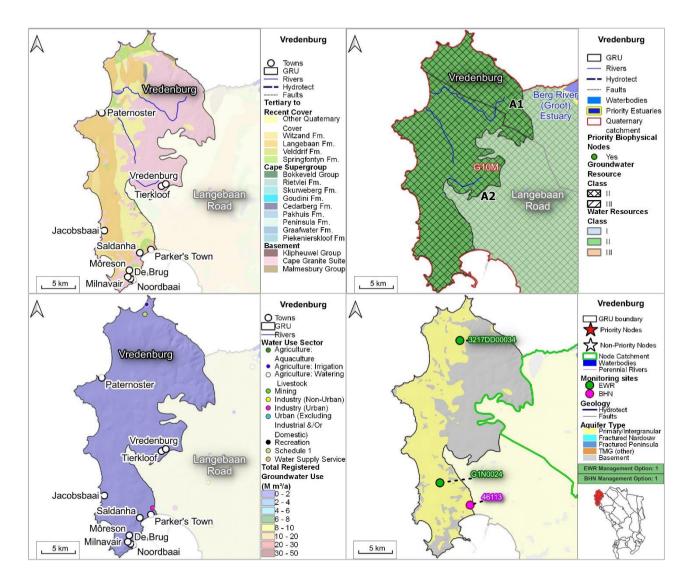


Figure 3-25 A series of maps for the Vredenberg GRU: Top-left displays the GRU extent with geology and structural features; Top-right displays IUAs, WRCs, and Groundwater Classes; Bottom-left indicates total registered groundwater use with boreholes and water use sectors; Bottom-right depicts EWR and BHN monitoring sites per GRU based on Management Options.



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