HIGH CONFIDENCE GROUNDWATER RESERVE DETERMINATION STUDY IN THE BERG CATCHMENT

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PURPOSE OF THIS DOCUMENT

The purpose of this Background Information Document (BID) is to inform stakeholders about the study, initiated by the Department of Water and Sanitation (DWS), to determine a High Confidence Groundwater Reserve in the Berg catchment. This study will determine groundwater Reserve requirements, in terms of quantity and quality, to satisfy the basic human needs (BHN) and to protect aquatic ecosystems in priority water resources within the Berg catchment. Detailed determinations aim to produce high-confidence results, which are based on site-specific 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.

Stakeholders are invited to participate by commenting on information sent, attending meetings or workshops, or by corresponding with the stakeholder engagement office or the technical team at the addresses provided below.

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PROJECT WEBSITE LINKS

Study Deliverables
https://www.dws.gov.za/rdm/currentstudies/default.aspx

Aim

To fulfill the Term of Reference (TOR) for this study, Operational Scenarios were formulated to assess the socio-economic and ecological impacts, as outlined in Step 5 of the eight-step Reserve determination procedure. These scenarios specifically focused on the aquifer-specific Groundwater Resource Units (GRUs) identified during Step 2 (DWS, 2022d).

As part of the Resource Directed Measures (RDM) process, which is mandated by Regulation 2(4) of the National Water Act (NWA; No. 36 of 1998), a study titled "The Determination of Water Resource Classifications and Resource Quality Objectives in the Berg Catchment" (DWS, 2016) was conducted. This study involved the development and evaluation of future catchment scenarios to determine the Ecologically Sustainable Base Configuration (ESBC) for different Integrated Units of Analysis (IUAs). These ESBC scenarios, along with the Present Status (PS) and preliminary groundwater Reserve determinations (i.e., Step 3 and Step 4 of this High Confidence Reserve determination process), were utilized to create operational scenarios and assess their impacts on the aquifer systems, the groundwater component of the Reserve, and the associated allocable volumes.

The scenarios were formulated with input from stakeholders and primarily focused on factors such as climate change, population growth, sectoral growth, water supply scheme development and the impact of invasive alien vegetation. These scenarios were evaluated based on their effects on recharge and water usage. In Step 6 of the RDM Reserve determination procedure, they will be reassessed in collaboration with stakeholders. The Operational Scenarios & Socio-Economic and Ecological Consequences Report serves as Deliverable 3.4 in Phase 3 of this study. For further details on the study's approach and scope of work, please refer to the projects Inception Report (accessible via the Study Deliverable link above).

Operational Scenarios

The table presented below offers an overview of the scenarios that were considered in modeling the impacts on the groundwater Reserve and associated allocable groundwater volumes in the Berg catchment. These scenarios were designed to assess various factors that could influence the preliminary Groundwater Reserve in the region. The scenarios encompassed population growth, sectoral water demand, groundwater developments, climate change, invasive alien plants, as well as combination scenarios that integrated multiple factors. Each scenario aimed to analyze specific aspects, including population projections, historical trends in water demand per sector, scheduled groundwater developments, climate change effects, and the impact of invasive alien plants. Through the examination of these scenarios, a comprehensive understanding of the potential implications for the Reserve and allocable volumes was achieved.

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	**Sectoral Water Demand**	Explore historical trends in groundwater demand per sector, focusing on agriculture, industry, and other sectors, to understand future water use.
Sc 3	**Groundwater Developments**	Evaluate scheduled groundwater developments and strategies for the Berg catchment, calculating their impact on the Reserve and allocable volumes.
Sc 4	**Climate Change**	Investigate the impact of climate change, particularly under warmer conditions, on groundwater recharge rates and its effects on the Reserve.
Sc 5	**Invasive Alien Plants**	Examine the impacts of Invasive Alien Plants (IAPs) on groundwater recharge and evaluate their effects on the Reserve and allocable volumes.
Sc 6a	**Combination Scenario**	Integrate population growth, sectoral growth, groundwater developments, climate change, and absence of clearing alien vegetation for impact assessment.
Sc 6b	**Combination Scenario**	Integrate population growth, groundwater developments, climate change, and clearing alien vegetation for impact assessment.

Impact Assessment

To assess the potential impact on GRUs, an Allocation Stress Index was developed. This index represents the ratio of the groundwater 'still allocable' (after considering the Reserve and future water use) to the total recharge for the GRU. The stress index is divided into six allocation categories, labeled 'A' through 'F,' reflecting a spectrum from unstressed to potentially critically stressed conditions. As this ratio approaches zero, the level of stress increases, indicating minimal remaining “still allocable” volumes and a potential threat to the groundwater Reserve.

Allocation Category	Description	Allocation Stress Index (Still Allocable Volume / Recharge Volume)
A	Unstressed or slightly stressed	>0.95
B		0.75 - 0.95
C	Moderately stressed	0.5 - 0.75
D		0.35 - 0.50
E	Potentially highly stressed	0.15 - 0.35
F	Potentially critically stressed	<0.15

Through the integration of findings from scenarios Sc 1 to Sc 5, two combination scenarios were formulated: Sc 6a (Worst Case) and Sc 6b (Most-Likely Case). These scenarios took into account projected population growth (Sc 1), sectoral growth (Sc 2), ongoing groundwater development initiatives (Sc 3), the impact of climate change (Sc 4), and the presence or absence of alien vegetation (Sc 5a and Sc 5b).

The most likely scenario (Sc 6b) primarily focused on the decrease in Recharge resulting from climate change, increase in recharge from the removal of all IAPs, the rise in the BHN Reserve based on population growth rate, and the increased groundwater usage due to sectoral growth and the implementation of groundwater development schemes. These changes had direct implications on the parameters used to estimate the Groundwater Reserve, consequently affecting the Total Allocable Volume and Still Allocable Volumes of individual GRUs. By comparing projected volumes in 2050 with the baseline values from the Present Status (PS) and preliminary groundwater Reserve, the analysis provided valuable insights into the cumulative effects of the identified factors.

Table A **Table comparing preliminary groundwater Reserve and necessary parameters for calculating allocable volume per GRU, based on the results calculated in Scenario 6b: Combination Scenario – Most-Likely Case (2050).**

GRU	Preliminary Groundwater Reserve (2022)								Combination Scenario – Most-Likely Case							
	Recharge (Mm^3/a)	EWR Reserve (Mm^3/a)	BHN Reserve (Mm^3/a)	GW Reserve (Mm^3/a)	Total Allocable Volume (Mm^3/a)	Water Use (Mm^3/a)	Still Allocable (Mm^3/a)	Allocable Stress Index	Recharge (Mm^3/a)	EWR Reserve (Mm^3/a)	BHN Reserve (Mm^3/a)	GW Reserve (Mm^3/a)	Total Allocable Volume (Mm^3/a)	Water Use (Mm^3/a)	Still Allocable (Mm^3/a)	Allocable Stress Index
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
Atlantis	22.74[1]	0.08	0.03	0.11	22.63	3.84[2]	18.79	0.83	21.63	0.08	0.05	0.13	21.50	3.31	18.19	0.84
Cape Flats	41.25[3]	0.51	0.70	1.21	40.04	12.00[4]	28.04	0.68	38.70	0.51	1.29	1.80	36.90	23.02	13.88	0.36
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
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
Darling	9.95	0.03	0.02	0.05	9.91	0.76[5]	9.15	0.92	8.02	0.03	0.03	0.06	7.97	1.40	6.56	0.82
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
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
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
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
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
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
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
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
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

[1] Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2018).
[2] Includes city municipal abstraction of 5 Mm^3/a as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) water use licence) of up to 2.92 Mm^3/a (as a negative water use).
[3] Rainfall recharge value is from a model-based calibrated recharge estimation (after CoCT, 2020).
[4] Includes city municipal abstraction of 20 Mm^3/a in development as per NWA Section 21(a). The total volume includes Managed Aquifer Recharge (as per NWA Section 21(e) water use licence) of up to 14.6 Mm^3/a (as a negative water use).
[5] The WARMS dataset places Yzerfontein's municipal abstraction of 0.26 Mm^3/a in the Darling GRU. It has been updated to reflect for the Yzerfontein GRU.

GRU	Preliminary Groundwater Reserve (2022)								Combination Scenario – Most-Likely Case							
	Recharge (Mm^3/a)	EWR Reserve (Mm^3/a)	BHN Reserve (Mm^3/a)	GW Reserve (Mm^3/a)	Total Allocable Volume (Mm^3/a)	Water Use (Mm^3/a)	Still Allocable (Mm^3/a)	Allocable Stress Index	Recharge (Mm^3/a)	EWR Reserve (Mm^3/a)	BHN Reserve (Mm^3/a)	GW Reserve (Mm^3/a)	Total Allocable Volume (Mm^3/a)	Water Use (Mm^3/a)	Still Allocable (Mm^3/a)	Allocable Stress Index
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
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
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
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
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
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
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
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
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
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**	

[6] Rainfall recharge value is from the first order GRAII Spatial Distribution (modified after CoCT, 2022).
[7] Includes city municipal abstraction of 8 Mm^3/a in development (phase 1) as per NWA Section 21(a).

Project Plan and Progress

	STEP		OUTCOME	STATUS
PHASE 1	Inception		• Scope of work • Capacity building programme • Expenditure schedule & projections • Stakeholder engagement planning	Complete
PHASE 2				
	Data collection and collation		• Collate, review and analyse all available, relevant data and literature pertaining to the project area in the form of a desktop assessment.	Complete
PHASE 3				
	Step 1	Initiate Groundwater Reserve Study	• Complete a review of available information and data to determine the process and detail of the assessment and determination. • Identify relevant stakeholders to be included in the project.	Complete
	Step 2	Water RU Delineation	• Determine eco-regions, delineate aquifer specific groundwater related RUs (GRUs), select study sites.	Complete
	Step 3	Ecological Status and Reference Conditions per RU	• Determine the reference conditions, Present Ecological Status (PES), Ecological Importance (EI) and Ecological Sensitivity (ES) of each of the selected study sites.	Complete
	Step 4	Determine BHN and EWR	• Determine the groundwater component of the BHN and EWR for all GRUs delineated in the study area, supported by the ecological findings of the gazetted Water Resource Classes and RQOs.	Complete
	Step 5	Operational Scenarios & Socio-economic	• Review current and future operational scenarios and its socio-economic and ecological consequences.	Complete
	Step 6	Evaluate scenarios with Stakeholders	• Evaluate the scenarios with stakeholders where the outcome of Step 3 – Step 5 will be presented, evaluated, adjusted and agreed upon.	Started
	Step 7	Monitoring Programme	• Design an appropriate monitoring programme by taking into account the hydraulic characteristics and the status of identified water resources.	Not Started
	Step 8	Gazette & implement Reserve	• Gazetting template will be drafted, based on the results of the study	Not Started

Public Meetings

Six PSC meetings will be held during the study, with the fourth scheduled for the 11 July 2023. The PSC is representative of all major sectors and interests within the study area and are encouraged to provide strategic advice and guidance. Comments can be sent to the Stakeholder Engagement Office, DWS Study Managers or the PSP team for Technical Enquiries.