GEOSS
Groundwater & Geo-Environmental Solutions

Water Use Licence Application Geohydrological Assessment: Kleinfontein, Villiersdorp, Western Cape

OCTOBER 14, 2025

GEOSS REPORT NUMBER: 2025/09-13

Executive Summary

GEOSS South Africa (Pty) Ltd (GEOSS) was tasked by Elgin Free Range Chickens to conduct a geohydrological assessment for the Water Use Licence Application (WULA) to abstract groundwater for livestock water (chickens and sheep) and domestic usage at Kleinfontein, Villiersdorp, Kleinfontein is located within Quaternary Catchment H40E, and the General Authorisation (GA) for groundwater abstraction is 150 m3/ha/a. To date, four boreholes have been drilled on the property; however, only two boreholes are viable for abstraction. The total area on which the boreholes are located is 940 67 ha, and a total of 40 000 m^3/a can be abstracted under the GA. The total volume of groundwater that can currently be delivered from the two existing boreholes is 154 526 m^3/a.

The current boreholes mentioned in the study revealed that the area hosts a “fractured” aquifer, which is made up of sandstone, mudstone and shale of the Gydo Formation (Bokkeveld Group) underlain by mudstone, sandstone, shale, and siltstone from the Rietvlei Formation (Table Mountain Group). The regional maps indicate yields of > 5 0 L/s in the study area. Regarding quality, the area is characterised by an electrical conductivity that ranged between 0-300 mS/m.

The four production boreholes that have been drilled are KF_BH1, KF_BH2, KF_BH3, and FK_BH4, KF_BH3 and KF_BH4 however, did not yield enough water to conclude yield testing. KF_BH1 and KF_BH2 have been correctly yield tested (according to SANS 10299_4-2003). The results have been used to determine the sustainable (i.e., long-term and safe) yield of the boreholes. The sustainable yield of the boreholes is within the indicated regional yields of the aquifer. KF_BH1 yields 3.7 L/s, while KF_BH2 yields 1.2 L/s. The proposed sustainable volume that can be abstracted from the drilled boreholes is 154 526 m^3/a. The proposed abstraction does exceed the GA limit amount; however, the application also triggers Section 21 c,g and i water uses and an application to DWS for a water use license will be required. The groundwater quality, specifically EC, is measured at 40.8mS/m for KF_BH1 and 34 mS/m for KF_BH2. Trace metal concentrations, however, are high and water would need to be treated.

The current groundwater requirement and supply analysis for the site are provided below:

- **GROUNDWATER REQUIREMENT**: The current groundwater requirement for the Kleinfontien Farm is **49 458 m^3/a**.
- **GROUNDWATER SUPPLY:** The boreholes have been correctly tested and if the boreholes are pumped according to the guidelines set out in this report, a volume of **154 526 m^3/**a can be abstracted.

This volume requested is 68 % less than what the boreholes can deliver. If groundwater abstraction stays within these volumes, sustainable abstraction is possible.

The aquifer is considered to have a “low” to “medium” vulnerability to contamination as it is a fractured aquifer. The development on the property may proceed; however, only on the basis that the construction and operation of the facility employs relevant mitigation measures so as not to impact on groundwater and associated groundwater users. It is therefore recommended that the development design include a groundwater monitoring plan. It should also be noted that various risks to the aquifer have been identified in the report along with mitigation measures. It is recommended that the general Groundwater Management guideline outlined in **Section 11** of this report be included in the licence conditions of the WULA.

Client Information:

Prepared for	Elgin Free Range Chickens 2760 Industriele Way Grabouw 7160
Contact Person	Jaco Viljoen
Contact Email	jacov@efrc.co.za
Contact Number	071 687 2246

Author Information:

Prepared by	GEOSS South Africa (Pty) Ltd Unit 12, Technostell Building 9 Quantum Street TechnoPark Stellenbosch 7600
Contact Email	info@geoss.co.za
Contact Number	(021) 880 1079

Document Information and History:

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1	2	25 September 2025	Update: Risk assessment for groundwater abstraction impacting on surface water. New treatment design and new site layout plan in Appendix B and C, respectively.
1	3	14 October 2025	Amended the water balance
1	4	29 October 2025	Update infrastructure map and risk assessment

Principal Author and Reviewer:

	Principal Author	**Final Reviewer**
		
Name	Danita Hohne	Dale Barrow
Qualification	MSc (Hons) Geochemistry	MSc (Hydrogeology)
SACNASP No.	400445/14	400289/13
Registration	Earth Science (Pr.Sci.Nat)	Earth Science (Pr.Sci.Nat)

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Abbreviations

AD	Available Drawdown
AFYM	Aquifer Firm Yield Model
bh	Borehole
BOCMA	Breede-Olifants Catchment Management Agency
CDT	Constant Discharge Test
CGS	Council for Geoscience
CMA	Catchment Management Agency
DD	Decimal degrees
DO	dissolved oxygen
DWA	Department of Water Affairs (pre- 1994)
DWAF	Department of Water Affairs and Forestry (1994 - 2009)
DWS	Department of Water and Sanitation (2009 - ....)
EC	Electrical Conductivity
FC	Flow Characteristic
GA	General Authorisation
GRF	Generalised Radial Flow
GRU	Groundwater Resource Unit
ha	hectare
IARF	Infinite Acting Radial Flow
ID	inner diameter
km	kilometre
L/s	litres per second
L/day	litres per day
m	metres
m^3/a	metres cubed per annum
MAE	Mean Annual Evapotranspiration
mamsl	meters above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbgl	metres below ground level

m^3/ha/a	metres cubed per hectare per annum
mg/L	milligrams per litre
mm	millimetre
mm/a	millimetres per annum
mS/m	milliSiemens per meter
NGA	National Groundwater Archive
SANAS	South African National Accreditation System
SANS	South African National Standard
SGWCA	Subterranean Government Water Control Area
TDS	total dissolved solids
WARMS	Water Authorisation Registration Management System
WGS84	World Geodetic System 1984
WULA	Water Use Licence Application

Glossary of Terms

aquifer	a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].
aquitard	A saturated low-permeability unit that can restrict the movement of groundwater.
borehole	includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer.
electrical conductivity	the ability of groundwater to conduct electrical current, due to the presence of charged ionic species in solution (Freeze and Cherry, 1979).
fractured aquifer	fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures.
groundwater	water found in the subsurface in the saturated zone below the water table or piezometric surface i.e., the water table marks the upper surface of groundwater systems.
groundwater resource unit	a groundwater body that has been delineated or grouped into a single significant water resource based on one or more characteristics that are similar across that unit.
groundwater vulnerability	the vulnerability of groundwater to contaminants generated by human activities taking into account the inherent geological, hydrological, hydrolgeological characteristics of an aquifer.
regulated area	(a) The outer edge of the 1 in 100-year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; (b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or (c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

sustainable yield	the maximum rate of withdrawal that can be sustained by an aquifer without causing an unacceptable decline in the hydraulic head or deterioration in water quality in the aquifer.

SPECIALIST EXPERTISE

CURRICULUM VITAE – Danita Hohne

GENERAL

Nationality: South African

Profession: Hydrogeologist

Specialization: Groundwater exploration, development, management and monitoring. Hydrogeological impact studies and assessment of groundwater –Managed Aquifer Recharge.

Position in firm: Senior Hydrogeologist at GEOSS South Africa (Pty) Ltd

Date commenced: August 2023

Year of birth & ID #: 1984 – 840805 0144 085

Language skills: Afrikaans (mother tongue) and English (average)

KEY SKILLS

- Hydrogeological technical input on projects
- Working on Managed Aquifer Recharge (MAR) projects in the Karoo towns.
- Guidance and comments on Shale Gas Development
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater monitoring –development and analysis of groundwater level and quality data.
- Groundwater management – sustainable aquifer development and management.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2020	M.Sc. (Geochemistry)	University of the Free State. South Africa
2007	B.Sc (Hons) Geology	University of the Free State. South Africa
2006	B.Sc Geology	University of the Free State. South Africa

Papers and Chapters:

- CSIR: Shale Gas Development in the Central Karoo: A Scientific Assessment of the Opportunities and Risks, 2016.

- South African Journal of Geology Special Issue on South African Hydrostratigraphy; Case study: Methane gas in groundwater system located in a dolerite ring structure in the Karoo, South Africa, Sept 2019

- Journal of African Earth Sciences; Enhancing groundwater recharge in the main Karoo. South Africa during periods of drought, through managed aquifer recharge, Sept 2020.

- Springer April 2024: Managed aquifer recharge in the Western Karoo; South Africa: Success and challenges in Monograph on "Artificial Recharge to Groundwater and Rain Water Harvesting: Issues & Learning from Developing Countries."

Memberships/Organisations

- Groundwater Division of the Geological Society of South Africa Mem. No. 004
- South African Council for National Scientific Professions (SACNASP) Mem. No. 400445/14
- International Association for Hydrogeologist (IAH) Men No. 136321

EMPLOYMENT RECORD

31 July 2023 to present: GEOSS South Africa (Pty) Ltd. Senior Hydrogeologist

14 April 2009 – 21 July 2023 Department of Water and Sanitation: Northern Cape: Scientific Technician Grade B.

SPECIALIST DECLARATION

I, Danita Hohne, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to our specialist input/study to be true and correct;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the National Water Act, 1998 (Act No.36 of 1998) and the amended regulations in section 26 (1)(k) and 41 (6) of this Act: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, published in Government Gazette on No.;267 (Government Gazette, 2017);
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Water Act, 1998 (Act No.36 of 1998) and the amended regulations in section 26 (1)(k) and 41 (6) of this Act: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, published in Government Gazette on No.;267 (Government Gazette, 2017);
- are fully aware of and meet the responsibilities in terms of the National Water Act, 1998 (Act No.36 of 1998) and the amended regulations in section 26 (1)(k) and 41 (6) of this Act: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, published in Government Gazette on No.;267 (Government Gazette, 2017), and that failure to comply with these requirements may constitute and result in disqualification; and
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not.

Danita Hohe
GEOSS South Africa (Pty) Ltd
SACNSAP – Pr.Sci.Nat: 400445/14
14 October 2025

1. Introduction

Jaco Viljoen of Elgin Free Range Chickens appointed GEOSS South Africa (Pty) Ltd to compile a geohydrological assessment for the proposed groundwater usage on the property, Kleinfontein, Farm nr 954, Villiersdorp. A summary of the borehole details on the property is shown in **Table 1**. The study included a desktop assessment of various groundwater databases as well as a field visit to determine the potential impact on the existing groundwater users.

Table 1: Details of boreholes on Kleinfontein, Farm nr 954, Villiersdorp.

Borehole	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Borehole Depth (m)
KF_BH1	-33.922230°	19.385410°	96.94
KF_BH2	-33.92208°	19.38852°	163.00

The WULA is for Section 21 a – taking water from a water resource; and Section 21 c - impeding or diverting the flow of water in a watercourse; and Section 21 i - altering the bed, banks, courses or characteristics of a watercourse. It is proposed that the abstracted groundwater be used for domestic purposes (potable and non-potable) and to provide water to poultry and sheep. Regarding the legal aspect of the proposed groundwater use, the following details are relevant:

Table 2: General Authorisation limit for Kleinfontein, Farm nr 954, Villiersdorp.

Property	Farm nr 954
Quaternary Catchment	H40E
Property Size (ha)	940.67
General Authorisation (m^3/ha/a)	150
General authorisation zone	D
General authorisation volume (m^3/a)	40 000
Required abstraction for the property (m^3/a)	49 458
Is General Authorisation exceeded?	Yes

The calculation in **Table 2** indicates that the groundwater use will have to be licensed with the Department of Water and Sanitation (DWS), as additional water uses are also triggered. It is a requirement from DWS that a geohydrological report must accompany the groundwater portion of the licence application. The application will be submitted to the regional DWS office and when a Water Use Licence (WUL) is granted, the management of the WUL will fall under the authority of the Breede-Olifants Water Management Area (WMA).

2. Scope of Work

The scope of work is to provide groundwater specialist services, including the tasks outlined below:

- Review of available literature and other specialist studies pertaining to the study site;
- Complete a geohydrological characterisation of the groundwater, in the vicinity of the property;
- Determine the managed (i.e., long-term and safe) yield of the borehole as well as the quality of the groundwater;
- Complete an assessment of the importance of groundwater (both socio-economically and environmentally) in the area by means of a hydrocensus;
- Provide recommendations and mitigation measures to minimise risk and impacts from proposed groundwater abstraction; and
- Document the above findings in a format fully compatible with the requirements for a water use licence application (which is to be submitted to the DWS).

The assessment has been conducted in accordance with accepted best practice principles.

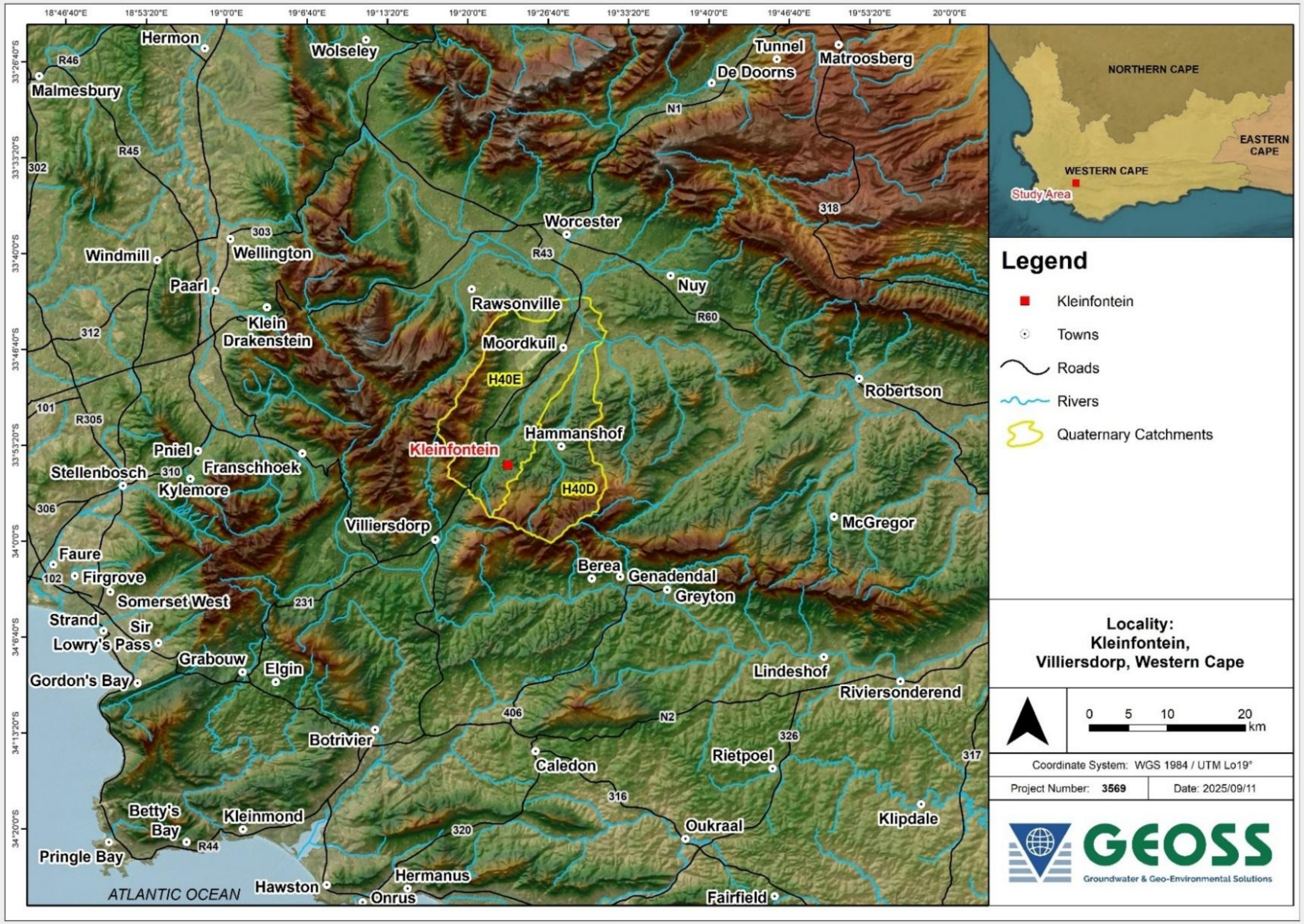
3. Methodology

The procedure adopted for this study involved a desktop study, followed by field work. The initial desktop study involved obtaining and reviewing all relevant data to the project site. This included reviewing relevant site plans, reports and geological maps of the area, analysing data from multiple groundwater databases which include information on groundwater yield and quality.

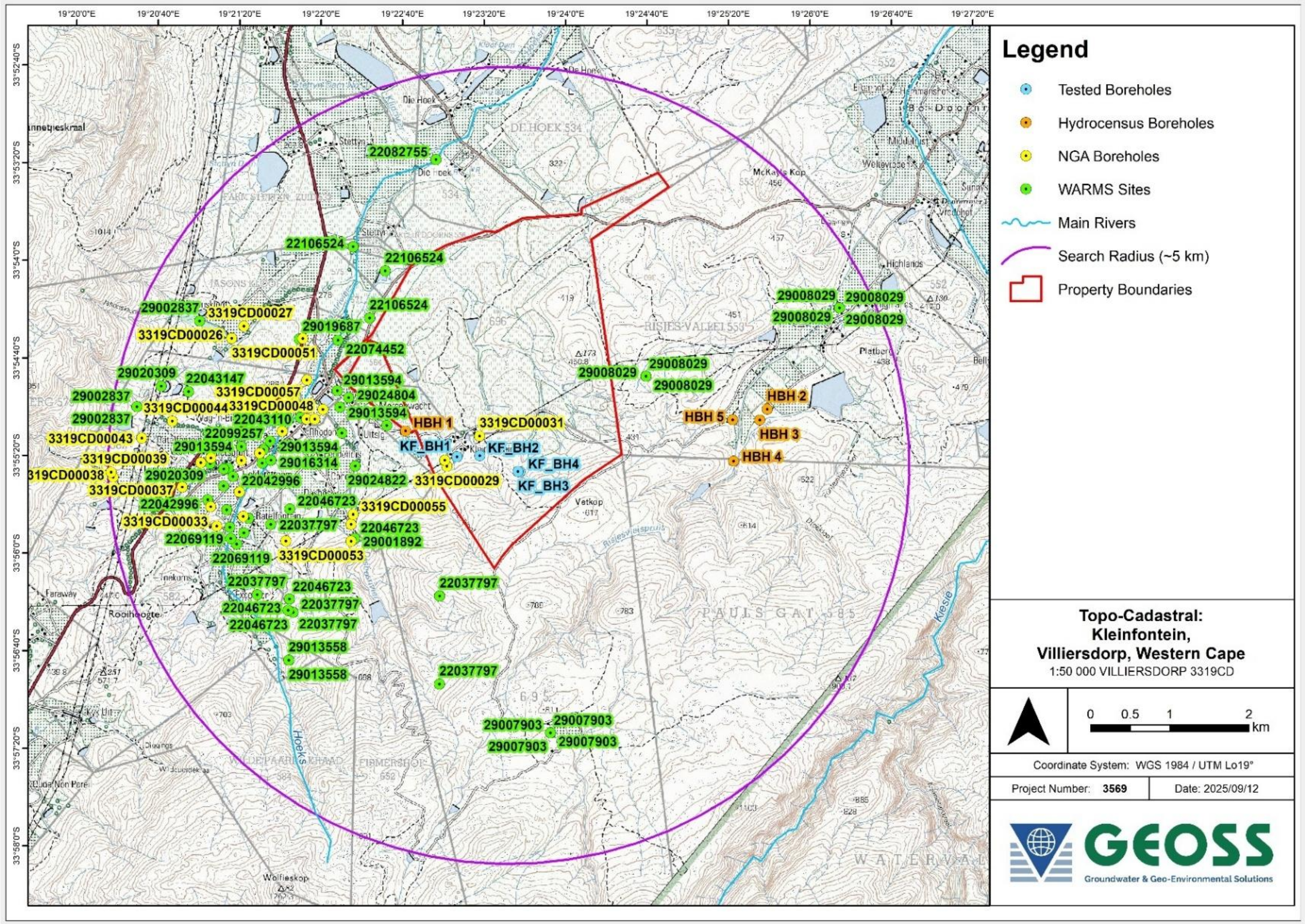
A site visit was then conducted to collect additional data and verify as much of the existing data as possible. This included a hydrocensus of groundwater users in the area and noting any subsurface conditions where possible. The local minimum potential of the aquifer in question was calculated as well as the managed yields of the boreholes.

All collected data was analysed and interpreted to assess the potential risks associated with the proposed water use as they pertain to groundwater, as well as assessing the sustainability of the proposed abstraction. Management recommendations were included to ensure sustainability of the proposed water use.

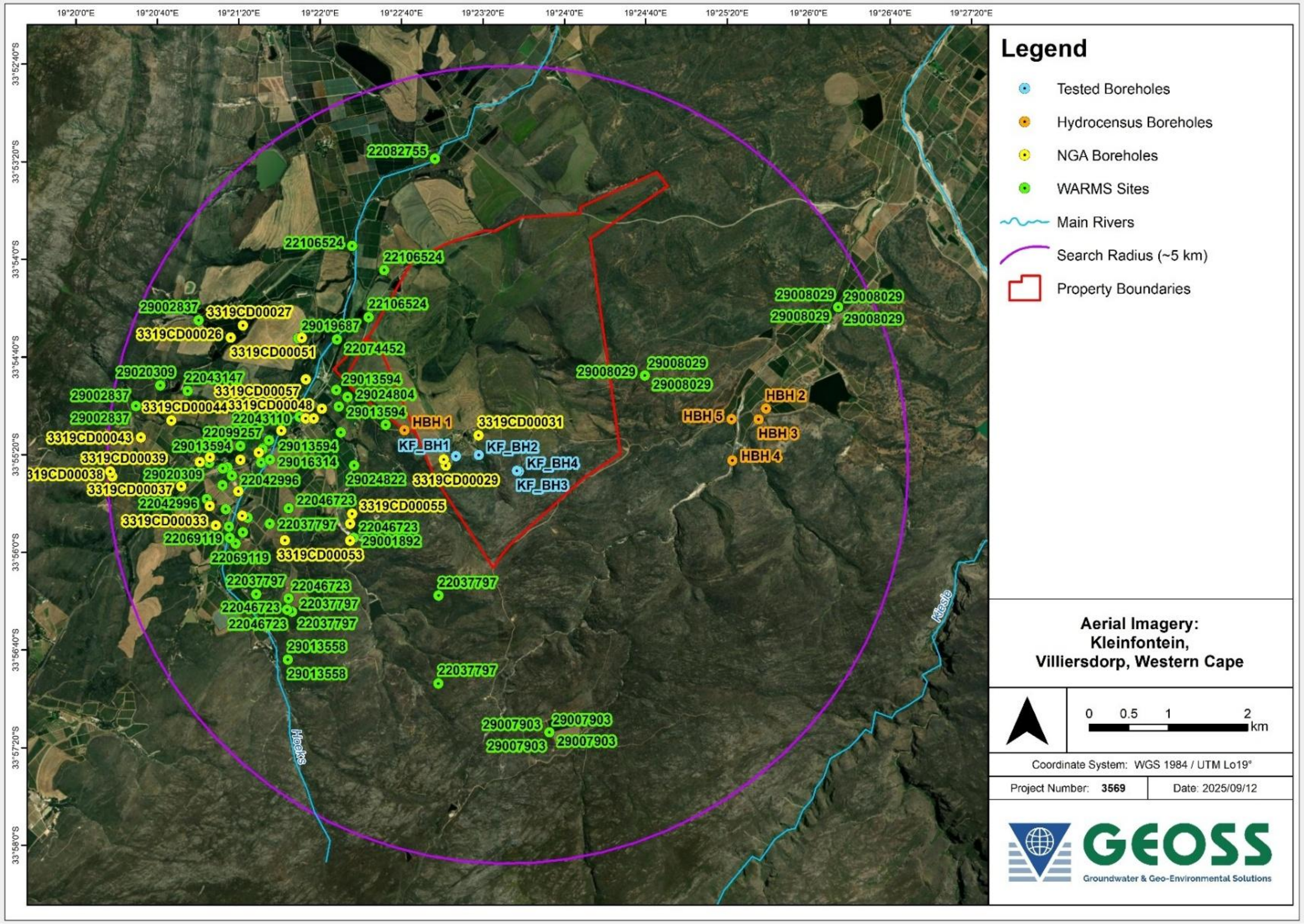
The study area, within a regional context, is shown in **Map 1**. **Map 2** and **Map 3** show a more detailed view of the study site with relevant information (borehole positions at and near the property) superimposed on a 1:50 000 topo-cadastral map and satellite image respectively.



Map 1: Locality of the proposed groundwater use at Elgin Free Range Chickens, Kleinfontein Farm, Villiersdorp.



Map 2: The study site with the property boundary showing the production, NGA, WARMS, and hydrocensus boreholes superimposed on a 1:50 000 scale topo-cadastral map (3319CD).



Map 3: The study site with the property boundary showing the production, hydrocensus, NGA and WARMS boreholes, superimposed on a satellite image.

4. Regional Setting

4.1 Site Context

The property, Kleinfontein, Farm nr 954 is 940.67 ha in size and it is located adjacent to the town of Villiersdorp, within the Theewaterskloof Municipality and the Overberg District Municipality. It is located within quaternary catchment H40E, and forms part of the Breede-Olifants Water Management Area. The quaternary catchment is approximately 285.43 km^2 in extent and has a General Authorisation (GA) of 150 m^3/ha/a for groundwater use.

The nearest river to the borehole is the Hoeks River, which runs adjacent to Kleinfontein Farm. The river is located 2.08 km from the proposed production borehole (KF_BH1), and 2.3 km from the proposed production borehole (KF_BH2). Both boreholes are also located next to non-perennial rivers. During the hydrocensus, these rivers were dry. Based on the understanding of the area and the regional groundwater flow from the study area towards the topographical low, the Hoeks River, the perceived risk of the groundwater abstraction impacting the non-perennial rivers is considered very low. Thus, a surface water–groundwater interaction assessment did not form part of the study.

The topography of the area on which the property is located is characterised by steep slopes that extend down towards the Hoeks River. The property's elevation is highest on the southern corner (695 mamsl) and lowest on the north-northwestern corner (269 mamsl), sloping down towards where the Hoeks River (tributary of the Breede River) is situated. The surrounding land use is dominated by irrigated farming.

4.2 Climate

The Villiersdorp area experiences a Mediterranean climate with cool, wet winters and warm, dry summers, **Figure 1** illustrates the monthly average minimum and maximum air temperatures, and **Figure 2** illustrates the monthly mean rainfall and evaporation distribution for the study area (Schulze, 2009).

The study area receives a mean annual precipitation of 361 mm/a. Precipitation in the study area is in the form of low and variable winter rainfall. The peak groundwater recharge period will be in the winter months when the rainfall exceeds to the evaporation.

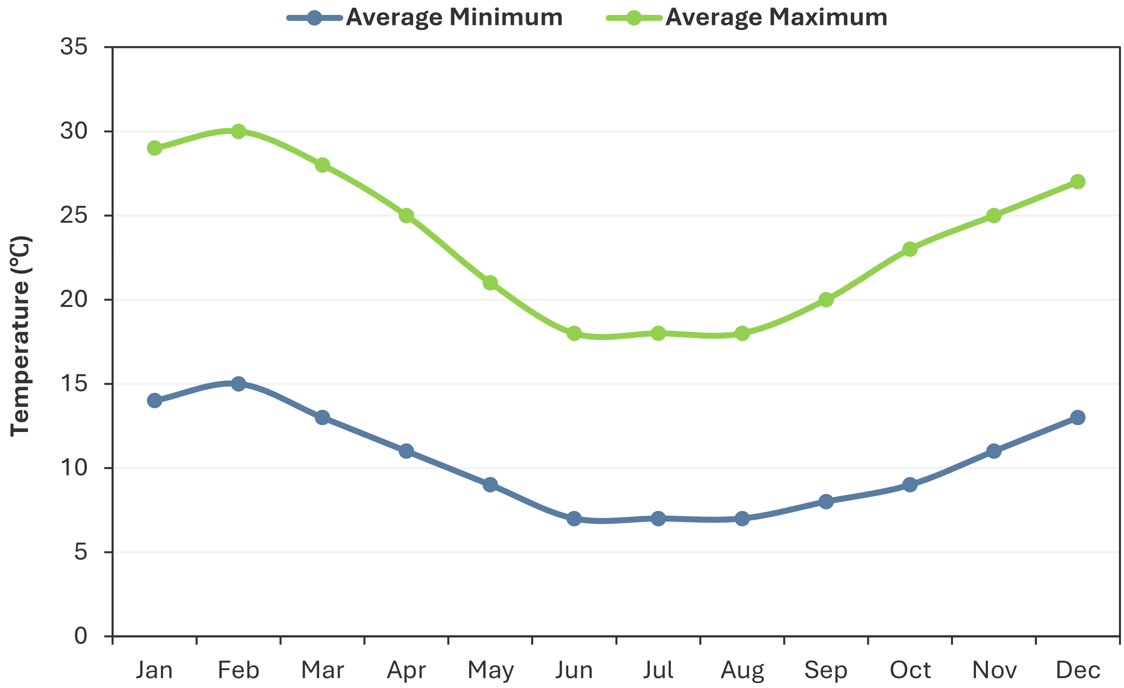


Figure 1: Monthly average minimum and maximum air temperatures for the study area (Schulze, 2009).

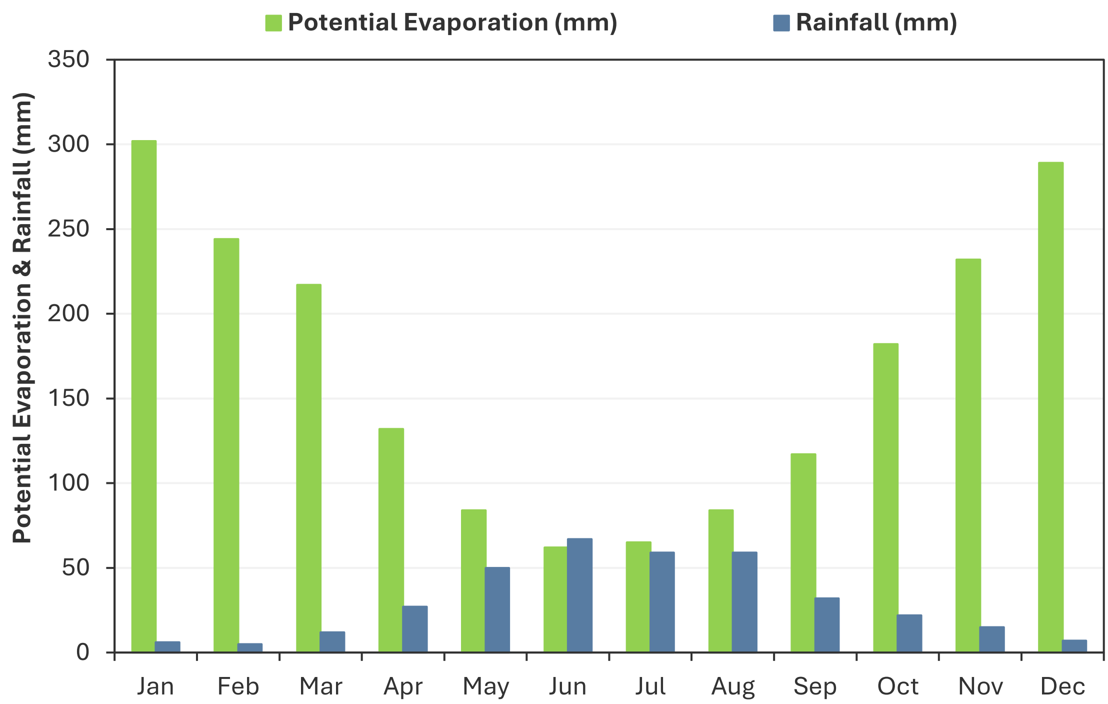


Figure 2: Monthly average rainfall and evaporation distribution for the study area (Schulze, 2009).

5. Regional Geology

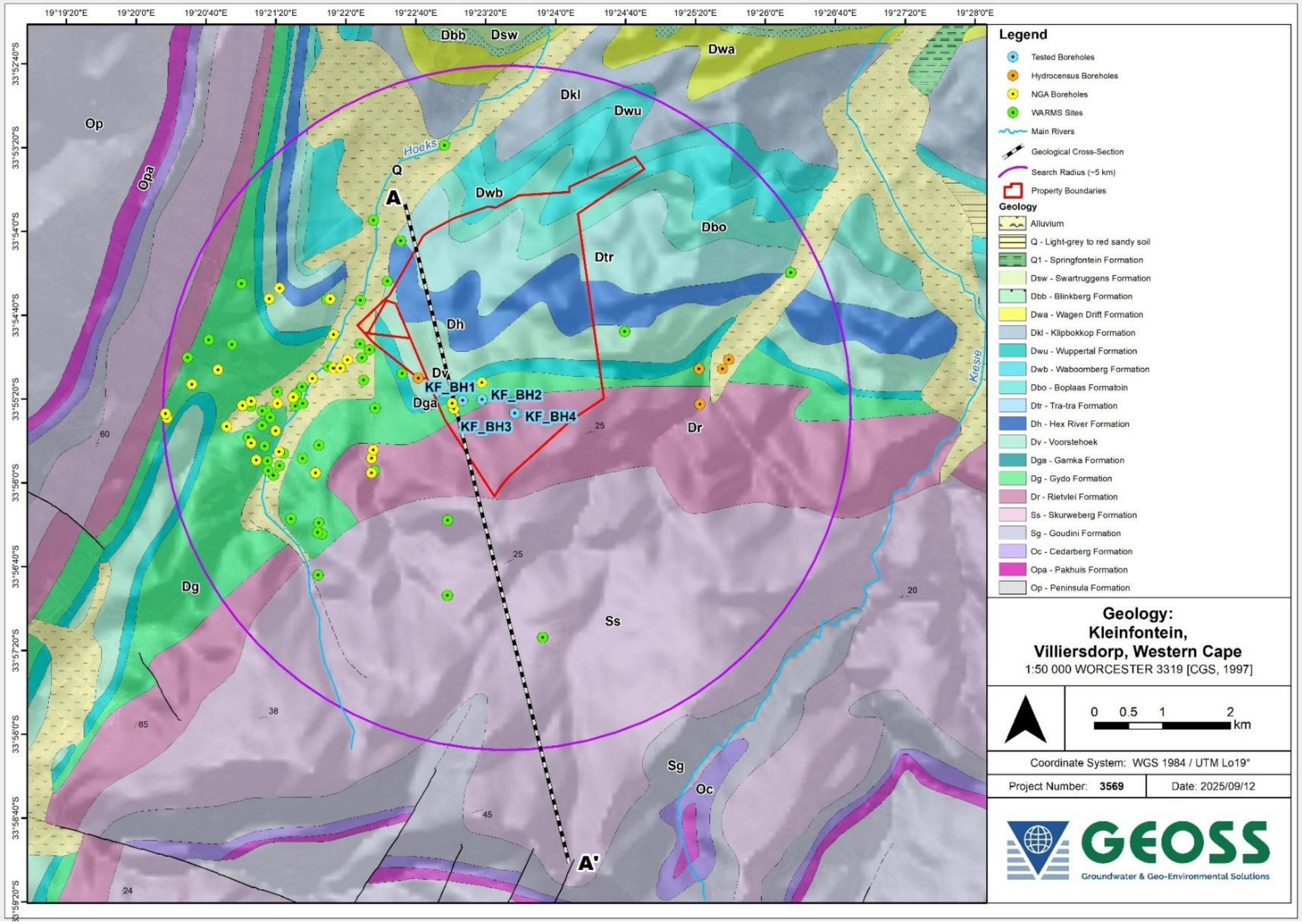
The Geological Survey of South Africa (now the Council for Geoscience (CGS)) has mapped the area at 1:250 000 scale (3319 Worcester, CGS 1997). The geological setting is shown in **Map 4** and the main geology of the area is listed in **Table 3**.

Table 3: Geological formations within the study area

Code	Formation	Group	Lithology
	n/a – Quaternary Age		Alluvium
Q			Light grey to pale red sandy soils
Dsw	Swartruggens	Witteberg Group	Siltstone and mudstone with micaceous sandstone beds: weathered reddish brown
Dbb	Blinkberg		Quarzitic sandstone, micaceous and white weathering, subordinate shale and sandstone
Dwa	Wagendrift		Siltstone, arenaceous shale, mudstone and thin, light-grey sandstone beds: exceptionally micaceous, weather red brown
Dki	Klipbokkop	Bokkeveld Group	Reddish grey weathering, micaceous siltstone and mudstone, thin sandstone beds
Dwu	Wuppertal		Fine to medium-grained micaceous sandstone and siltstone, subordinate dark-grey shale
Dwb	Waboomsberg		Dark grey siltstone and shale with intercalated mudstone and immature sandstone
Dbo	Boplaas		Light grey feldspathic and micaceous sandstone, subordinate shale; siltstone
Dtr	Tra-Tra		Mudstone, siltstone, subordinate sandstone
Dh	Hex-River		Feldspathic arenite, wacke, mudstone
Dv	Voorstehoek		Grey shale, siltstone and fine-grained sandstone
Dga	Gamka		Fine-grained, feldspathic sandstone, subordinate mudstone
Dg	Gydo		Shale, Siltstone, thin sandstone beds
Dr	Rietvlei	Table Mountain Group	White, siliceous, feldspathic sandstone, subordinate muddtonein places
Ss	Skurweberg		Thick-bedded, medium- to coarse-grained, cross-bedded, white-weathering, quartzitic sandstone
Sg	Goudini		Brownish-weathering, quartzitic sandstone, subordinate shale and siltstone
Oc	Cederberg		Shale, siltstone, subordinate sandstone
Opa	Pakhuis		Mudstone (diamictite) or sandstone containing scattered pebbles, cobbles and boulders
Op	Peninsula		Quartzitic sandstone, minor conglomerate and shale

The majority of the property is underlain by lithologies associated with the Bokkeveld Group, and the Table Mountain Group. The area is known for hosting complex folding (minor parasitic folds forming part of a large-scale Cape Fold Belt Mountain range) and variably faulted lithological outcrops. Towards the south of the property, outcrops of mudstone, sandstone, shale, and siltstone associated with the upper Table Mountain Group are recorded. Towards the north, outcrops of the lower Bokkeveld Group are recorded, represented by mudstone, siltstones and sandstones. The river valleys next to the property which extend eastward are associated with erosion and surface water transport and are covered by alluvium, boulders, sand, silt and clay.

An approximation of the subsurface geological conditions at a localised scale, based on the information contained in the 1:250 000 Worcester geological map (CGS, 1997) and is shown in **Map 4**. In the schematic cross-section shown in **Figure 3.** The regional scaled mapped geology suggests that the boreholes intersect the Gydo Formation (Bokkeveld Group), which is then underlain by the Rietvlei Formation from the Table Mountain Group, but this could not be confirmed by the borehole logs **(Appendix A).** The formation is around 160 m thick and because of the thin sandstone layers found in the formation, recharge would be more favourable (Meyer, 2001).



Map 4: Geological map with the property boundary showing the production, hydrocensus, NGA and WARMS boreholes *(1:250 000 Geological Map Series, 3319 Worcester) (CGS, 1997)*.

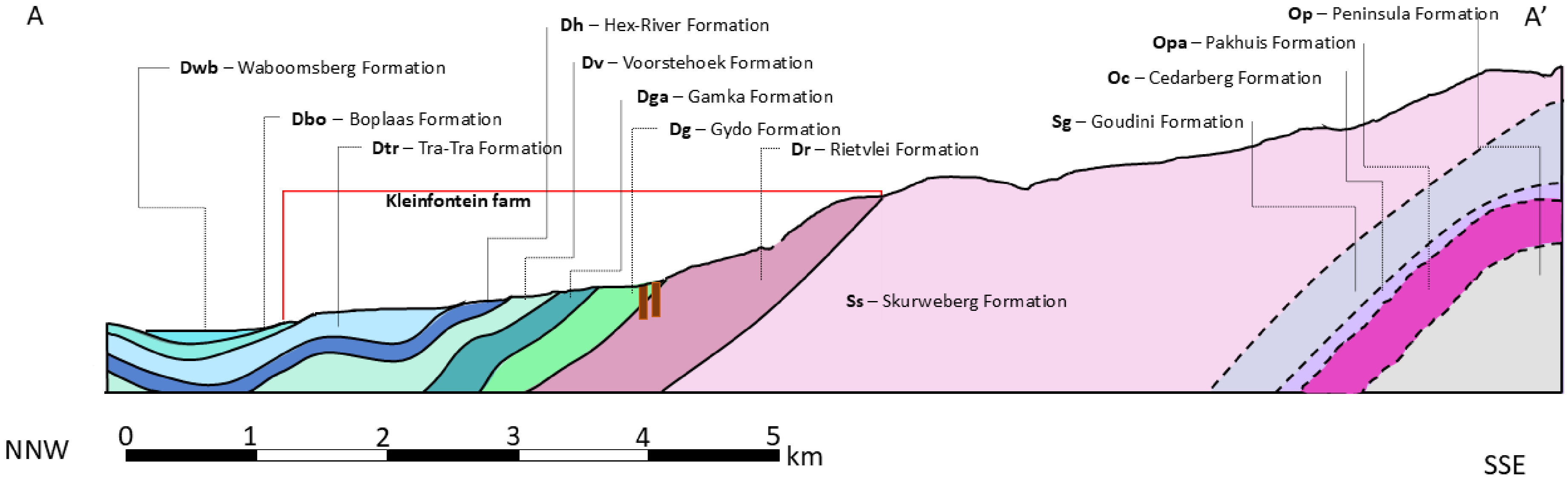


Figure 3: A schematic and conceptual NNW-SSE geological cross section.

6. Regional Hydrogeology

The presence and characteristics of groundwater in the study area are primarily governed by the rate and volume of groundwater recharge, as well as the geological formations that serve as storage and flow pathways. The region consists of fractured aquifers, which influence groundwater availability and movement. The aquifer yield and quality classifications are based on regional datasets and provide an indication of expected conditions rather than precise site-specific measurements.

6.1 Aquifer Yield

According to the 1:500 000 scale hydrogeological map (DWAF, 2000), the study area hosts a **fractured aquifer** with an average **borehole yield of 0.5 L/s** (**Map 5**). A fractured aquifer is defined as a formation that contains sufficient fissures, fractures, cracks, joints and faults that yield economic quantities of water to boreholes and springs. Groundwater will then move along these fractures and joints. The fractured aquifer depicted on the map likely refers to the Rietvlei Formation from the Table Mountain Group, which underlays the Gydo Formation.

6.2 Aquifer Quality

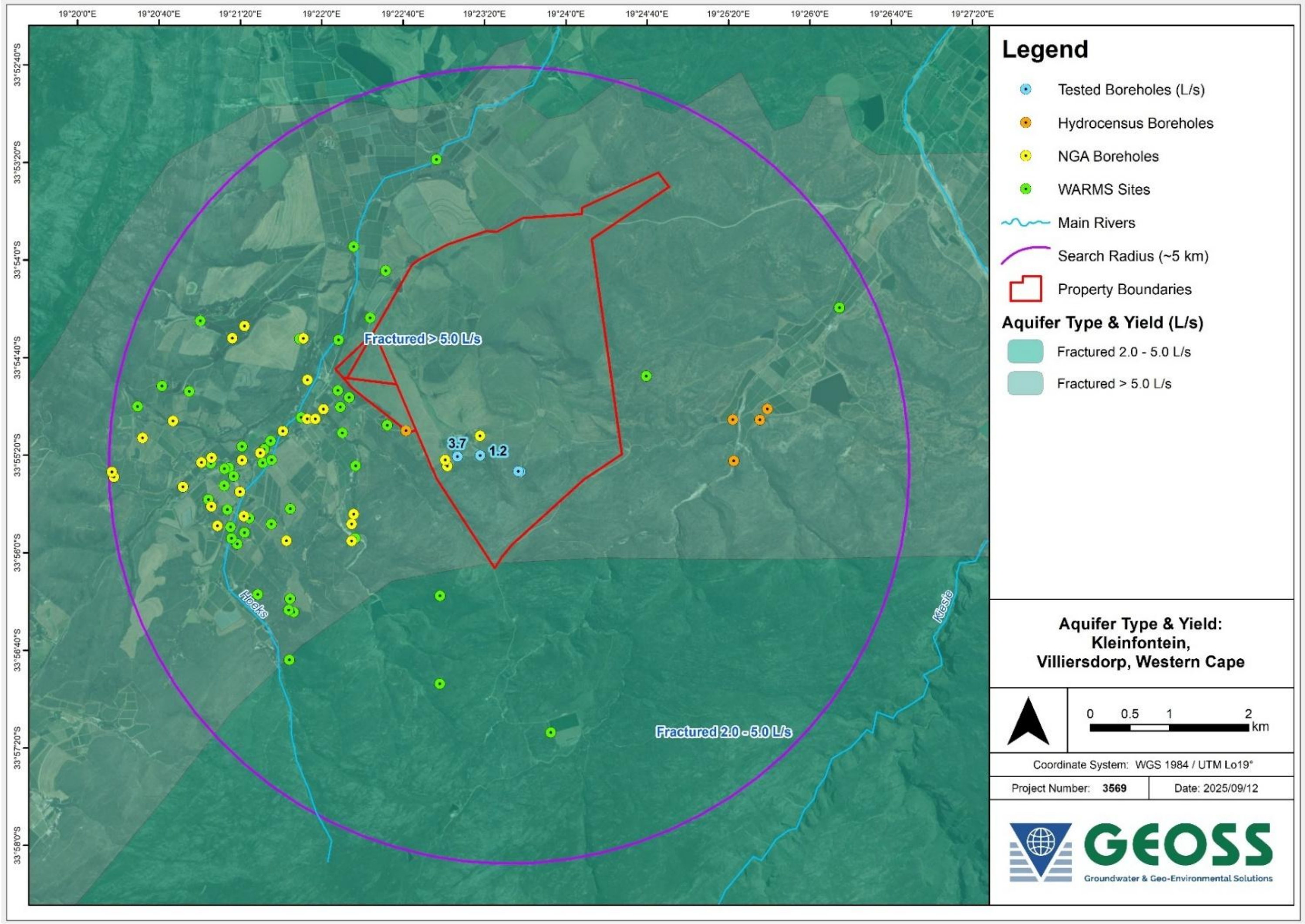
Electrical conductivity (EC) is a measure of the ability of the groundwater to conduct electricity. EC is directly related to the concentration of dissolved ions in the water and this parameter is used as an indication of groundwater quality. The groundwater map indicates that the aquifer has EC values in the range of 0-70 mS/m (**Map 6**) (DWAF, 2000). This is classified as **good** water quality in terms of domestic water standards (DWAF, 1998). In the valley west of the farm, the water quality is **poor** (300 – 1 000 mS/m).

6.3 Aquifer Vulnerability Classification

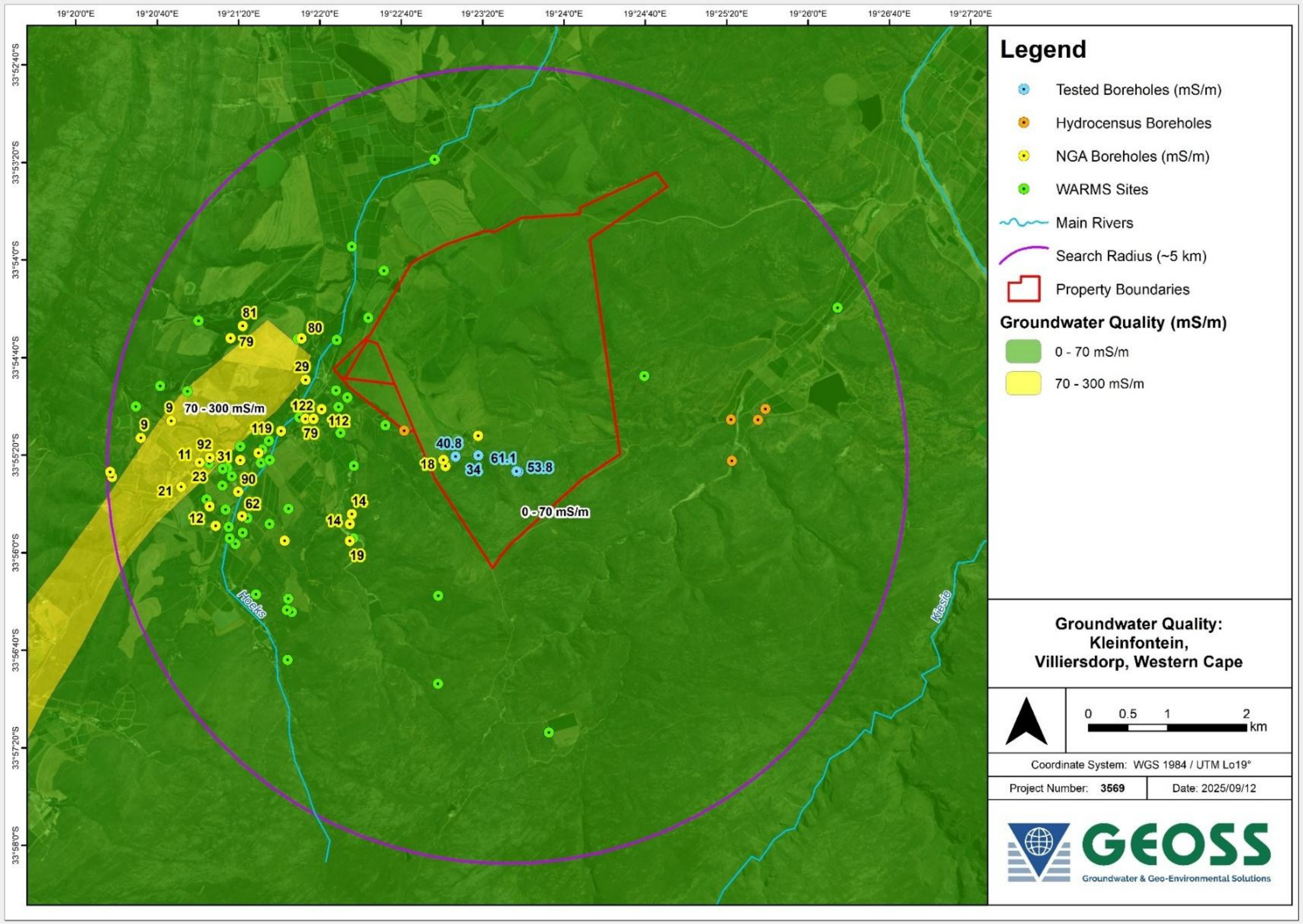
The national scale groundwater vulnerability map, which was developed according to the DRASTIC methodology (Conrad and Munch, 2007), indicates that the study area has a "very low to low/medium" vulnerability to surface-based contaminants (**Map 7**). The DRASTIC method considers the following factors:

D	=	depth to groundwater	(5)
R	=	recharge	(4)
A	=	aquifer media	(3)
S	=	soil type	(2)
T	=	topography	(1)
I	=	impact of the vadose zone	(5)
C	=	conductivity (hydraulic)	(3)

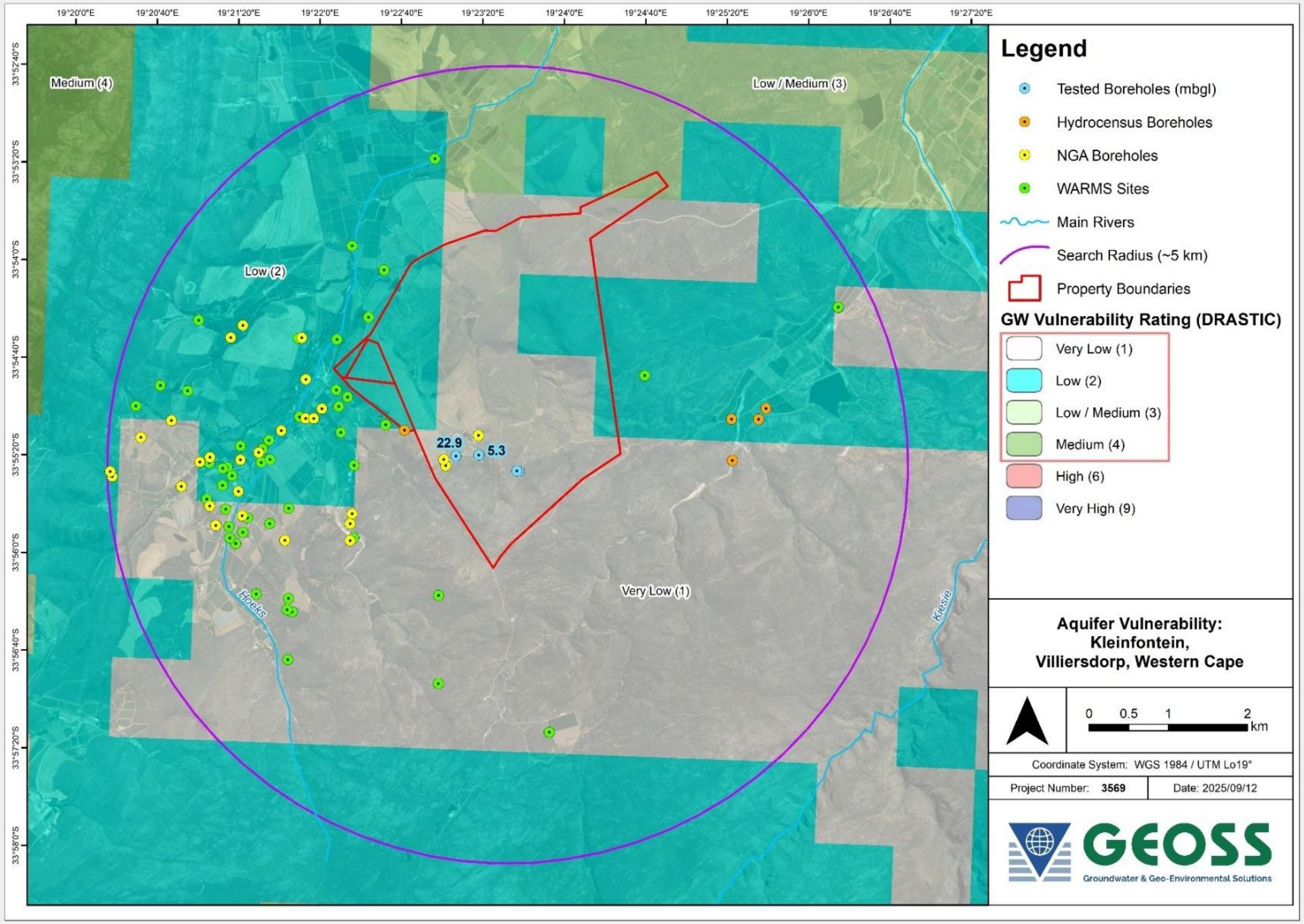
The number indicated in parenthesis after each factor description, is the weighting or relative importance of that factor. This "**very low to low/medium**" rating is likely associated with the fact that the aquifer is regionally classified as a fractured aquifer overlain by an aquitard. While still susceptible to contamination, fractured aquifers are generally less permeable than intergranular alluvial systems, and groundwater levels tend to be deeper, reducing the risk of rapid pollutant infiltration. However, contaminants can still enter the groundwater system, particularly in areas where fractured rock is exposed or where boreholes act as direct conduits for pollution.



Map 5: Regional aquifer yield (L/s) according to (DWAF, 2000) with the managed yield (L/s) of the proposed production boreholes.



Map 6: Regional groundwater quality (EC in mS/m) from DWAF (2000).



Map 7: Vulnerability rating (DWAF, 2000) and groundwater depths (mbgl).

7. Volume and Purpose of Water Use

Although this report focuses on groundwater abstraction under Section 21 (a) water use, other water uses are also applicable under Section 21, and are briefly discussed below:

- taking water from a water resource - Abstraction of water from the proposed two boreholes for domestic (non-potable and potable) and livestock watering on the property.
- storing water – Storage of water in six earth dams (registered Existing Lawful Use (ELU)).(PHS Consulting Pers. Comm. 2025)
- impeding or diverting the flow of water in a watercourse(PHS Consulting Pers. Comm. 2025).
- disposing of waste in a manner that may detrimentally impact on a water resource. (PHS Consulting Pers. Comm. 2025)
- altering the bed, banks, course or characteristics of a watercourse (PHS Consulting Pers. Comm. 2025)

The property Kleinfontein is in the process of being purchased by Elgin Free Range Chickens. The company wants to develop the property as a poultry farm. The abstracted groundwater will be used for domestic use (non-potable and potable), providing water to 20 workers, a Gate House, and two ablution areas on-site, as well as for livestock watering of the chickens in 20 houses (chicken coups), and 2 000 sheep in the summer. Additional supply will come from six earth dams to irrigate trees on the property. This water has been registered for a volume of 19 800 m^3/a with registration number:29008029 (PSH Consulting Pers. Comm. 2025)

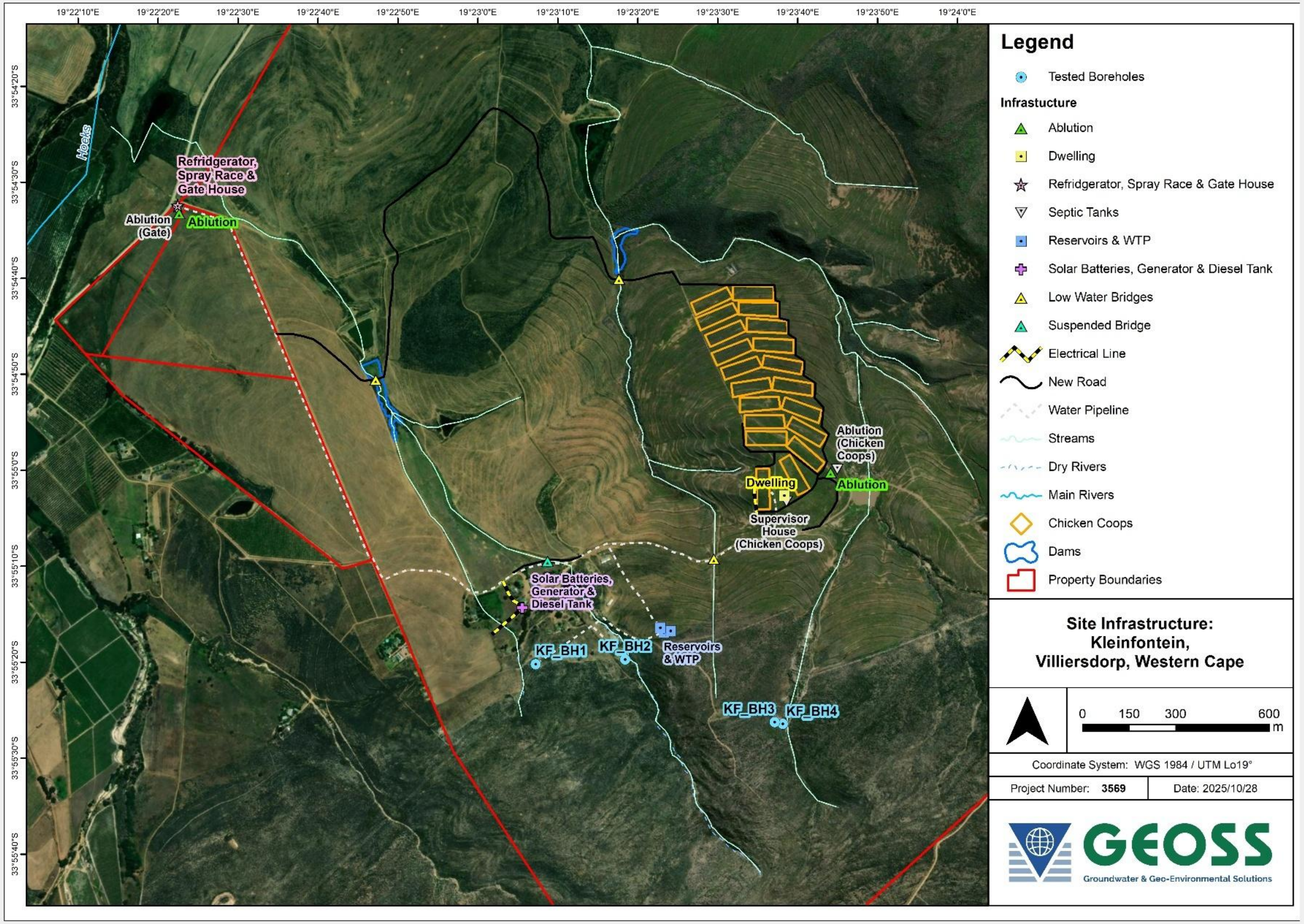
The property is located within quaternary catchment H40E, which forms part of the Breede-Olifants Water Management Area. The quaternary catchment is 285 43km^2 in extent and has a groundwater General Authorisation (GA) of 150 m^3/a/ha. The total combined area of the property is 940 67 ha, and a maximum volume of 40 000 m^3/a can be abstracted under the GA. The proposed volume to be abstracted is **49 458** m^3/a. The proposed abstraction does exceed the GA limit, and the application is also triggered Section 21 c, g and, i component (PSH Consulting Pers. Comm. 2025), a water use licence will need to be granted by the DWS. Risk associated with Section 21 c, g and i, is discussed in **Section 10.3.**

The groundwater will be abstracted from two (2) production boreholes (**Map 2** and **Map 3**). The production boreholes were correctly yield tested (according to SANS 10299_4-2003) and the results used to determine the managed (i.e., long term and safe) yield of the borehole. The total conservative volume, which can be abstracted from the boreholes, is 154 526 m^3/a. The application volume (**49 458** m^3/a) is 32% of the recommended abstraction volume. A water management plan is displayed in **Table 4**, and the demand was calculated as follows:

The domestic requirement for 20 workers on site, has been calculated at 7 508 m^3/a, while the watering of livestock (chickens and 2000 sheep) requirement has been calculated at 41 950 m^3/a. Treatment loss is not expected; a proposed treatment design can be viewed in **Appendix B**. No municipal water will be used; thus, the property is solely reliant on groundwater for day-to-day activities. The proposed site layout can be viewed in **Map 8** with the provided Site Layout included in **Appendix C.** All calculations have been provided by PSH Consulting.

Table 4: A water management plan for Kleinfontein, Villiersdorp.

Date	Water Supply (m³/a)			Water Demand (m³/a)			
	BH 1	BH2	Six earth dams (m/a)	20 Houses@ 94.9 (m³/a)	Potable needs (m³/a)	Sheep watering (m³/a)	Irrigation from six earth dams (m³/a)
	3.7L/s	1.2L/s					
January	3192.38	1008.12	1681.44	2941.9	636.89	1891	168 144
February	2883.44	910.56	1518.72	2668.588	580.5284	1708	151 872
March	3192.38	1008.12	1681.44	2941.9	636.89	0	168 144
April	3089.4	975.6	1627.2	2847	617.32	0	16 272
May	3192.38	1008.12	1681.44	2941.9	636.89	0	168 144
June	3089.4	975.6	1627.2	2847	617.32	0	16 272
July	3192.38	1008.12	1681.44	2941.9	636.89	0	168 144
August	3192.38	1008.12	1681.44	2941.9	636.89	0	168 144
September	3089.4	975.6	1627.2	2847	617.32	0	16 272
October	3192.38	1008.12	1681.44	2941.9	636.89	0	168 144
November	3089.4	975.6	1627.2	2847	617.32	1830	16 272
December	3192.38	1008.12	1681.44	2941.9	636.89	1891	168 144
Total (m³/a)	**49 458**		**19 800**	**49 458**			**19 800**
Balance	**69 258**			**69 258**			



Map 8: Proposed site layout.

8. Site Specific Information

8.1 Desktop Assessment (Existing Groundwater Information)

To determine whether there are any groundwater users in the area that may be affected by activities on site, a database search was conducted using a 5-km radius around the property boundary. This portion of the study was completed by studying and inquiring from existing databases that contain groundwater information. A search was conducted on a number of databases, namely the National Groundwater Archive (NGA) and the Water Use Authorisation and Registration Management System (WARMS). The NGA provide data on borehole positions, groundwater chemistry, and yield, when available; whereas the WARMS inform existing registrations of groundwater use. Based on the desktop assessment of the various databases, it is evident that there are a large number of groundwater users in the area surrounding Kleinfontein

8.1.1 National Groundwater Archive (NGA) Database

The NGA was consulted to indicate any existing boreholes and groundwater users in the area. These sites are then typically verified in the field, should time allow, and provide background information on the area, should it exist. A search radius of 5 km was used to research any known information surrounding the site of interest.

According to the NGA there are 29 boreholes within the search radius, summarised in **Table 5** and shown spatially in **Map 3**. Borehole depths range between 34.0 – 130.0 mbgl with associated EC values recorded ranging between 12.0 – 122.0 mS/m, the water is classified as a good water quality based on DWAF 1998 domestic standards). Discharge rates were also available; however no indication of whether it was the tested yield or blow yields. No water levels and lithology were available on the NGA records.

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Table 5: Summary of NGA borehole details.

Site ID	Latitude (DD. WGS84)	Longitude (DD. WGS84)	Date	Discharge rates (L/s)	EC (mS/m)	Depth (m)
3319CD00053	-33.93189	19.36208	1 June 1989	7.6	-	160
3319CD00052	-33.93189	19.37097	1 June 1989	18.9	19	60
3319CD00033	-33.93022	19.35263	1 June 1989	-	-	126
3319CD00054	-33.92995	19.37097	1 June 1989	17	14	56
3319CD00034	-33.92911	19.35624	1 June 1989	7.6	62	87
3319CD00055	-33.92883	19.37125	-	-	14	49
3319CD00035	-33.92800	19.35180	1 June 1989	6.3	12	122
3319CD00036	-33.92633	19.35569	1 June 1989	12.6	90	31
3319CD00037	-33.92578	19.34791	1 June 1989	12.6	21	69
3319CD00038	-33.92467	19.33846	1 June 1989	10.1	-	91
3319CD00039	-33.92411	19.33819	1 June 1989	8.8	-	91
3319CD00029	-33.92332	19.38402	1 June 1989	15.1	-	110
3319CD00040	-33.92300	19.35041	1 June 1989	15.1	11	76
3319CD00041	-33.92300	19.35042	1 June 1989	12.6	23	85
3319CD00046	-33.92272	19.35597	1 June 1989	13.3	31	34
3319CD00030	-33.92262	19.38374	1 June 1989	0.6	18	130
3319CD00042	-33.92245	19.35180	1 June 1989	8.8	92	90
3319CD00047	-33.92189	19.35847	1 June 1989	11.1	85	40
3319CD00043	-33.92022	19.34235	1 June 1989	6.3	9	90
3319CD00031	-33.91985	19.38846	1 June 1989	6.3	-	-
3319CD00049	-33.91939	19.36152	1 June 1989	9.5	119	85
3319CD00044	-33.91828	19.34652	1 June 1989	12.6	9	76
3319CD00048	-33.91800	19.36486	1 June 1989	7.6	79	61
3319CD00050	-33.91800	19.36597	1 June 1989	3.8	122	40
3319CD00056	-33.91689	19.36708	1 June 1989	7.6	112	73
3319CD00057	-33.91355	19.36486	1 June 1989	2.5	29	61
3319CD00026	-33.90883	19.35458	1 June 1989	3.8	79	80
3319CD00051	-33.90883	19.36430	1 June 1989	12.6	80	61
3319CD00027	-33.90744	19.35624	1 June 1989	10.1	81	80

8.1.2 Water Use Authorisation and Registration Management System (WARMS) Database

The WARMS database (last assessed in May 2025) was consulted to indicate any existing registrations for groundwater use in the area. There are four sites registered on the WARMS database within the H40D catchment and 21 sites registered within the H40E catchment, within the search radius of 5 km from the property boundary The registered uses are shown spatially in **Map 3**. and listed in

Table 6. Sites 290424804, 29013594 and 22106524 are located next to the property boundary.

Table 6: Summary of WARMS borehole details.

Registered No.	Latitude (DD. WGS 84)	Longitude (DD. WGS 84)	Lawfulness	Water Use Sector	Catchment	Registered Volume (m^2/a)
29007903	-33.9536	19.3983	Existing Lawful Water Use	Agriculture: Irrigation	H40D	45 798
29008029	-33.9051	19.4375	Existing Lawful Water Use	Agriculture: Irrigation	H40D	79 969
29008029	-33.9130	19.4111	Existing Lawful Water Use	Agriculture: Irrigation	H40D	88 036
29024804	-33.9187	19.3758	Existing Lawful Water Use	Agriculture: Irrigation	H40D	30 247
Total						**249 650**
29024804	-33.9156	19.3706	Existing Lawful Water Use	Agriculture: Irrigation	H40D	5 600
22037797	-33.9400	19.3631	Existing Lawful Water Use	Agriculture: Irrigation	H40E	14 948
22042996	-33.9236	19.3542	Existing Lawful Water Use	Agriculture: Irrigation	H40E	9 280
22042996	-33.9246	19.3548	Existing Lawful Water Use	Agriculture: Irrigation	H40E	55 145
22043110	-33.9178	19.3640	Existing Lawful Water Use	Agriculture: Irrigation	H40E	27 467
22046723	-33.9316	19.3715	Unverified	Agriculture: Irrigation	H40E	118 500
22046723	-33.9385	19.3626	Existing Lawful Water Use	Agriculture: Irrigation	H40E	19 836
22046723	-33.9385	19.3626	Existing Lawful Water Use	Agriculture: Watering Livestock	H40E	2 110
22046723	-33.9398	19.3624	Existing Lawful Water Use	Reasonable Domestic Use	H40E	440
22069119	-33.9303	19.3544	Existing Lawful Water Use	Agriculture: Irrigation	H40E	84 076
22069119	-33.9293	19.3570	Existing Lawful Water Use	Agriculture: Watering Livestock	H40E	550
22069119	-33.9316	19.3546	Existing Lawful Water Use	Agriculture: Irrigation	H40E	50 200

29001892	-33.9316	19.3715	Unverified	Agriculture: Irrigation	H40E	118 500
29013558	-33.9454	19.3625	Existing Lawful Water Use	Agriculture: Irrigation	H40E	124 304
29013594	-33.9196	19.3697	Existing Lawful Water Use	Agriculture: Irrigation	H40E	650
29013923	-33.9205	19.3599	Existing Lawful Water Use	Agriculture: Irrigation	H40E	29 010
29014343	-33.9284	19.3540	Existing Lawful Water Use	Agriculture: Irrigation	H40E	53 610
29019687	-33.9089	19.3638	Existing Lawful Water Use	Agriculture: Irrigation	H40E	15 000
29024822	-33.9233	19.3715	Existing Lawful Water Use	Agriculture: Irrigation	H40E	199 734
22043021	-33.9257	19.3536	Unverified	Agriculture: Irrigation	H40E	50 000
22043021	-33.9237	19.3536	Unverified	Agriculture: Irrigation	H40E	40 000
Total						**1 013 360**

8.1.3 Hydrocensus

A site visit was conducted on the 19th of August 2025 to assess groundwater use within the study area. The results of the field investigation are spatially represented on **Map 2** and **Table 7.** During the hydrocensus, seven boreholes were visited.

The information gathered during the hydrocensus can be summarised as follows:

- It was noted that the depths of the boreholes were generally deep (>80 m).
- Water levels are between 15-32 mbgl.
- Groundwater is used for both domestic and irrigation purposes.

Table 7: Hydrocensus Data

Site ID	Type of abstraction point	Latitude (DD. WGS84)	Longitude (DD. WGS84)	Use	Depth (mbgl)	Water level (mbgl)	General comments	Approx. yield (L/s)	Picture
HBH1	Borehole	-33.9167	19.4277	Domestic supply	130	32 (28 February 2011)	Pump hangs at 96 m	-	
HBH2	Borehole	-33.9179	19.4267	Irrigation	122	15	Pump hangs at 62 m	-	
HBH3	Borehole	-33.9225	19.4232	Irrigation	86	-	Pump hangs at 82 m	-	

Site ID	Type of abstraction point	Latitude (DD. WGS84)	Longitude (DD. WGS84)	Use	Depth (mbgl)	Water level (mbgl)	General comments	Approx. yield (L/s)	Picture
HBH4	Borehole	-33.9181	19.4232	Irrigation	-	-	-	-	
HBH5	Borehole	-33.916	19.4275	Domestic supply and irrigation	84	-	-	6.6	
HBH6	Borehole	-33.92225	19.3854	Water supply and stock watering	96.94	24	-	3.7	

Site ID	Type of abstraction point	Latitude (DD. WGS84)	Longitude (DD. WGS84)	Use	Depth (mbgl)	Water level (mbgl)	General comments	Approx. yield (L/s)	Picture
HBH7	Borehole	-33.9221	19.3886	Domestic supply and stock watering	163	19.54	-	1.2	

8.2 Yield Testing

8.2.1 Methodology

The yield testing was undertaken by GEOSS from 28 January to 5 February 2025 and carried out according to the National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes). This included a Step Test, Constant Discharge Test (CDT) and recovery monitoring of the borehole. For the Step Test, a borehole is pumped at a constant rate for one-hour intervals and the flow rates are incrementally increased for each step. This test is followed by a Constant Discharge Test where the boreholes are pumped at a constant rate for an extended period of time, followed by recovery monitoring. The water level drawdown is monitored at pre-determined intervals during these tests (drawdown refers to the difference in water level from the rest water level (RWL) measured before commencement of the yield test). Raw data and measurements taken during the yield tests are presented in **Appendix D.**

The yield test data were analysed using the excel-based FC program, developed by the IGS (Institute for Groundwater Studies) in Bloemfontein. The managed yield of the borehole was calculated based upon long-term extrapolations of the CDT data according to (1) the Cooper-Jacob approximation of the Theis solution for confined aquifers, (2) the Barker Generalised Radial Flow Model (GRF) for hydraulic tests in fractured rock and (3) the Flow Characteristic (FC) method(s) using first and second derivative calculations. Boundary conditions are accounted for in multiplication factors to the rate of drawdown (derivatives), according to each of the above three methods. These three methods are briefly described below.

1. The Cooper-Jacob approximation of the Theis solution for confined aquifers was designed for porous media aquifers, where infinite acting radial flow (IARF) was observed during the pumping of a borehole. The application of this method to fractured aquifers was discussed by Meier et al (1998). concluding that T estimates using the Cooper-Jacob analysis gave an effective T for the fracture zone. The Cooper-Jacob analysis (and more accurately the Theis method) is therefore viable for analysing pumping test data for fractured aquifers where IARF is observed. The parameters are then used to predict theoretical long-term drawdowns.
2. The Barker GRF Model (Barker, 1988) uses fracture hydraulic conductivity, fracture storativity and flow domain to predict drawdown due to abstraction in a borehole in a fractured medium. By changing these values, a curve of drawdown predictions can be made to fit real-world data and therefore predict theoretical long-term drawdowns.
3. The FC methods are the Basic FC, the FC Inflection Point and the FC Non-Linear. The Basic FC and the FC Inflection Point methods make use of the derivatives of the drawdown data to predict theoretical long-term drawdowns and the scale-back factors are applied to selected available drawdowns. The FC Non-Linear method uses curve fitting of the Step Test data to predict theoretical long-term drawdowns. Due to the short nature of the Step Test, this method is usually not included if the other methods of analysis differ from it.

In all three methods, the available drawdown (AD) was carefully selected to ensure that the flow regime described by the analytical solution is not extrapolated beyond its applicable depth, which may easily result in an overuse of the resource. For both KF_BH1 and KF_BH2 this was conservatively calculated as the geometric mean of the maximum drawdown reached during the CDT and the drawdown to the pump depth (24.1 m and 92.1 m respectively). A two-year extrapolation time without recharge to the aquifer was selected as per the recommendations within the FC method program.

Water samples were collected at the end of the yield tests and submitted for inorganic chemical analyses.

8.2.2 Yield Testing at KF_BH1

The yield testing was conducted between 28 and 30 of January 2025. The borehole was measured to a depth of 96.94 meters below ground level (mbgl). The test pump was installed at a depth of 90.50 mbgl. The rest water level (RWL) at the start of the test was 22.97 mbgl.

During the Step Test, the water level was drawn down 6.13 meters below the rest water level to 29.10 mbgl during the 3rd step at a rate of 5.11 L/s (18 396 L/hour, pump max due to borehole inner diameter). **Figure 4** shows the time-series drawdown for the Step Test.

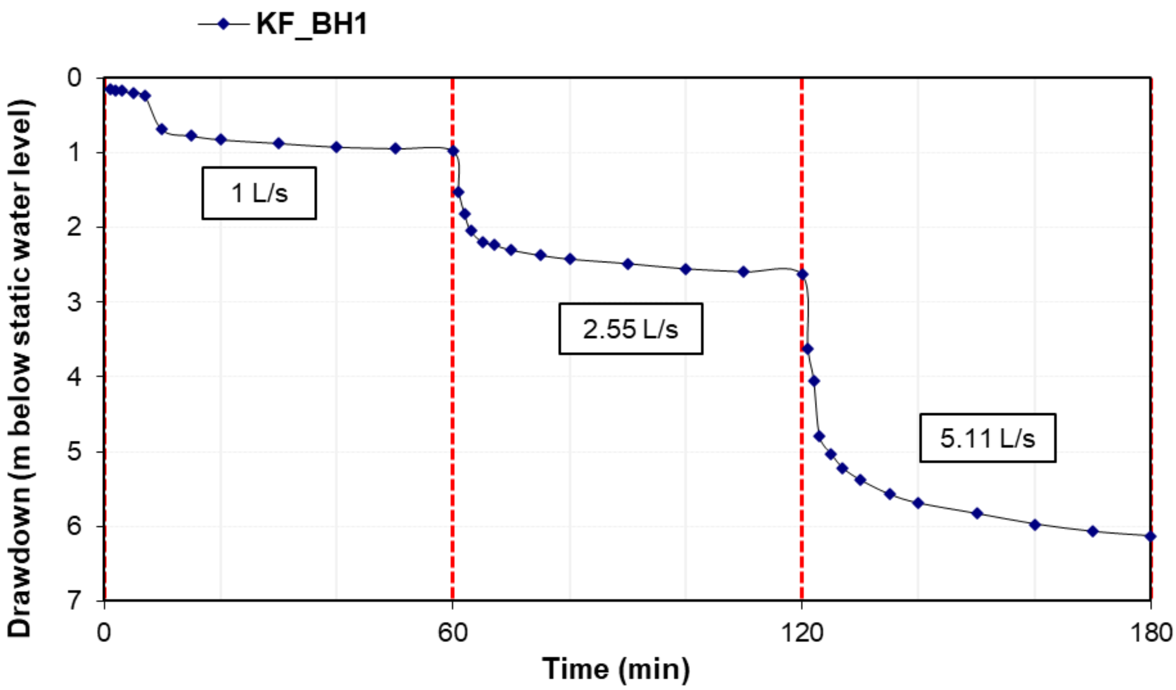


Figure 4: Step Test drawdown data for KF_BH1.

The water level was left to recover overnight. Before starting the CDT, the water level recovered to 23.23 mbgl. Based on the results of the Step Test, the planned 24-hour CDT was conducted at a rate of 5.13 L/s (18 468 L/hour). At the end of the 24-hour period, the water level had drawn down 8.67 meters below the rest water level (31.9 mbgl).

The semi-log plot of the drawdown from the CDT is presented in **Figure 5**. The available drawdown is indicated with the horizontal red line at 24.1 m.

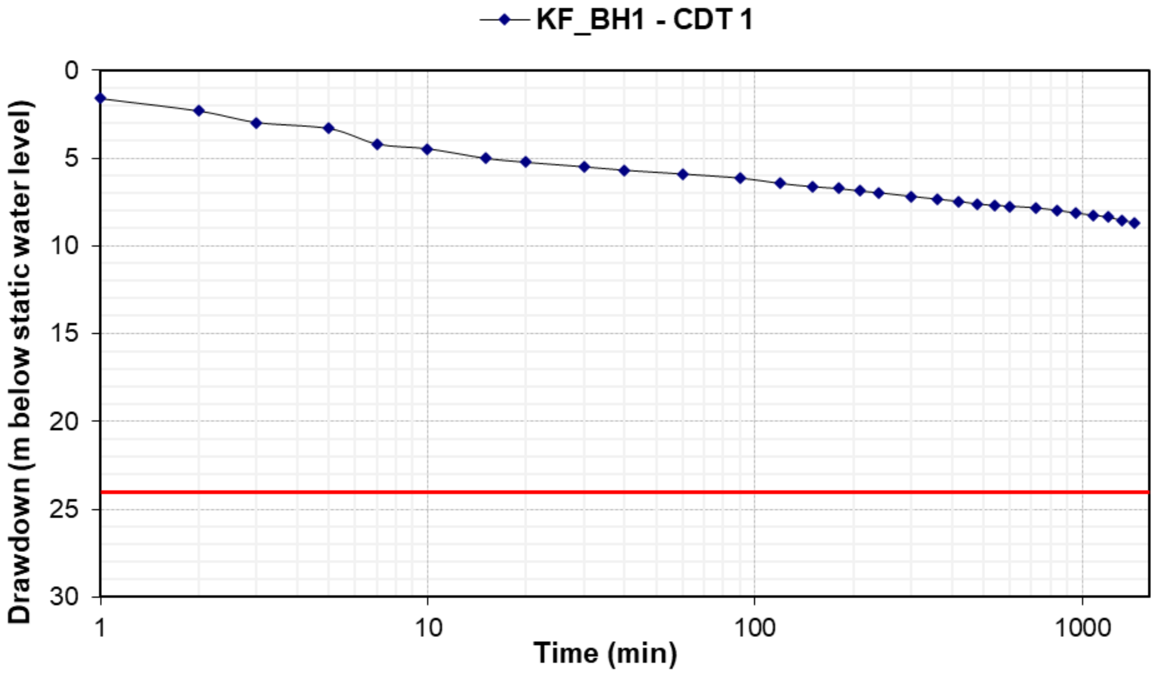


Figure 5: Semi-Log Plot of drawdown during the CDT of KF_BH1 (5.13 L/s).

The recovery of the water level was monitored after the CDT and is presented in **Figure 6**. The recovery was moderate to slow, only reaching 82.7% in 24 hours. Monitoring will be essential to determine the long-term recovery of the borehole.

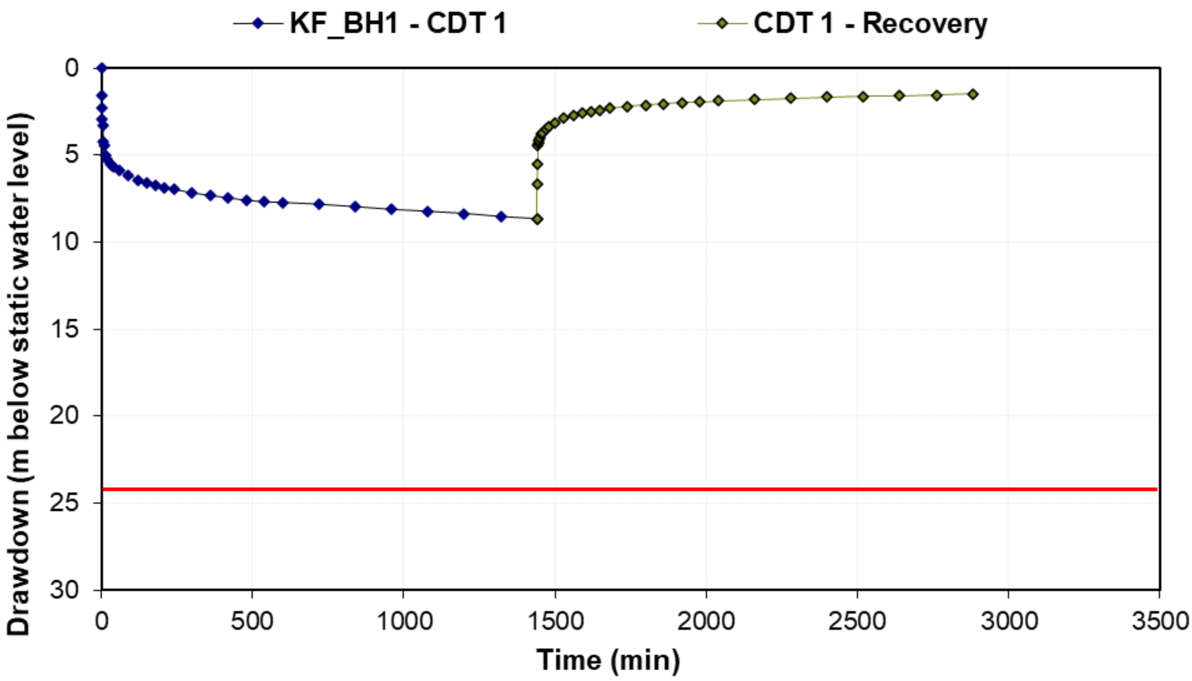


Figure 6: Time-series drawdown and recovery for KF_BH1 (5.13 L/s).

Several methods were used to assess the yield test data as presented in **Table 8**. It is recommended that the borehole can be abstracted from at a rate of up to 3.7 L/s (13 320 L/hour) for up to 24 hours per day.

The assessments were based on an available drawdown of 24.10 meters below the RWL of the CDT, which equates to 47.33 mbgl.

Table 8: Yield Determination – KF_BH1.

KF_BH1			
Method	**Managed Yield (L/s)**	**Late *T (m^2/d)**	***AD used (m)**
Basic FC	3.6	29.5	24.1
Cooper-Jacob	4.3	35.5	24.1
Barker	3.1		24.1
Average Q_sust (L/s)	**3.7**		
Recommended Abstraction			
Abstraction Rate (L/s)	**Abstraction Duration (hours)**		**Recovery Duration (hours)**
3.7	24		0

**AD- Available Drawdown
* T – Transmissivity

8.2.3 Yield Testing at KF_BH2

The yield testing was conducted between 31 January and 05 February 2025. The borehole was measured to a depth of 163 meters below ground level (mbgl). The test pump was installed at a depth of 140.00 mbgl. The rest water level (RWL) at the start of the test was 5.31 mbgl.

During the Step Test, the water level was drawn down 113.32 meters below the rest water level (pump inlet) during the 4th step at a rate of 2.4 L/s (8 640 L/hour). **Figure 7** shows the time-series drawdown for the Step Test.

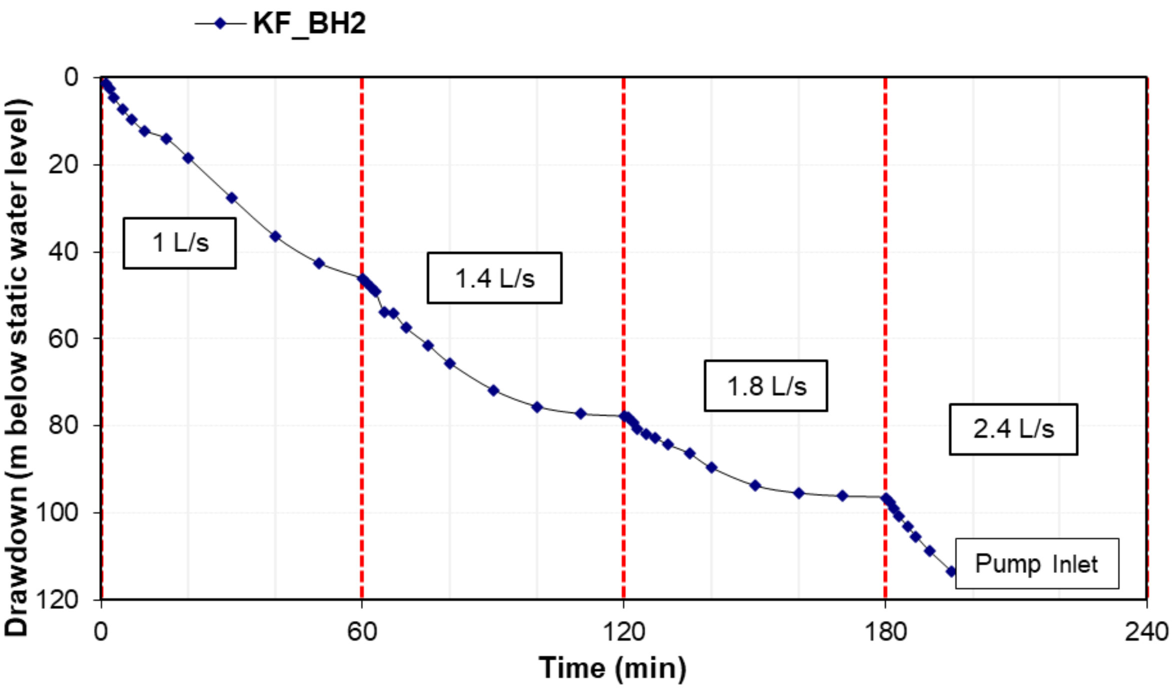


Figure 7: Step Test drawdown data for KF_BH2.

The water level was left to recover overnight. Before starting the CDT, the water level recovered to 18.71 mbgl. Based on the results of the Step Test, the planned 24-hour CDT was conducted at a rate of 1.5 L/s (5 400 L/hour). At the end of the 24-hour period, the water level had drawn down 70.07 meters below the rest water level (88.78 mbgl).

The semi-log plot of the drawdown from the CDT is presented in **Figure 8** The available drawdown is indicated with the horizontal red line at 92.10 m

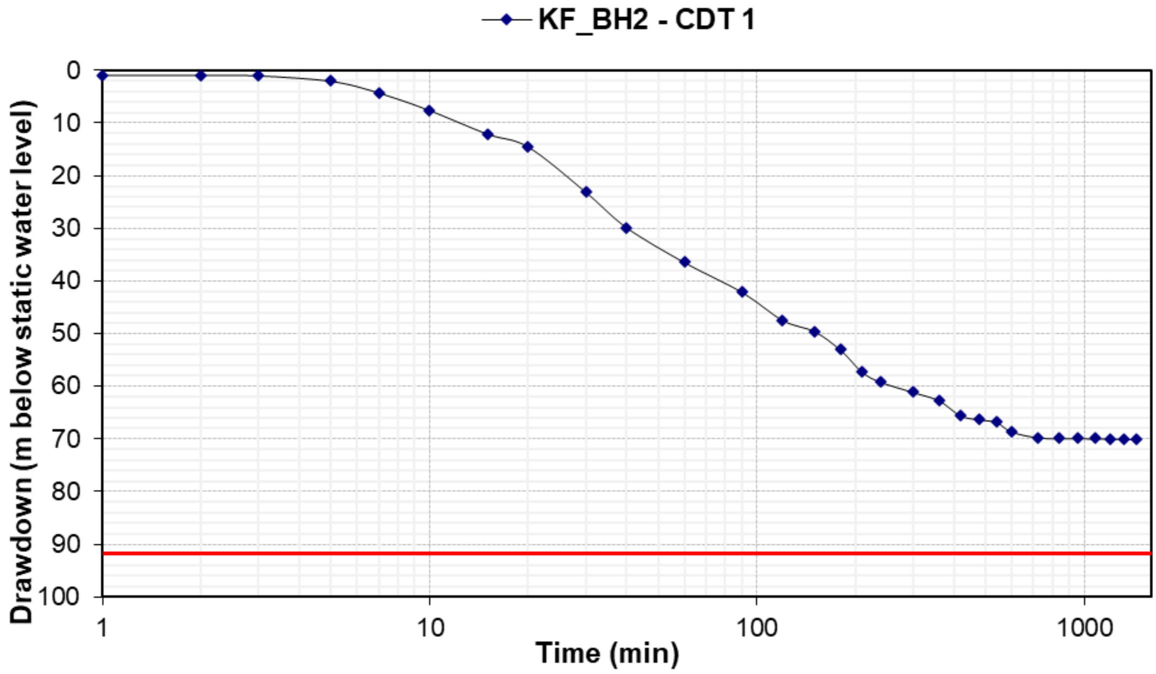


Figure 8: Semi-Log Plot of drawdown during the CDT of KF_BH2 (1.5 L/s).

The recovery of the water level was monitored after the CDT and is presented in **Figure 9** The recovery was good, reaching 96.2% in 24 hours. Monitoring will be essential to determine the long-term recovery of the borehole.

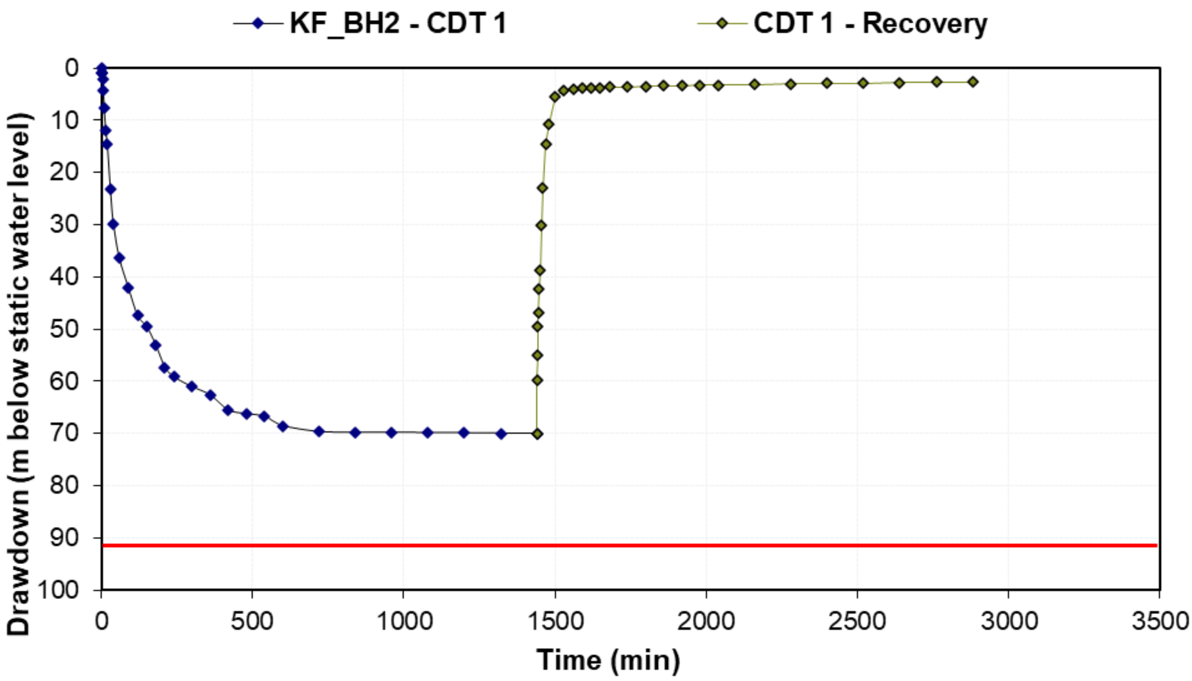


Figure 9: Time-series drawdown and recovery for KF_BH2 (1.5 L/s).

Several methods were used to assess the yield test data as presented in **Table 9**. It is recommended that the borehole can be abstracted from at a rate of up to 1.2 L/s (4 320 L/hour) for up to 24 hours per day. The assessments were based on an available drawdown of 92.10 meters below the RWL of the CDT, which equates to 110.81 mbgl.

Table 9: Yield Determination – KF_BH2.

KF_BH2			
Method	**Sustainable Yield (L/s)**	**Late *T (m^2/d)**	***AD used (m)**
Basic FC	1.4	6.9	92.1
Cooper-Jacob	1.0	29.6	92.1
Barker	1.2		92.1
Average Q_sust (L/s)	**1.2**		
Recommended Abstraction			
Abstraction Rate (L/s)	**Abstraction Duration (hours)**		**Recovery Duration (hours)**
1.2	24		0

**AD- Available Drawdown

* T – Transmissivity

8.2.4 Radius of Influence

No influence was observed between boreholes during the testing process. As such aquifer parameters could not be determined from the monitoring boreholes. Transmissivities were calculated through the Theis method using the drawdown response in the tested boreholes during the CDTs. The transmissivity of KF_BH1 and KF_BH2 was respectively calculated at 35.5 and 29.6 m^2/d. A storativity value of $5x10^{-4}$ was used for the radius of influence calculation based on an average expected value for confined aquifers as reported by Todd (1980). Based on the aquifer parameters the radii of influence were calculated for the recommended managed yields of the boreholes. A drawdown of up to 3 m and 1.1 m, respectively. can be expected 1 kilometre away from KF_BH1 and KF_BH2 at the recommended rates (3.7 L/s and 1.2 L/s for 24 hours per day) after 2 years of abstraction without recharge (**Figure 10**).

It must be noted that the Cooper-Jacob modelling of radius of influence is based on a homogenous, confined aquifer and therefore does not account for the heterogeneity associated with secondary aquifers (fractured rock). Thus, the radius of influence solution will only provide an indication of how abstraction at KF_BH1 and KF_BH2 will impact the water level in the fracture network. This suggests that the cone of depression will not expand equivalently in all directions surrounding the borehole, but will rather propagate along the fracture network within the secondary aquifer.

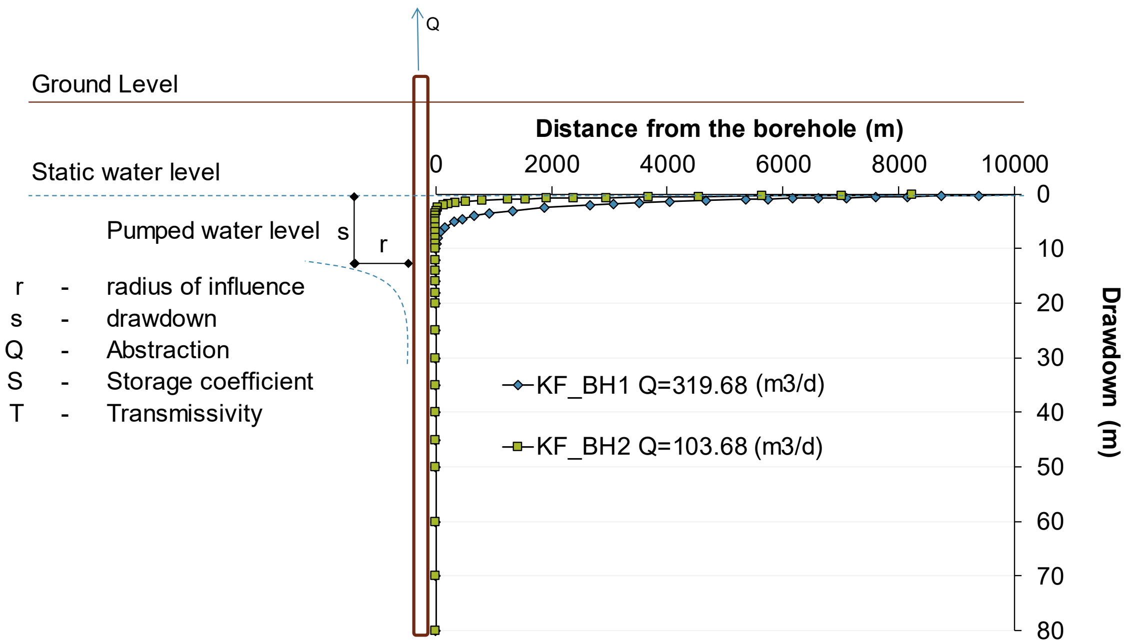


Figure 10: Radii of influence for KF_BH1 and KF_BH2 at the recommended managed yields.

8.2.5 Summary of the yield of the boreholes

Based on the information obtained from the yield tests, the abstraction recommendations for the boreholes are presented in **Table 10**. The yield testing was conducted with a Step Test, Constant Discharge Test and Recovery Test and while this data can be analysed to estimate sustainable yields, additional drilling in the area may result in long term cumulative impacts. Optimisation of the resource is also likely through making small changes to the abstraction rates, should the dynamic water level's drawdown be less or more than expected as per **Table 10**. Both of these points are best managed through long term monitoring data.

Table 10: Borehole Abstraction Recommendations.

Borehole Details				
Borehole Name	**Latitude (DD)**	**Longitude (DD)**	**Borehole Depth (m)**	**Inner Diameter (mm)**
KF_BH1	-33.922230	19.385410	96.	150
KF_BH2	-33.922080°	19.388520°	163.00	210
Abstraction Recommendations				
Borehole Name	**Abstraction rate (L/s)**	**Abstraction Duration (hrs)**	**Recovery Duration (hrs)**	**Possible Volume Abstracted (L/d)**
KF_BH1	3.7	24	0	319 680
KF_BH2	1.2	24	0	103 680
			Total	**423 360**
Pump Installation Details				

Borehole Name	Pump Installation Depth (mbgl)	Critical Water Level (mbgl)	Dynamic Water Level (mbgl)*	Rest Water Level (mbgl)
KF_BH1	55.00	47.33	34.00	22.97
KF_BH2	115.00	110.80	77.00	5.31

* Typical water level expected during long-term production

For borehole KF_BH1 it is recommended that continuous abstraction can occur at a rate of up to 3.7 L/s. A pump suitable to deliver the recommended rate should be installed at a depth of 55.00 mbgl. It is anticipated that abstraction at the recommended rate will cause the water level to drop to a depth of approximately 34.00 mbgl – this is referred to as the dynamic water level. During abstraction, a maximum level cut off switch should be installed to 47.33 mbgl to ensure the groundwater level does not drop to the pump inlet.

For borehole KF_BH2 it is recommended that continuous abstraction can occur at a rate of up to 1.2 L/s. A pump suitable to deliver the recommended rate should be installed at a depth of 115.00 mbgl. It is anticipated that abstraction at the recommended rate will cause the water level to drop to a depth of approximately 77.00 mbgl (dynamic water level). During abstraction, a maximum level cut off switch should be installed to 110.80 mbgl to ensure the groundwater level does not drop to the pump inlet.

To address the potential for iron to clog the borehole and abstraction infrastructure, it is recommended to maintain a constant and continuous pumping schedule as much as possible. Thus, should a daily volume of less than 319 680 L/d for KF_BH1 and 103 680 L/d for KF_BH2 be required. it is recommended to decrease the pumping rate and not the pumping duration. By pumping continuously instead of a stop-start schedule, iron oxidation in the borehole is minimised, decreasing the amount of iron precipitation inside the boreholes and pumps.

Through long term water level monitoring data, the abstraction volumes can be optimised by adjusting the abstraction rate if required. It is recommended that the boreholes are equipped with a variable frequency drive. This enables adjustments to the flow rate to be made if required, as determined by the hydrogeological analysis of water level and flow rate monitoring data.

As of January 2018 the Department of Water and Sanitation released a Government Gazette stating that: “All water use sector groups and individuals taking water from any water resource (surface or groundwater) regardless of the authorisation type, in the Breede, Olifants and Breede Gouritz Water Management Area, shall install electronic water recording, monitoring or measuring devices to enable monitoring of abstractions, storage and use of water by existing lawful users and establish links with any monitoring or management system as well as keep records of the water used.”

Therefore, to facilitate monitoring and informed management of the boreholes, it is highly recommended that the boreholes be equipped with the following monitoring infrastructure and equipment (diagram included in **Appendix G**):

- Installation of a 32 mm (inner diameter, class 10) observation pipe from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10 m.

- Installation of an electronic water level logger (for automated water level monitoring).
- Installation of a sampling tap (to monitor water quality).
- Installation of a flow volume meter (to monitor abstraction rates and volumes).

8.3 Water Quality

Groundwater samples were collected from the boreholes at the end of the yield tests and submitted for inorganic chemical analyses to a SANAS accredited laboratory (Vinlab) in the Western Cape. The certificate of analysis for the samples is presented in **Appendix E**. The chemistry results obtained for the boreholes have been classified according to the SANS241-1: 2015 standards for drinking water (**Table 11**). **Table 13** presents the water chemistry analysis results, colour coded according to the SANS241-1: 2015 drinking water assessment standards.

Table 11: Classification table for the specific limits.

Acute Health	Aesthetic	Chronic Health	Operational	Acceptable

The limits and associated risks for drinking water as determined by the South African National Standard (SANS) 241:2015 are as follows, where:

- Health risks: parameters falling outside these limits may cause acute or chronic health problems in individuals.
- Aesthetic risks: parameters falling outside these limits indicate that water is visually, aromatically or palatably unacceptable.
- Operational risks: parameters falling outside these limits may indicate that operational procedures to ensure water quality standards are met may have failed.

The chemistry results obtained have also been classified according to the DWAF (1998) standards for domestic water, **Table 12** enables an evaluation of the water quality with regards to the various parameters measured (DWAF. 1998). **Table 14** presents the water chemistry analysis results colour coded according to the DWAF domestic water assessment standards.

Table 12: Classification table for the groundwater results (DWAF. 1998).

Class	Water quality	Description
Class 0	Ideal	Suitable for lifetime use.
Class I	Good	Suitable for use, with rare instances of negative effects.
Class II	Marginal	Conditionally acceptable. Negative effects may occur.
Class III	Poor	Unsuitable for use without treatment. Chronic effects may occur.
Class IV	Dangerous	Totally unsuitable for use. Acute effects may occur.

Table 13: Production borehole results classified according to SANS241-1:2015.

Analyses	KF_ BH1	KF_ BH2	SANS 241-1:2015
Date and Time Sampled	29 January 2025	4 February 2025	
pH (at 25 °C)	4.2	5.6	5.0≤ Operational ≤ 9.7
Conductivity (mS/m) (at 25 °C)	40.8	34.0	Aesthetic ≤170
Total Dissolved Solids (mg/L)	276.62	230.52	Aesthetic ≤1200
Turbidity (NTU)	4.01	1536.00	Operational ≤1 Aesthetic ≤5
Colour (mg/L as Pt)	<15	<15	Aesthetic ≤15
Sodium (mg/L as Na)	54	50	Aesthetic ≤200
Potassium (mg/L as K)	7	4	N/A
Magnesium (mg/L as Mg)	7	6	N/A
Calcium (mg/L as Ca)	<0.20	<0.20	N/A
Chloride (mg/L as Cl)	96.17	85.15	Aesthetic ≤300
Sulphate (mg/L as SO_4)	23.04	14.85	Aesthetic ≤250 Acute ≤500
Nitrate & Nitrite Nitrogen (as a ratio)	0.068	0.068	≤1 Acute Health
Nitrate Nitrogen (mg/L as N)	<1.00	<1.00	Acute Health ≤11
Nitrite Nitrogen (mg/L as N)	<0.05	<0.05	Acute Health ≤0.9
Ammonia Nitrogen (mg/L as N)	<0.15	<0.15	Aesthetic ≤1.5
Total Alkalinity (mg/L as $CaCO_3$)	<10.00	10.3	N/A
Total Hardness (mg/L as $CaCO_3$)	29.2	25.1	N/A
Fluoride (mg/L as F)	<0.15	<0.15	Chronic Health ≤1.5
Aluminium (mg/L as Al)	0.972	0.299	Operational ≤0.3
Total Chromium (mg/L as Cr)	<0.004	<0.004	Chronic Health ≤0.05
Manganese (mg/L as Mn)	0.054	0.796	Aesthetic ≤0.1 Chronic ≤0.4
Iron (mg/L as Fe)	1.146	1.891	Aesthetic ≤0.3 Chronic ≤2
Nickel (mg/L as Ni)	0.010	0.016	Chronic Health ≤0.07
Copper (mg/L as Cu)	0.025	0.034	Chronic Health ≤2
Zinc (mg/L as Zn)	0.094	0.091	Aesthetic ≤5
Arsenic (mg/L as As)	<0.010	<0.010	Chronic Health ≤0.01
Selenium (mg/L as Se)	<0.008	<0.008	Chronic Health ≤0.04
Cadmium (mg/L as Cd)	0.002	<0.001	Chronic Health ≤0.003
Antimony (mg/L as Sb)	<0.013	<0.013	Chronic Health ≤0.02
Mercury (mg/L as Hg)	<0.001	0.001	Chronic Health ≤0.006
Lead (mg/L as Pb)	<0.008	0.010	Chronic Health ≤0.01
Uranium (mg/L as U)	<0.028	<0.028	Chronic Health ≤0.03
Cyanide (mg/L as CN^-)	<0.01	0.017	Acute Health ≤0.2
Total Organic Carbon (mg/L as C)	1.46	7.55	N/A
Charge Balance Error %	2.0	2.9	≥-5 - ≤5 Acceptable

Table 14: Classified production borehole results according to DWAF (1998).

Sample Marked:	**KF_BH1**	**KF_BH2**	**DWAF (1998) Domestic Water Assessment Guide**				
			Class 0	**Class I**	**Class II**	**Class III**	**Class IV**
			Ideal	**Good**	**Marginal**	**Poor**	**Dangerous**
Date	29 January 2025	4 February 2025					
pH	4.2	5.6	5-9.5	4.5-5 & 9.5-10	4-4.5 & 10-10.5	3-4 & 10.5-11	< 3 & >11
Conductivity (mS/m)	40.8	34.0	<70	70-150	150-370	370-520	>520
Turbidity (NTU)	4.01	1536.00	<0.1	0.1-1	1.0-20	20-50	>50
	mg/L						
Total Dissolved Solids	276.62	230.52	<450	450-1000	1000-2400	2400-3400	>3400
Sodium (as Na)	54	50	<100	100-200	200-400	400-1000	>1000
Potassium (as K)	7	4	<25	25-50	50-100	100-500	>500
Magnesium (as Mg)	7	6	<70	70-100	100-200	200-400	>400
Calcium (as Ca)	<0.20	<0.20	<80	80-150	150-300	>300	
Chloride (as Cl)	96.17	85.15	<100	100-200	200-600	600-1200	>1200
Sulphate (as SO_4)	23.04	14.85	<200	200-400	400-600	600-1000	>1000
Fluoride (as F)	<0.15	<0.15	<0.7	0.7-1.0	1.0-1.5	1.5-3.5	>3.5
Manganese (as Mn)	0.054	0.796	<0.1	0.1-0.4	0.4-4	4.0-10.0	>10
Iron (as Fe)	1.146	1.891	<0.5	0.5-1.0	1.0-5.0	5.0-10.0	>10
Copper (as Cu)	0.025	0.034	<1	1-1.3	1.3-2	2.0-15	>15
Zinc (as Zn)	0.094	0.091	<20	>20			
Arsenic (as As)	<0.010	<0.010	<0.010	0.01-0.05	0.05-0.2	0.2-2.0	>2.0
Cadmium (as Cd)	0.002	<0.001	<0.003	0.003-0.005	0.005-0.020	0.020-0.050	>0.050
Hardness (as $CaCO_3$)	29.20	25.10	<200	200-300	300-600	>600	
Charge Balance Error %	2.0	2.9	≥-5 - ≤5 Acceptable				

From the chemical results presented in **Table 13** and **Table 14**, groundwater from the boreholes does not meet the required quality standards for potable use. Iron concentrations are elevated in all four boreholes, with manganese levels also exceeding acceptable limits, except in KF_BH1. Turbidity is significantly elevated across all boreholes, ranging from 4.01 NTU to 1 536 NTU, likely attributed to high iron and manganese concentrations. If not properly managed, iron and manganese biofouling is expected to occur, potentially leading to clogging of both the borehole and abstraction infrastructure.

The pH and electrical conductivity of the boreholes are generally within acceptable limits, with the exception of KF_BH1, which has a pH of 4.1—falling below the operational limit of SANS 241-1:2015. Additionally, low concentrations of lead (0.010 mg/L) were detected in KF_BH2, and are classified as chronic health risks according to SANS 241-1:2015. Continuous groundwater monitoring for arsenic and lead is recommended to assess whether these concentrations persist.

Given the observed water quality, the groundwater from these boreholes is unsuitable for direct potable use and should undergo treatment prior to consumption. However, it remains suitable for irrigation purposes as long as the turbidity and iron concentrations are considered.

A number of chemical diagrams have been plotted for the groundwater sample and these are useful for chemical characterisation of the water and illustrate the similarities and differences in the water types.

The chemistry of the samples has been plotted on a tri-linear diagram known as a Piper diagram. This diagram indicates the distribution of cations and anions in separate triangles and then a combination of the chemistry in the central diamond. According to **Figure 11,** the tested borehole groundwater samples are classified as potassium/chloride hydrofacies, which is typical of groundwater that is hosted within the rocks of the Table Mountain Group.

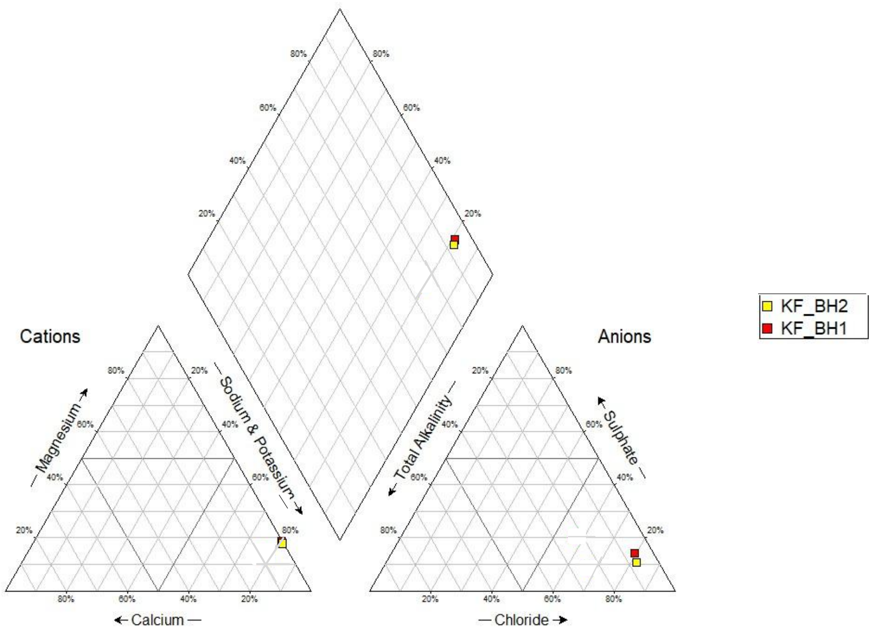


Figure 11: *Piper diagram of the groundwater samples.*

The Sodium Adsorption Ratio (SAR) of the groundwater is plotted in **Figure 12**. All four boreholes (KF_BH1 andKF_BH2) plots as S1/C2, thus classified as low risk in terms of sodium adsorption and medium risk in terms of salinity hazard. This graph is typically applicable to irrigation, however, it is dependent on soil texture and crop type.

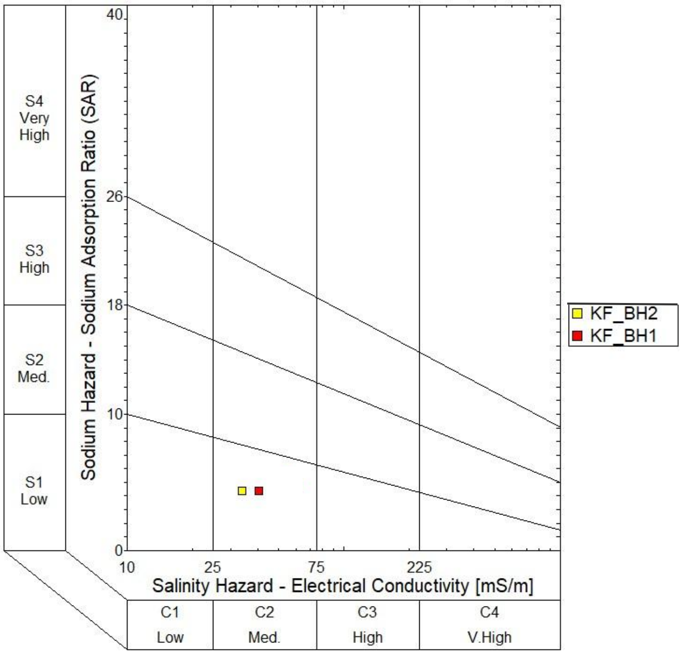


Figure 12*: SAR diagram of the groundwater samples.*

9. Aquifer Firm Yield Model

To evaluate the sustainable volume of groundwater that can be abstracted from the aquifer for the property, the Aquifer Firm Yield Model (AFYM) was utilised (WRC, 2012). The model uses a single-cell "Box Model" approach and makes use of a critical management water level, below which aquifer storage levels cannot be drawn down, to provide estimates of aquifer firm and assured yields.

The "Box Model" approach is schematically presented in **Figure 13.**

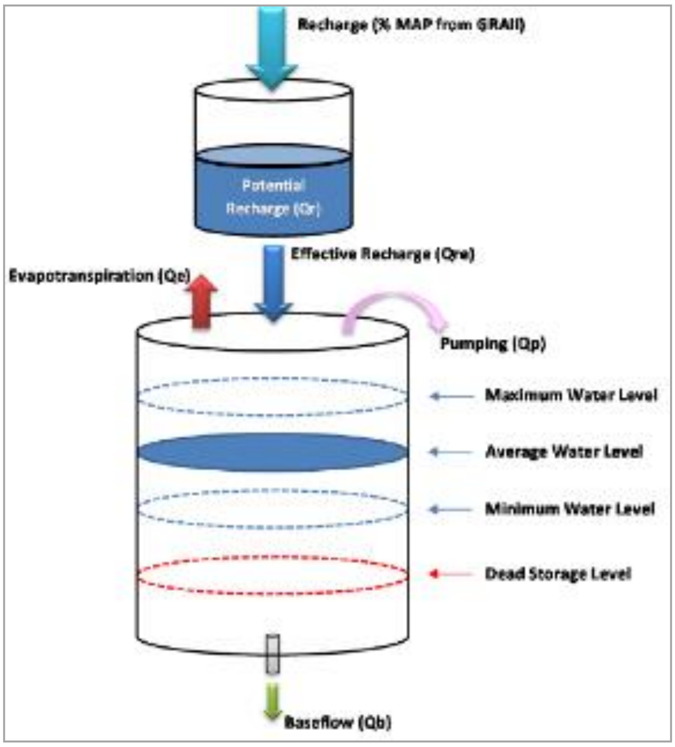


Figure 13: Aquifer Firm Yield lumped box model (WRC, 2012).

An evaluation was completed using the Aquifer Firm Yield model (WRC, 2012). The Input parameters used for the catchment are the default values presented in WRC (2012). These are taken from datasets like WR2005 (e.g. rainfall data) (Middleton and Bailey, 2008) and GRAII (e.g. specific yield and recharge (%MAP)) (DWAF. 2005), and others generated during the WRC (2012) (e.g. recharge threshold and riparian zone (% catchment area)). Although the boreholes are situated in catchment H40E, recharge to the aquifer is likely to extend to catchment H40D. The parameters for quaternary catchments H40D (181.76 km^2) and H40E (285.43 km^2), are presented in **Table 15.**

Table 15: Hydrogeological Parameters for Quaternary catchment H40D and H40E (WRC, 2012).

Parameter	H40D	H40E
Groundwater Level (mbgl)	17.2	13.5
Max Drawdown (m)	5	5
Specific Yield	0.002091	0.002091
Firm Yield (L/s)	75.2	53.3
Firm Yield (L/s/km^2)	0.4136	138.5
Recharge %	3.6	0.4853
Recharge Threshold (mm)	23	22
MAP (mm)	556.7	539.1
Hydrological MAR (mm)	136.3	126.3
Hydrological MAE (mm)	1500	1545
Baseflow: Default (Mm^3/a)	20.15	0
ET Model	Linear	Linear
ET Extinction Depth (m)	4	4
Riparian Zone (%)	3.6	2.6

The Aquifer Firm Yield Model was run for both catchments. For catchment H40D, the Aquifer Firm Yield was determined to be 2 373 131.52 m^3/a (75.20 L/s) with a recharge of 3 642 628.40 m^3/a (**Table 16**). For catchment H40E, the Aquifer Firm Yield was determined to be 4 370 727.60 m^3/a (138.50 L/s) with a recharge of 6 616 522.60 m^3/a (**Table 16**).

Table 16: Results of the Aquifer Firm Yield Model for quaternary catchments H40D and H40E.

Name	Q (L/s)	Q (m^3/month)	Q (m^3/a)
H40D	75.20	194 918.40	2 373 131.52
H40E	138.50	358 992.00	4 370 727.60

For this study area there are geological features that enable the definition of a more localised aquifer (i.e, a groundwater resource unit (GRU)). The Kleinfontein Farm is located on the South Eastern limb of a North East – South West trending synform hosted in the Cape Supergroup. All the boreholes are drilled intersecting the fractured rock aquifer of the Table Mountain Group. The southern boundary of the GRU was delineated based on the quaternary catchment boundary and the Skurweberg-Goudini contact. The northern boundary of the GRU was delineated based on the Gydo-Gamka contact with the western and southern boundaries delineated as per the topographical lay of the area. The area is highly faulted, with major faults in both NE-SW and NW-SE orientations, creating groundwater flow paths. The GRU has been delineated and is displayed in **Map 9** and **Figure 3** depicts a schematic cross-section of the geology and the groundwater flow.

On assessment of the geological map, the GRU has an extent of approximately 9.78 km^2, predominantly within catchment H40D and catchment H40E (H40D = 7.85 km^2 + H40E = 1.93 km^2). Using the GRAII recharge values, the combined direct vertical recharge (minimum recharge volume) is calculated to be 202 063.33 m^3/a (H40D = 157 323.42 m^3/a + H40E = 44 739.91 m^3/a). The firm yield of the GRU is calculated to be 132 048.60 m^3/a (H40D = 102 494.4 m^3/a + H40E = 29 554.20 m^3/a), which is estimated to be approximately 65% of groundwater recharge within the GRU.

It is important to note that a conservative approach was used to calculate the recharge and firm yield volumes and that the actual volumes are believed to be higher than the calculated volumes.

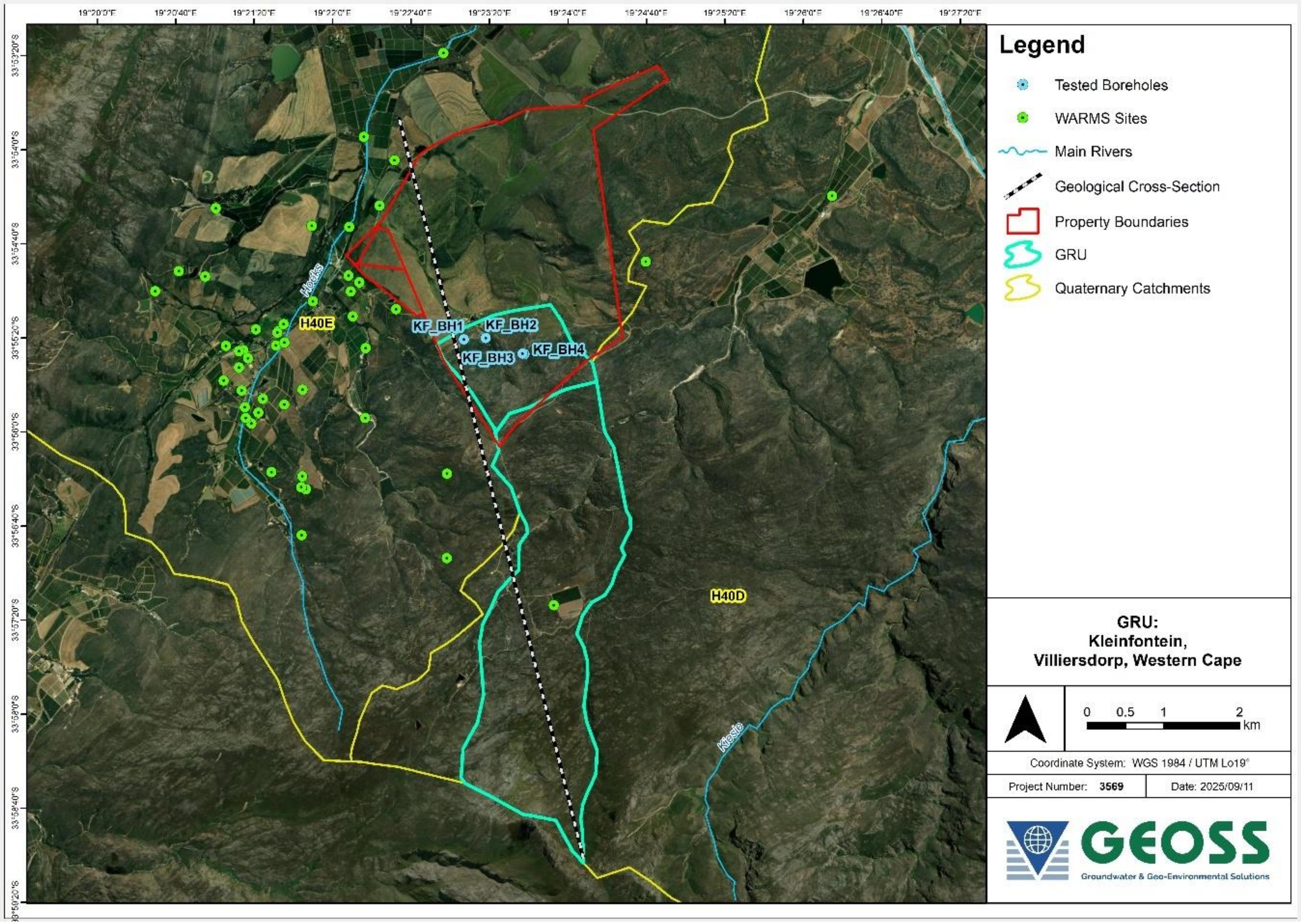
The current volume of groundwater abstracted within the GRU. based on the registered WARMS boreholes (database last updated in May 2025), is 45 798 m^3/a (**Map 9**). Note that only registered and active sites were taken into account. Based on these volumes, a volume of 86 250.60 m^3/a (132 048.60 m^3/a - 45 798 m^3/a = 86 250.60 m^3/a) is available for abstraction in the GRU. The additional volume of 49 458 m^3/a for which a licence is being applied is less than the volume of 86 250.60 m^3/a available within the firm yield of the GRU. Because the firm yield of the GRU is in excess of the predicted water demand of the property, the proposed abstraction volume is considered to be within the sustainable supply volume of the local aquifer The proposed additional abstraction is not likely to impact on the regional groundwater flow, however site-specific long-term monitoring is required to ensure the sustainability of the abstraction.

GRU (9.78 km^2) Total recharge = 202 063.33 m^3/a
Total firm yield = 132 048.60 m^3/a
Authorised existing abstraction (from WARMS 2025) = 45 798.00 m^3/a

Available groundwater = 86 250.60 m^3/a

Requested additional groundwater use = 49 458 m^3/a

Is there sufficient groundwater for the proposed demand? **YES**



Map 9: GRU. property boundaries and WARMS boreholes.

10. Risk Impact Assessment

The site is located on a fractured aquifer, which has a “low to medium” vulnerability classification indicating that the aquifer has low susceptibility to contamination from anthropogenic activities.

The impact assessment included in this section address the potential negative impacts of the proposed groundwater abstraction, focusing on the following identified risks:

- The risk of depletion of the groundwater due to over-abstraction, and
- The risk of groundwater quality deterioration as a result of over-abstraction, and
- The risk of groundwater abstraction impacting surface water
- The risk of groundwater contamination due to a leaking septic tank, which may detrimentally impact a water resource

The risk assessment includes the identification and rating of the potential risks associated with the proposed groundwater abstraction for Kleinfontein, along with possible mitigation measures. Each risk is qualitatively assessed based on the existing information. The risk rating is measured according to the criteria in **Appendix F**.

10.1 Depletion of the Groundwater Resource as a Result of Over-Abstraction

Over-abstraction of groundwater from boreholes is likely to lead to depletion of the water levels in the area over time. This can cause damage to the aquifer and also damage the groundwater-dependent ecosystems and impact neighbouring groundwater users. Since there is a lot of groundwater use in the area, it is essential that the boreholes are well managed and not over-abstract to ensure impact on the neighbouring properties does not occur. The boreholes have been tested according to SANS 10299_4-2003, and the total managed yield has been determined to be 154 526 m^3/a. The application volume (49 458 m^3/a) is 32 % of the recommended abstraction volume. The yields calculated are conservative and if abstraction is kept to the recommended rate, over abstraction is unlikely to occur. The risk assessment is presented in **Table 17**.

Groundwater level monitoring is recommended to ensure that groundwater abstraction is sustainable. The monitoring will also indicate if the groundwater resource is impacted and if mitigation measures can be instituted before long-term impacts occur. Mitigation for over-abstraction would be a reduction in abstraction.

Table 17: Impact table assessing the risk of depletion of the groundwater due to over-abstraction.

Depletion of the groundwater resource due to over-abstraction	
Potential impact and risk:	Negative – Over abstraction from the borehole would drop the regional groundwater level.
Nature of impact:	Direct
Extent and duration of impact:	Local, Long term >15 years but lest than <30
Consequence of impact or risk:	Medium
Probability of occurrence:	Unlikely, if reported demand is not exceeded
Degree to which the impact may cause irreplaceable loss of resources:	Can impact groundwater flow paths and fractures may collapse
Degree to which the impact can be reversed:	To some degree reversible if water bearing fractures did not collapsed
Consequence of impact or risk:	Decreasing access to water for people and the environment in the immediate area.
Cumulative impact prior to mitigation:	High – Unless properly managed, over abstraction of groundwater could impact on the groundwater availability for neighbouring water users as well as groundwater-reliant ecosystems. Although this specific abstraction is low enough to not cause a regional impact, large scale over abstraction can impact on groundwater flow paths.
Significance rating of impact prior to mitigation	**Moderate**
Degree to which the impact can be avoided:	Fully avoidable
Degree to which the impact can be managed:	Fully manageable
Degree to which the impact can be mitigated:	Fully mitigatable
Proposed mitigation:	Groundwater abstraction volumes must be monitored. Water levels must be monitored and should not drop below the critical water level (**47.33 mbgl for KF_BH01 and 110.80 mbgl for KF_BH02**). Monitoring information must be assessed regularly (suggest monthly in summer). If the water level in the borehole drops below the critical water level, abstraction will immediately be reduced by 10%. Monitoring will persist and after 30 days, if the water level in the borehole did not recover to above the critical water level, abstraction will be reduced by a further 10%. This process will continue until the water level in the borehole is stable. A groundwater management plan needs to be implemented.
Residual impacts:	Decreased groundwater availability.
Cumulative impact post mitigation:	If the impacts are mitigated as detailed in this report, the cumulative impact would be negligible with little to no impact on availability of groundwater resources.
Significance rating of impact after mitigation	**Low**

10.2 Quality Deterioration as a Result of Over-Abstraction

Over-abstraction of groundwater can have negative impacts on water quality. One major concern is the potential of iron clogging occurring due to over-abstraction. It is recommended to maintain a constant and continuous pumping schedule as much as possible. Thus, should a daily volume of less than 319 680 L/d for KF_BH1 and 103 680 L/d for KF_BH2 be abstracted from the aquifer. Additionally, the lowering of the water table can expose previously saturated minerals to air, leading to the oxidation of sulphide minerals and other geochemical changes. This oxidation process can produce acidic conditions and release harmful substances, such as metals, into the groundwater. When the water table eventually recovers, these oxidized minerals can dissolve back into the groundwater, further degrading water quality and posing risks to ecosystems and water users.

Indicated by the regional datasets, the groundwater EC is in the range of 0 - 70 m S/m and is of good quality, while west of the site poorer quality is observed according to DWA 1998 domestic standards. The risk assessment is presented in **Table 18**.

Groundwater quality monitoring is recommended to ensure that groundwater abstraction is sustainable. The monitoring will also indicate if the groundwater resource is impacted and mitigation measures can be instituted before long term impacts occur. Mitigation for over-abstraction would be a reduction in abstraction.

Table 18: Risk assessment for the groundwater quality deterioration as a result of over-abstraction.

Groundwater quality deterioration as a result of over-abstraction	
Potential impact and risk:	Negative – Over-abstraction of groundwater can degrade water quality and iron clogging can occur, which can clog the fractures in the borehole and the equipment
Nature of impact:	Direct
Extent and duration of impact:	Local, Long term >15 years but lest than <30
Consequence of impact or risk:	High
Probability of occurrence:	Unlikely if abstraction recommendations are adhered to.
Degree to which the impact may cause irreplaceable loss of resources:	The impact is highly likely to cause loss of resource.
Degree to which the impact can be reversed:	The impact is reversible.
Consequence of impact or risk:	Decreasing access to water for people and the environment in the immediate area.
Cumulative impact prior to mitigation:	Moderate – Unless properly managed, other groundwater users may face reduced water quality, leading to potential health risks and increased treatment costs. Additionally, ecosystems dependent on groundwater may be disrupted, as contaminated or lower-quality water can harm vegetation, aquatic life, and overall biodiversity, potentially leading to long-term ecological damage.

Groundwater quality deterioration as a result of over-abstraction	
Significance rating of impact prior to mitigation	**Moderate**
Degree to which the impact can be avoided:	Fully avoidable
Degree to which the impact can be managed:	Fully manageable
Degree to which the impact can be mitigated:	The impact can be mitigated through monitoring of the quality.
Proposed mitigation:	Groundwater quality must be monitored. Monitoring information must be assessed regularly (suggest monthly in summer). If an increase of 25% in electrical conductivity is observed, abstraction will immediately be reduced by 10%. Monitoring will persist and after 30 days if the water quality of the borehole did not recover, abstraction will be reduced by a further 10 %. This process will continue until the water quality has stabilised.
Residual impacts:	Decreased groundwater quality.
Cumulative impact post mitigation:	If the impacts are mitigated as detailed in this report, the cumulative impact would be negligible with little impact on the availability of groundwater resources.
Significance rating of impact after mitigation	**Low**

10.3 Groundwater abstraction impacting surface water

The risk of groundwater abstraction impacting the non-perennial streams near the boreholes is considered **low** based on the available data, although some uncertainty remains. KF_BH01 is located in the Rietvlei Formation (a water-bearing fractured aquifer) overlain by the Gydo Formation (an aquitard), as described in **Section 5** and **Appendix A**. For KF_BH02, the geology is not fully known; however, the borehole is cased to 5 m depth. Resting water levels for KF_BH02 were recorded at 5.31 mbgl in February 2025 and 19.54 mbgl during the hydrocensus on 19 August 2025 (**Section 8.1.3**). This discrepancy may be attributed to seasonal variations, short-term drawdown, or measurement differences and highlights the uncertainty in interpreting groundwater-surface water connectivity. Despite this, given the depth of the aquifer relative to the surface water and the other hydrogeological data available, the perceived risk of abstraction impacting the streams remains low. The dynamic water levels for KF_BH01 and KF_BH02 are 34 mbgl and 77 mbgl, respectively, significantly deeper than the surface water, indicating that the groundwater and surface water systems are most likely not hydraulically connected.

The aquifer vulnerability classification (Section 6.3) is very low to **low/medium**. This is consistent with a fractured aquifer overlain by an aquitard, which restricts groundwater movement. The deeper water-bearing fractures further reduce the risk of depleting or influencing surface water. Proper management of the boreholes is essential to avoid over-abstraction. The boreholes have been tested according to SANS 10299_4-2003, with a total managed yield of 154 526 m^3/a. The proposed application volume of 49

458 m^3/a represents 32% of the recommended yield, indicating that over-abstraction is unlikely if the recommended limits are adhered to. The risk assessment is presented in

Groundwater monitoring is recommended to ensure sustainable abstraction and to detect any potential impacts on surface water early. Mitigation measures can then be implemented to prevent long-term impacts. In the event of over-abstraction, a reduction in pumping is the primary mitigation measure.
Table 19.

Groundwater monitoring is recommended to ensure sustainable abstraction and to detect any potential impacts on surface water early. Mitigation measures can then be implemented to prevent long-term impacts. In the event of over-abstraction, a reduction in pumping is the primary mitigation measure.

Table 19: Impact assessment of potential surface water depletion due to groundwater abstraction

Depletion of surface water due to abstraction from groundwater	
Potential impact and risk:	Negative – Over abstraction from the borehole would influence surface water.
Nature of impact:	Direct
Extent and duration of impact:	Local, Short-term 0-5 years
Consequence of impact or risk:	Low
Probability of occurrence:	Improbable
Degree to which the impact may cause irreplaceable loss of resources:	Can impact surface water
Degree to which the impact can be reversed:	Fully reversible
Consequence of impact or risk:	Decreasing access to water for people and the environment in the immediate area.
Cumulative impact prior to mitigation:	Low – Unless properly managed, over abstraction of groundwater could impact on the surface water runoff. Although this specific abstraction is low enough not to cause a regional impact.
Significance rating of impact prior to mitigation	**Low**
Degree to which the impact can be avoided:	Fully avoidable
Degree to which the impact can be managed:	Fully manageable
Degree to which the impact can be mitigated:	Fully mitigatable
Proposed mitigation:	Groundwater levels and chemistry must be assessed regularly (suggest monthly in summer). If a change of 25% in electrical conductivity is observed, abstraction will immediately be reduced by 10% as indicated in **Table 10.** Monitoring will persist and after 30 days if the water quality of the borehole did not recover, abstraction will be reduced by a further 10 %. This process will continue until the water quality has stabilised. A groundwater management plan needs to be implemented.
Residual impacts:	Minor decrease in surface water runoff.

Depletion of surface water due to abstraction from groundwater	
Cumulative impact post mitigation:	If the impacts are mitigated as detailed in this report, the cumulative impact would be negligible with little to no impact on surface water runoff.
Significance rating of impact after mitigation	**Very Low**

10.4 The risk of groundwater contamination due to a leaking septic tank, which may detrimentally impact a water resource

The risk associated is leakage of wastewater from the septic tanks that may contaminate the groundwater quality. It is advised that the boreholes be tested for the parameters outlined in **Table 20** which refers to the General Notice 169 of 2013, Table 2.2: Monitoring requirements for domestic wastewater discharge. These parameters are also listed in **Section 12**, where the boreholes should be tested quarterly for these parameters. If this is not adhered to and the conservancy tank begins to leak, it will harm the surrounding groundwater users.

Table 20: General Notice 169 of 2013, Table 2.2: Monitoring requirements for domestic wastewater discharges

Discharge volume on any given day	Minimum Monitoring Requirements
10-100 cubic meters	Faecal Coliforms (per 100 ml)
	pH
	Electrical Conductivity (mS/m)

The aquifer vulnerability is 'low to medium' as determined by the DRASTIC methodology, the risks associated with leakage of wastewater from the septic tank are determined as medium risk since the upper formation of the aquifer consists of the Gydo Formation, which acts as an aquitard. Even with a low vulnerability, there is always a chance that leakage can occur. Therefore, management and preventative measures are crucial to safeguard the aquifer from contamination and mitigate its potentially severe consequences.

By implementing these measures, the risk of groundwater contamination can be significantly reduced, protecting both water quality and the surrounding ecosystems. The risk assessment is presented in *Table 21*.

Table 21: Risk assessment for groundwater quality deterioration as a result of leaking wastewater from septic tanks on site.

Groundwater contamination due to leaking wastewater from septic tanks	
Potential impact and risk:	Negative – if the septic tank is leaking, it can lead to widespread water quality issues and ecosystem impacts.
Nature of impact:	Indirect
Extent and duration of impact:	Local, Long term >15 years but lest than <30
Consequence of impact or risk:	Medium
Probability of occurrence:	Possible
Degree to which the impact may cause irreplaceable loss of resources:	High, of groundwater contamination from leakage of contaminants can lead to severe and lasting damage to water quality and ecosystems.
Degree to which the impact can be reversed:	The impact is partly reversible.
Consequence of impact or risk:	Removing people and the environment's access to usable water resources in the immediate area.
Cumulative impact prior to mitigation:	Moderate – Unless properly managed, the persistent infiltration of excess nutrients can disrupting aquatic ecosystems and reducing biodiversity. Together, these effects can compromise water resources, damage ecosystems, and result in long-term environmental and economic consequences, highlighting the urgent need for effective management and preventive measures.
Significance rating of impact prior to mitigation	**Moderate**
Degree to which the impact can be avoided:	Fully avoidable
Degree to which the impact can be managed:	Fully manageable
Degree to which the impact can be mitigated:	The impact can be mitigated through monitoring of the quality.
Proposed mitigation:	Groundwater quality must be monitored. Use early warning systems to detect potential contamination sources and address them promptly.
Residual impacts:	Deterioration in groundwater quality.
Cumulative impact post mitigation:	If the impacts are mitigated as detailed in this report, the cumulative impact would be negligible with little to no impact on the availability of groundwater resources.
Significance rating of impact after mitigation	**Low**

11. Groundwater Management Plan

The management of the groundwater abstraction includes the following recommendations:

1. It is recommended to maintain a constant and continuous pumping schedule as much as possible. Thus, should a daily volume of less than 319 680 L/d for KF_BH1 and 103 680 L/d for KF_BH2 be required, it is recommended to decrease the pumping rate and not the pumping duration. By pumping continuously instead of a stop-start schedule, iron oxidation in the borehole is minimised, decreasing the amount of iron precipitation inside the boreholes and pumps.
2. An "observation pipe" needs to be installed (32 mm inner diameter, class 10 as shown in **Appendix G**) from the pump depth to the surface, closed at the bottom and slotted for the bottom 5 – 10 m, for the production borehole. This allows for a 'window' of access down the borehole which enables manual water level monitoring and can house an electronic water level logger.
3. Continuous monitoring of groundwater levels using pressure transducers in the borehole is ideal. The water level in the borehole may not drop below the critical water level (**Table 10).** If the water level in the borehole drops below the critical water level, abstraction must be immediately reduced by 10 %. Monitoring must continue and after 30 days, if the water level in the borehole does not recover to above the critical water level. abstraction must be reduced by a further 10%. This process must continue until the water level in the borehole is stable.
4. Water quality monitoring which includes sampling and analysis of the groundwater at an accredited laboratory, is important. A sampling interval of quarterly is recommended for the first year of monitoring; thereafter, the water quality monitoring should be reviewed and can potentially be reduced to annual as proposed in **Table 22.**
5. The monitoring data should be reviewed on quarterly basis for the first two years and can then be scaled down to bi-annually.
6. Installation of a sampling tap at the production borehole (to monitor water quality) is essential.
7. Installation of a flow volume meter at the production borehole (to monitor abstraction rates and volumes) is also important. External flow (e.g. mag-flow) meters are recommended.
8. Abstraction volumes must be monitored and recorded by a designated person on site. Depending on the frequency of use, daily, weekly or monthly abstraction should be recorded.
9. The appropriate borehole pump must be installed. i.e. not an over-sized pump that is choked with a gate valve. If the monitoring shows that more water can be abstracted, then the duration of pumping time can be increased (not the flow rate).
10. If required, the pump and borehole casing (and associated infrastructure) can be serviced annually and cleaned.
11. A geohydrologist should review the above information at least annually to ensure optimal groundwater abstraction and management occurs.
12. The relevant DWS monitoring officer (as specified in the Water Use Licence) should be informed if water levels are dropping to critical level or if any parameters, as specified in **Table 22** changes by 20%.

The groundwater abstraction should be reviewed to ensure that it is sustainable based on the monitoring data obtained.

Table 22: Proposed groundwater monitoring parameters.

Parameter	Frequency
Groundwater Level	Ideally every 15 minutes with a data logger
Chemical parameters	
pH (at 25 ºC)	Quarterly (Field Chemistry)
Conductivity (mS/m) (at 25 ºC)	Quarterly (Field Chemistry)
Total Dissolved Solids (mg/L)	Quarterly (Field Chemistry)
Turbidity (NTU)	Quarterly*
Colour (mg/L as Pt)	Quarterly*
Sodium (mg/L as Na)	Quarterly*
Potassium (mg/L as K)	Quarterly*
Magnesium (mg/L as Mg)	Quarterly*
Calcium (mg/L as Ca)	Quarterly*
Chloride (mg/L as Cl)	Quarterly*
Sulphate (mg/L as SO_4)	Quarterly*
Nitrate & Nitrite Nitrogen (as a ratio)	Quarterly*
Nitrate Nitrogen (mg/L as N)	Quarterly*
Nitrite Nitrogen (mg/L as N)	Quarterly*
Ammonia Nitrogen (mg/L as N)	Quarterly*
Total Alkalinity (mg/L as $CaCO_3$)	Quarterly*
Total Hardness (mg/L as $CaCO_3$)	Quarterly*
Fluoride (mg/L as F)	Quarterly*
Aluminium (mg/L as Al)	Quarterly*
Total Chromium (mg/L as Cr)	Quarterly*
Manganese (mg/L as Mn)	Quarterly*
Iron (mg/L as Fe)	Quarterly*
Nickel (mg/L as Ni)	Quarterly*
Copper (mg/L as Cu)	Quarterly*
Zinc (mg/L as Zn)	Quarterly*
Arsenic (mg/L as As)	Quarterly*
Selenium (mg/L as Se)	Quarterly*
Cadmium (mg/L as Cd)	Quarterly*
Antimony (mg/L as Sb)	Quarterly*
Mercury (mg/L as Hg)	Quarterly*
Lead (mg/L as Pb)	Quarterly*
Uranium (mg/L as U)	Quarterly*
Cyanide (mg/L as CN-)	Quarterly*
Total Organic Carbon (mg/L as C)	Quarterly*
E.coli (count per 100 ml)	Quarterly*
Total Coliform Bacteria (count per 100 ml)	Quarterly*
Heterotrophic Plate Count (count per ml)	Quarterly*
Total Petroleum Hydrocarbons (TPH)	Quarterly*
*Quarterly for first year, can be reduced to annual if reviewed and deemed appropriate	

12. Assumptions and Limitations

During this study certain assumptions limited the accuracy of the data acquired and the outcome of this report.

- Available data was sourced from the relevant groundwater databases and sources. The aquifer vulnerability, yield and quality data are predominantly accurate, albeit mapped at a regional scale.
- The groundwater quality was assessed from one set of test results. Seasonal changes may occur in the chemistry of the water from the borehole and this has not been accounted for.
- The coordinates of the NGA boreholes are sometimes found to be inaccurate. Hence, it was difficult to incorporate the NGA data accurately into the field hydrocensus.
- All active, registered, verified, and lawful abstraction volumes (that could be obtained from the WARMS database, which was last updated in May 2025) were taken into account when calculating the available volumes within the firm yield of the GRU. This database is updated continuously; however, access to the latest data is limited and not easily accessible. Also, it should be noted that not all groundwater abstraction is suitably registered and documented and this study could only take into account what has been registered and active.
- Limited water level data could be obtained through the NGA database as well as through the hydrocensus and assumptions had to be made without this data available.
- The Aquifer Firm Yield model does not incorporate lateral groundwater flow as the model is a linear model.
- The water requirement was provided by PHS Consulting and it is assumed that the demand is worked out accordingly to the property's water requirement.
- It is assumed that treatment of the water is necessary; however. without an approved treatment plan. the risk associated with the plan cannot be determined.

13. Conclusion

GEOSS South Africa (Pty) Ltd was approached by Elgin Free Range Chickens to compile a geohydrological assessment for their Water Use Licence Application (WULA). The application is to abstract groundwater for the proposed watering of livestock and domestic purposes (potable and non-potable) at Kleinfontein, Villiersdorp. The nearest river to the borehole is the Hoeks River, which is located 2.03 km from the proposed production boreholes (KF_BH1 and KF_BH2).

The investigation entailed a desktop study of the local geology, climate, aquifer type and groundwater quality. Groundwater use in the area was also investigated through a field study. The local minimum potential of the aquifer in question was calculated as well as the managed yields of the boreholes.

The abstracted groundwater will be used for domestic use (potable and non-potable use), providing water to 20 workers, a Gate House, and two ablution areas on-site. as well as for livestock watering of the chickens in 20 houses (chicken coups), and 2 000 sheep in the summer. Additional supply will come from six earth dams to use as irrigation of trees on the property. This water has been registered for 19 800 m^3/a.

The groundwater from KF_BH1 and KF_BH2 is not suitable for consumption without prior treatment. The pH (4.2-5.6) is considered acidic, the electrical conductivity (34-40.8 mS/m) of KF_BH1 and KF_BH02 is good, while trace metals are elevated into the category of "marginal to dangerous" (DWAF. 1998). With elevated levels of turbidity and concentrations of iron, manganese, and aluminium, the water falls into the category of marginal according to the DWAF (1998) domestic standards. The turbidity has some aesthetic effects, such as murky water according to the SANS 241:2015 standards while the trace metals can cause chronic health issues.

The production boreholes have been correctly yield tested (according to SANS 10299_4-2003) and the results were used to determine the managed (i.e. long-term and safe) yield of the borehole. The total conservative volume, which can be abstracted from the boreholes is 154 526 m^3/a. The application volume (49 958 m^3/a) is 32% of the sustainable abstraction volume.

It is recommended that the general Groundwater Management guideline outlined in **Section 11** of this report be included in the licence conditions of the WULA.

14. References

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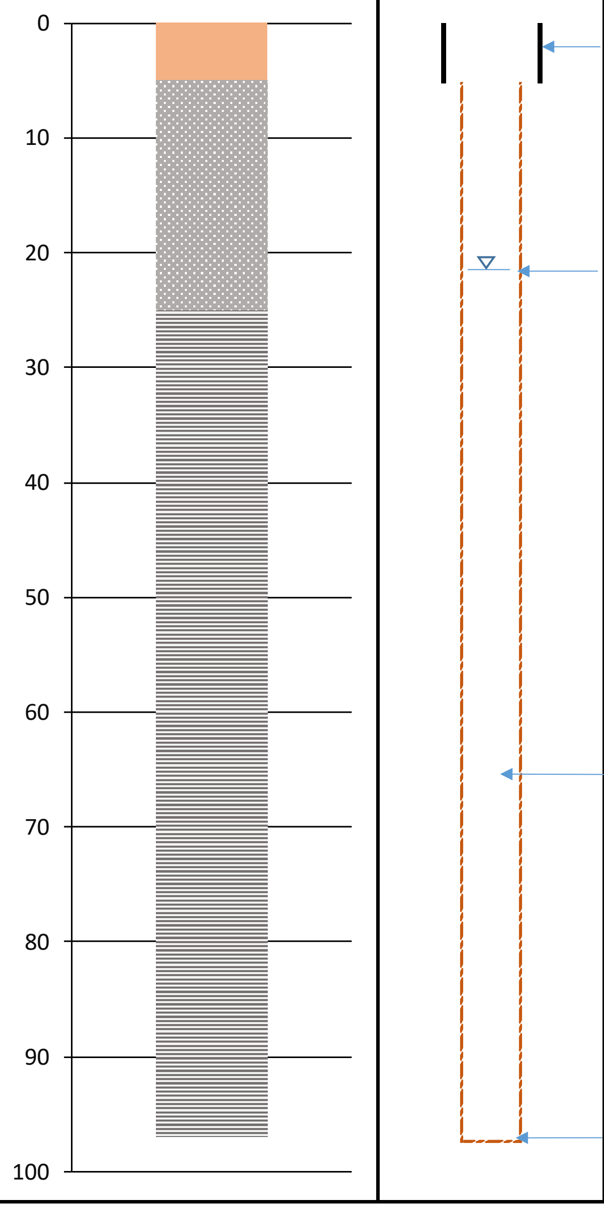
Appendix A: Drilling logs

Borehole log of KF_BH1

Log of Borehole No.: KF_BH1

Location:	Villiersdorp	**Latitude:**	-33.92223
Date:	19/02/2025	**Longitude:**	19.38541
Client:	EFRC	**Ground Elevation:**	372 mamsl

Lithological Description	Lithology Symbol & Depth (m)	Borehole Construction	Description & water strike
Expected: Overburden **Unknow Geology** Expected: Gydo Fm. Black to dark-grey shale, siltstone and thin sandstone Expected: Rietvlei Fm. Light-grey feldspathic sandstone and micaceous shale bands			150 mm (ID) Steel casing (to unknown depth) Water level (22.97 mbgl) Open hole EOH (96.94 mbgl)

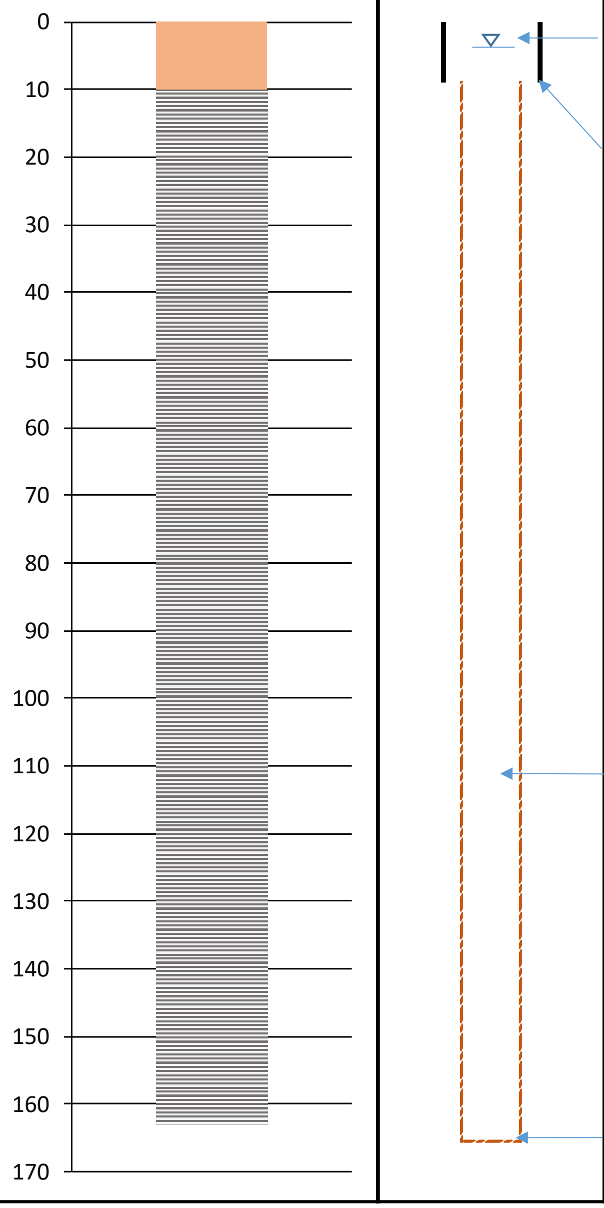
Drilled By:	Unknown	**Remarks:**	None of the estimated information included here is collected from the drilling records, but comes from the published 1:250 000 Geological Map of the area and measurements made during testing.
Drill Method:	Unknown		
Logged By:	Not logged, estimated from available data		

Borehole log of KF_BH2

Log of Borehole No.: KF_BH2

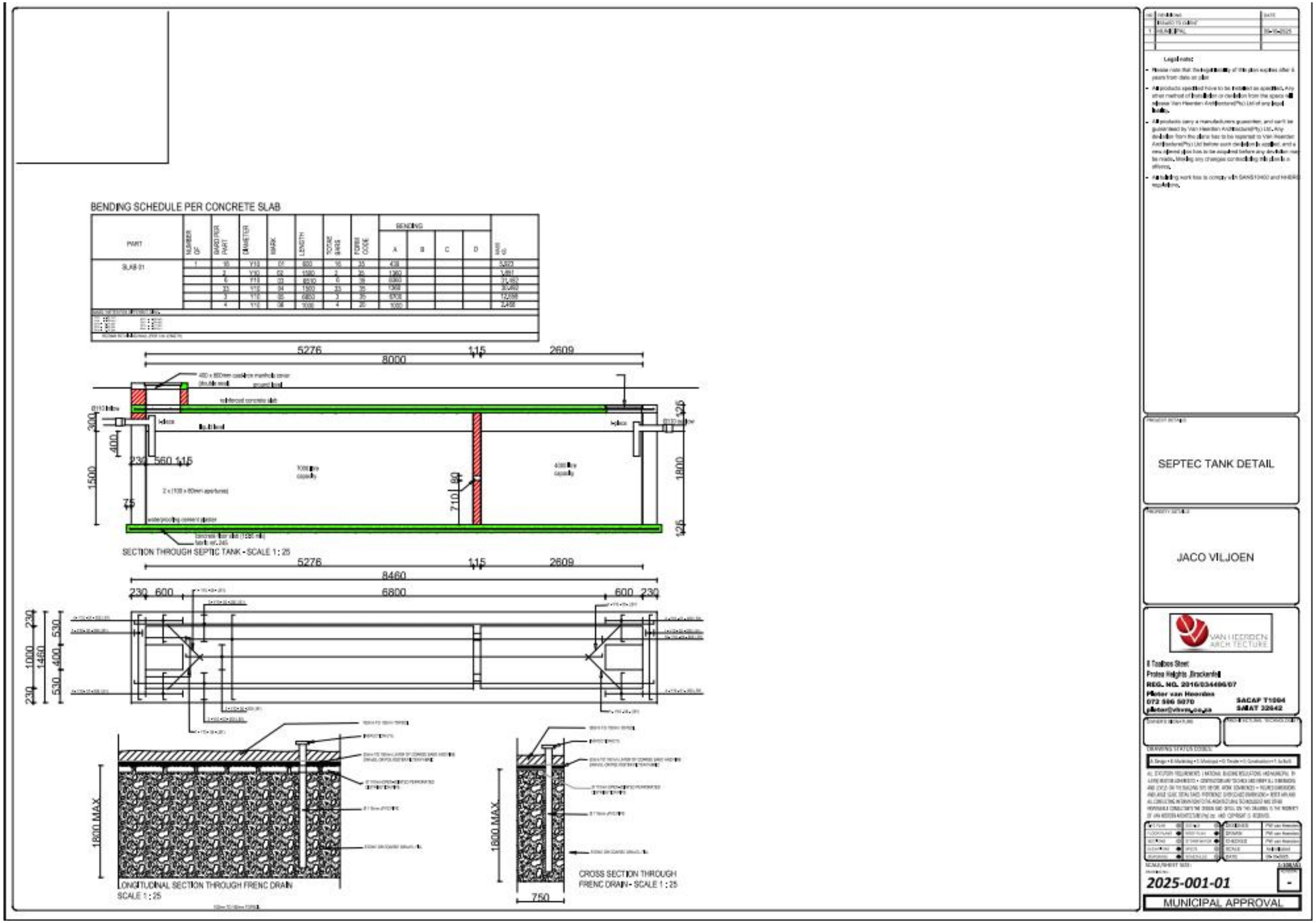
Location:	Villiersdorp	**Latitude:**	-33.92208
Date:	19/02/2025	**Longitude:**	19.38852
Client:	EFRC	**Ground Elevation:**	379 mamsl

Lithological Description	Lithology Symbol & Depth (m)	Borehole Construction	Description & water strike
Expected: Overburden **Unknow Geology** Expected: Rietvlei Fm. Light-grey feldspathic sandstone and micaceous shale bands			Water level (5.31 mbgl) 210 mm (ID) Steel casing (to unknown depth) Open hole EOH (163 mbgl)



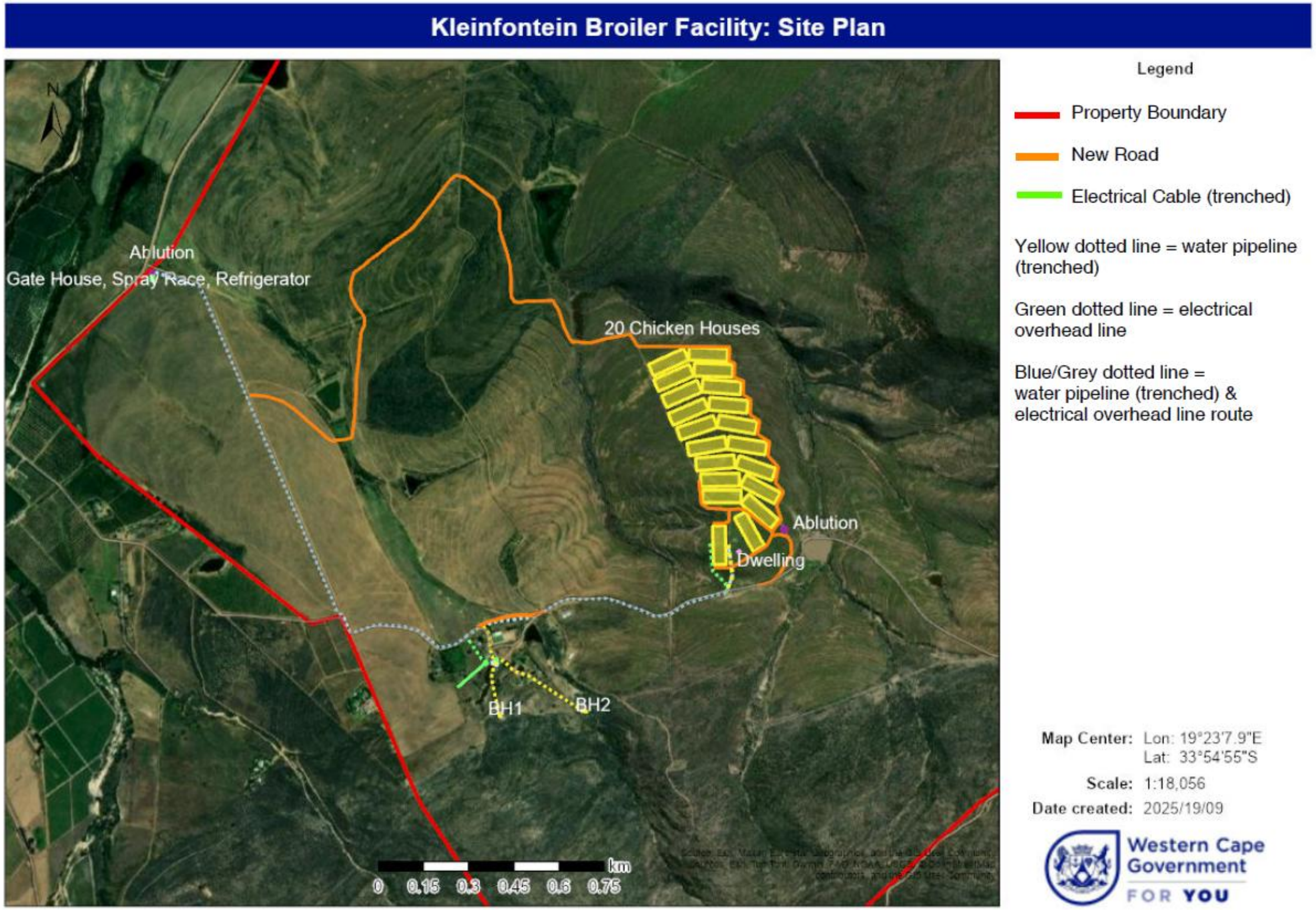
Drilled By:	Unknown	**Remarks:**	None of the estimated information included here is collected from the drilling records, but comes from the published 1:250 000 Geological Map of the area and measurements made during testing.
Drill Method:	Unknown		
Logged By:	Not logged, estimated from available data		

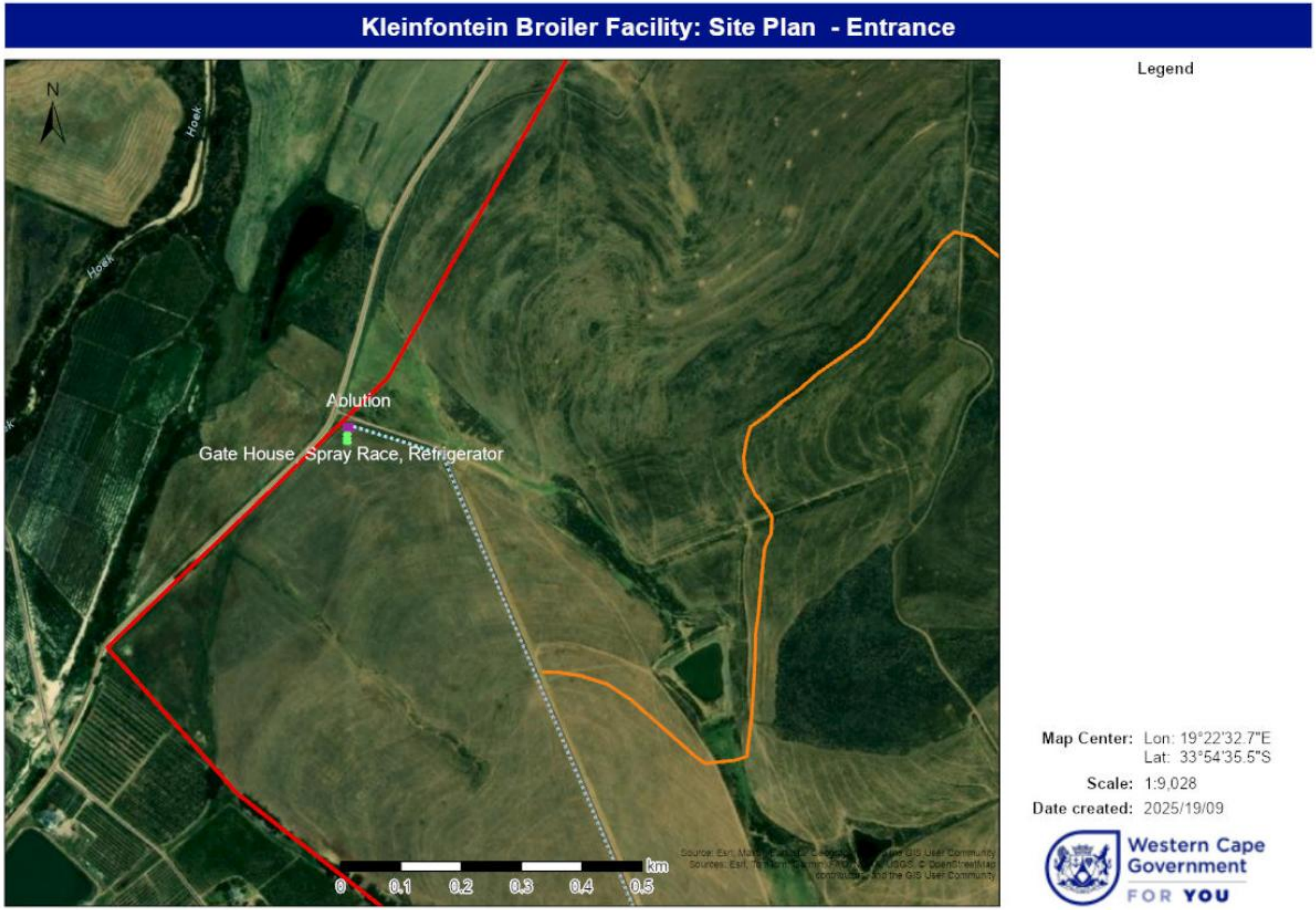
Appendix B: Proposed design for septic tank

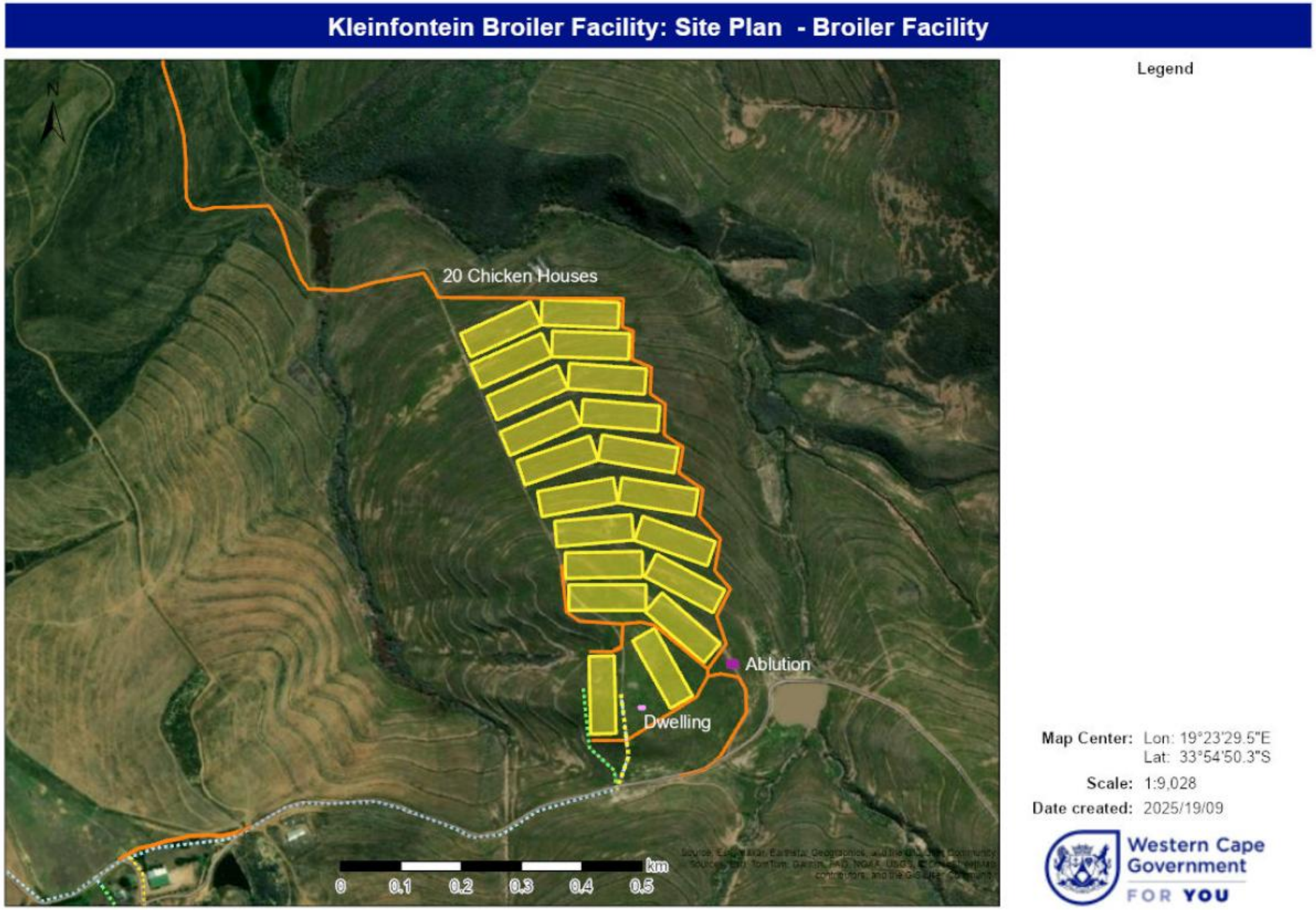


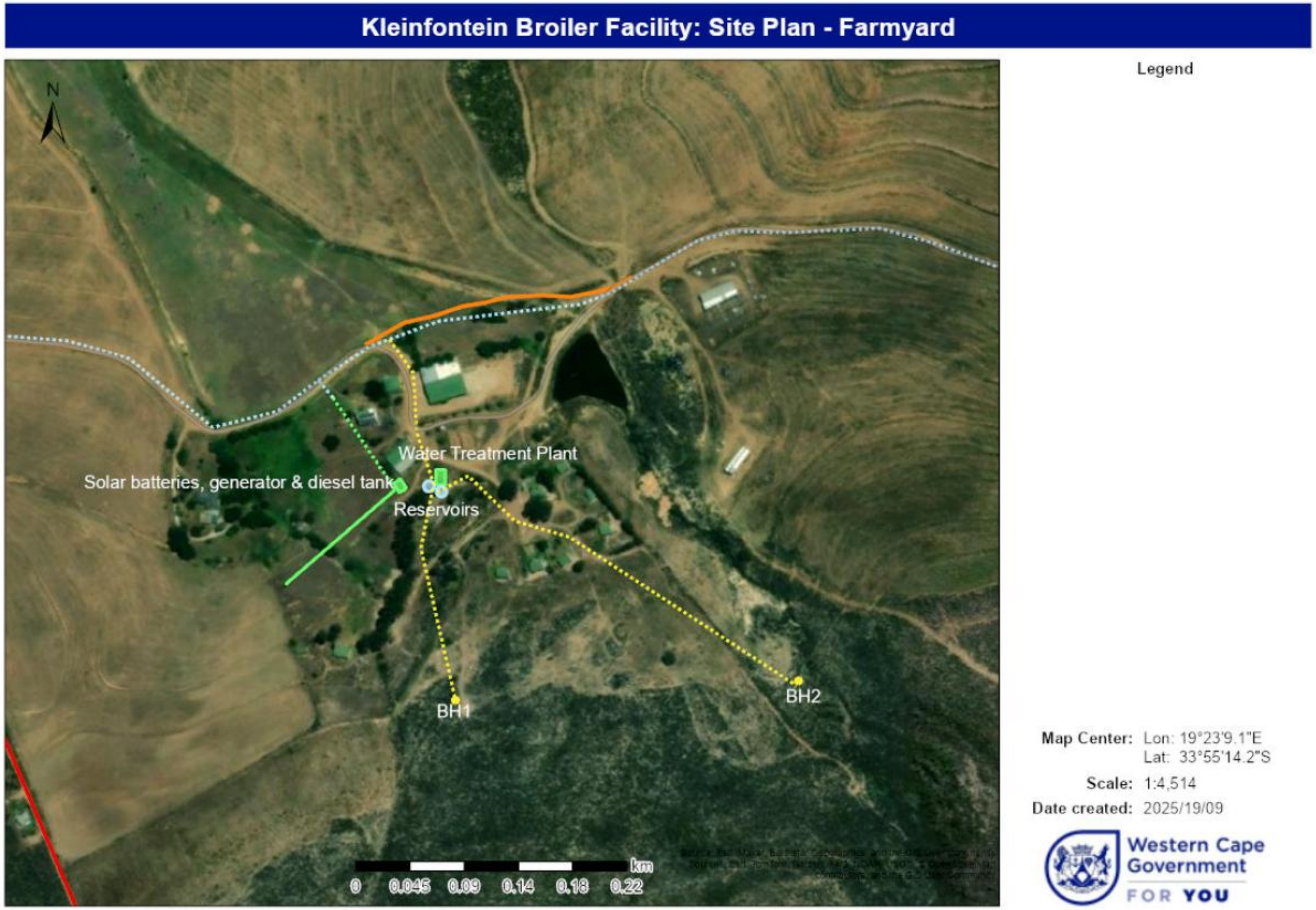
BENDING SCHEDULE PER CONCRETE SLAB
SECTION THROUGH SEPTIC TANK - SCALE 1 : 25
LONGITUDINAL SECTION THROUGH FRENC DRAIN
SCALE 1 : 25
CROSS SECTION THROUGH FRENC DRAIN - SCALE 1 : 25
1800 MAX
SEPTEC TANK DETAIL
JACO VILJOEN
VAN HEERDEN ARCHITECTURE
2025-001-01
MUNICIPAL APPROVAL

Appendix C: Site Layout


Kleinfontein Broiler Facility: Site Plan
Ablution
Gate House, Spray Race, Refrigerator
20 Chicken Houses
Ablution
Dwelling
BH1
BH2
km
0 0.15 0.3 0.45 0.6 0.75
Legend
Property Boundary
New Road
Electrical Cable (trenched)
Yellow dotted line = water pipeline (trenched)
Green dotted line = electrical overhead line
Blue/Grey dotted line = water pipeline (trenched) & electrical overhead line route
Map Center: Lon: 19°23'7.9"E
Lat: 33°54'55"S
Scale: 1:18,056
Date created: 2025/19/09
Western Cape Government
FOR YOU


Kleinfontein Broiler Facility: Site Plan - Entrance
N
Hoek
Hoek
Ablution
Gate House, Spray Race, Refrigerator
km
0 0.1 0.2 0.3 0.4 0.5
Legend
Map Center: Lon: 19°22'32.7"E
Lat: 33°54'35.5"S
Scale: 1:9,028
Date created: 2025/19/09
Western Cape Government
FOR YOU


Kleinfontein Broiler Facility: Site Plan - Broiler Facility
Legend
N
20 Chicken Houses
Ablution
Dwelling
0
0.1
0.2
0.3
0.4
0.5
km
Map Center: Lon: 19°23'29.5"E
Lat: 33°54'50.3"S
Scale: 1:9,028
Date created: 2025/19/09
Western Cape Government
FOR YOU


Kleinfontein Broiler Facility: Site Plan - Farmyard
N
Water Treatment Plant
Solar batteries, generator & diesel tank
Reservoirs
BH1
BH2
0 0.045 0.09 0.14 0.18 0.22 km
Legend
Map Center: Lon: 19°23'9.1"E
Lat: 33°55'14.2"S
Scale: 1:4,514
Date created: 2025/19/09
Western Cape Government
FOR YOU

Appendix D:
Scientific Yield Testing

KF_BH1

Abbreviations	
EC	Electrical conductivity
mbgl	Meters below ground level
mbch	Meters below casing height
mbdl	Meters below datum level
magl	Meters above ground level
L/S	Litres per second
RPM	Rates per minute
S/W/L	Static water level
µS/cm	Microsiemens per centimeter

ATS

BOREHOLE TEST RECORD

PR0JECT #	P3056
TEAM MEMBERS	

CONSULTANT:	GEOSS
DISTRICT:	BREEDE VALLEY
PROVINCE:	WESTERN CAPE
FARM / VILLAGE NAME :	ELGIN VILLIERSDORP
DATE TESTED:	28-01-2025

BOREHOLE LOCATION & ACCESS INFORMATION:

BOREHOLE COORDINATES		COMMENTS ON ACCESS IF ANY:
LATITUDE (SOUTH):	S33.92223	
LONGITUDE (EAST):	E19.38541	

BOREHOLE NO:	BH01
TRANSMISSIVITY VALUE:	
TYPE INSTALLATION:	SUBMERSIBLE PUMP
BOREHOLE DEPTH: (mbg	96.94

MAINTENANCE RECORD:		REHABILITATION RECORD:		DIGITAL CAMERA LOGGING:		EQUIPMENT FISHING RECORD	
Labour hours:		Jetting hours:		Camera logged once:		Hours spent:	
Cost of material:		Brushing hours:		Camera logged twice:			
Travelling (km):		Airlifting hours:		Camera logged three times:		OTHER COSTS ON PROJECT:	
		Sulphamic Acid KG's		Camera work sent to client:		Courier of samples:	
		Boresaver KG's				Km's for delivery:	
		Soda Ash KG's				Cost of packaging:	

COMMENTS:	RECOMMENDATIONS / CORRECTIVE ACTIONS:

SAMPLE INSTRUCTIONS :

Water sample taken	Yes	No	If consultant took sample, give name:		DATA CAPTURED BY	AH
Date sample taken	29-01-2025		If sample courier, to where:		DATA CHECKED BY:	AH
Time sample taken	14H40					

DESCRIPTION:	UNIT	QTY		UNIT	QTY
STRAIGHTNESS TEST:	NO	0	BOREHOLE DEPTH AFTER TEST:	M	96.90
VERTICALLY TEST:	NO	0	BOREHOLE WATER LEVEL AFTER TEST: (mbch)	M	24.35
CASING DETECTION:	NO	1	SAND/GRAVEL/SILT PUMPED?	YES/NO	0
SUPPLIED NEW STEEL BOREHOLE COVER:	NO	0	DATA REPORTING AND RECORDING	NO	1
BOREHOLE MARKING	NO	0	SLUG TEST:	NO	0
SITE CLEANING & FINISHING	NO	1	LAYFLAT (M):	M	100
LOGGERS FOR WATERLEVEL MONITORING	NO	0	LOGGERS FOR pH AND EC:	NO	0

It is hereby acknowledged that upon leaving the site, all existing equipment is in an acceptable condition.

NAME: ____________________ SIGNATURE: ____________________

DESIGNATION: ____________________ DATE: ____________________

FORM 5 E

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3056	Coordinates: SOUTH:	S33.92223	PROVINCE:	WESTERN CAPE
BOREHOLE NO:	BH01	EAST:	E19.38541	DISTRICT:	BREEDE VALLEY
ALT BH NO:	0			SITE NAME:	ELGIN VILLIERSDORP
ALT BH NO:	0				
BOREHOLE DEPTH (m)	96.94	DATUM LEVEL ABOVE CASING (m):	0.64	EXISTING PUMP:	SUBMERSIBLE
WATER LEVEL (mbdl):	23.61	CASING HEIGHT: (magl):	0.00	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	90-50	DIAM PUMP INLET (mm):	150.00	PUMP TYPE:	WA30-2

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1			RPM 408		DISCHARGE RATE 2			RPM 610		DISCHARGE RATE 3			RPM 1110	
DATE:	28-01-2025	TIME:	07H00		DATE:	28-01-202	TIME:	08H00		DATE:	28-01-202	TIME:	09H00	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	0.15		**1**		**1**	1.52		**1**		**1**	3.62		**1**	4.86
2	0.16		**2**		**2**	1.82	1.97	**2**		**2**	4.05		**2**	3.02
3	0.17		**3**		**3**	2.04	2.54	**3**		**3**	4.80	5.13	**3**	2.55
5	0.20	0.87	**5**		**5**	2.19		**5**		**5**	5.03	5.13	**5**	1.61
7	0.23	1.01	**7**		**7**	2.23	2.55	**7**		**7**	5.22		**7**	1.54
10	0.69		**10**		**10**	2.30		**10**		**10**	5.38	5.11	**10**	1.38
15	0.77	1.03	**15**		**15**	2.37	2.53	**15**		**15**	5.57		**15**	1.19
20	0.82		**20**		**20**	2.42		**20**		**20**	5.69	5.12	**20**	1.07
30	0.87	1.02	**30**		**30**	2.48	2.54	**30**		**30**	5.83		**30**	0.92
40	0.92		**40**		**40**	2.55		**40**		**40**	5.97	5.10	**40**	0.80
50	0.94	1.01	**50**		**50**	2.59	2.55	**50**		**50**	6.07		**50**	0.73
60	0.97		**60**		**60**	2.63		**60**		**60**	6.13	5.13	**60**	0.69
70			**70**		**70**			**70**		**70**			**70**	0.64
80			**80**		**80**			**80**		**80**			**80**	0.59
90			**90**		**90**			**90**		**90**			**90**	0.57
100			**100**		**100**			**100**		**100**			**100**	0.54
110			**110**		**110**			**110**		**110**			**110**	0.51
120			**120**		**120**			**120**		**120**			**120**	0.48
pH			**150**		**pH**			**150**		**pH**			**150**	0.41
TEMP	11.90	°C	**180**		**TEMP**	11.40	°C	**180**		**TEMP**	11.70	°C	**180**	0.37
EC	1023	µS/cm	**210**		**EC**	534	µS/cm	**210**		**EC**	525	µS/cm	**210**	

DISCHARGE RATE 4			RPM		DISCHARGE RATE 5			RPM		DISCHARGE RATE 6			RPM	
DATE:		TIME:			DATE:		TIME:			DATE:		TIME:		
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)	TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			**1**		**1**			**1**		**1**			**1**	
2			**2**		**2**			**2**		**2**			**2**	
3			**3**		**3**			**3**		**3**			**3**	
5			**5**		**5**			**5**		**5**			**5**	
7			**7**		**7**			**7**		**7**			**7**	
10			**10**		**10**			**10**		**10**			**10**	
15			**15**		**15**			**15**		**15**			**15**	
20			**20**		**20**			**20**		**20**			**20**	
30			**30**		**30**			**30**		**30**			**30**	
40			**40**		**40**			**40**		**40**			**40**	
50			**50**		**50**			**50**		**50**			**50**	
60			**60**		**60**			**60**		**60**			**60**	
70			**70**		**70**			**70**		**70**			**70**	
80			**80**		**80**			**80**		**80**			**80**	
90			**90**		**90**			**90**		**90**			**90**	
100			**100**		**100**			**100**		**100**			**100**	
110			**110**		**110**			**110**		**110**			**110**	
120			**120**		**120**			**120**		**120**			**120**	
pH			**150**		**pH**			**150**		**pH**			**150**	
TEMP		°C	**180**		**TEMP**		°C	**180**		**TEMP**		°C	**180**	
EC		µS/cm	**210**		**EC**		µS/cm	**210**		**EC**		µS/cm	**210**	
			240					**240**					**240**	
			300					**300**					**300**	
			360					**360**					**360**	

S/W/L:(mbch) 22.97

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3056	Coordinates: SOUTH: S33.92223		PROVINCE:	WESTERN CAPE
BOREHOLE NO:	BH01	EAST: E19.38541		DISTRICT:	BREEDE VALLEY
ALT BH NO:	0			SITE NAME:	ELGIN VILLIERSDORP
ALT BH NO:	0				
BOREHOLE DEPTH:	96.94	DATUM LEVEL ABOVE CASING (m):	0.64	EXISTING PUMP:	SUBMERSIBLE
WATER LEVEL (mbdl):	23.87	CASING HEIGHT: (magl):	0.00	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	90-50	DIAM PUMP INLET(mm):	150	PUMP TYPE:	WA30-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				**TEST COMPLETED**					
DATE:	28-01-2025	TIME:	15H00	DATE:		TIME:		TYPE OF PUMP:	WA30-2

					OBSERVATION HOLE 1			OBSERVATION HOLE 2			OBSERVATION HOLE 3	
					NR:	**BH02**		NR:			NR:	
DISCHARGE BOREHOLE					Distance(m);	290		Distance(m);			Distance(m);	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME MIN	RECOVERY (M)	TIME: (min)	Drawdown m	Recovery (m)	TIME: (min)	Drawdown (m)	Recovery	TIME: (min)	Drawdown (m)
1	1.61		**1**	6.66	**1**			**1**			**1**	
2	2.32		**2**	5.50	**2**			**2**			**2**	
3	2.97	4.77	**3**	4.48	**3**			**3**			**3**	
5	3.32	5.14	**5**	4.34	**5**			**5**			**5**	
7	4.20		**7**	4.17	**7**			**7**			**7**	
10	4.47	5.15	**10**	4.03	**10**			**10**			**10**	
15	5.01		**15**	3.82	**15**			**15**			**15**	
20	5.24	5.13	**20**	3.70	**20**			**20**			**20**	
30	5.50		**30**	3.50	**30**	0.00		**30**			**30**	
40	5.69	5.12	**40**	3.35	**40**			**40**			**40**	
60	5.91		**60**	3.13	**60**	0.00		**60**			**60**	
90	6.14	5.10	**90**	2.90	**90**	0.00		**90**			**90**	
120	6.45		**120**	2.73	**120**	0.00		**120**			**120**	
150	6.63	5.15	**150**	2.60	**150**	0.00		**150**			**150**	
180	6.74		**180**	2.50	**180**	0.00		**180**			**180**	
210	6.88	5.13	**210**	2.41	**210**	0.00		**210**			**210**	
240	6.98		**240**	2.33	**240**	0.00		**240**			**240**	
300	7.18	5.14	**300**	2.21	**300**	0.00		**300**			**300**	
360	7.34		**360**	2.12	**360**	0.00		**360**			**360**	
420	7.47	5.12	**420**	2.06	**420**	0.00		**420**			**420**	
480	7.62		**480**	2.01	**480**	0.00		**480**			**480**	
540	7.70	5.13	**540**	1.96	**540**	0.00		**540**			**540**	
600	7.74		**600**	1.90	**600**	0.00		**600**			**600**	
720	7.87	5.15	**720**	1.82	**720**	0.00		**720**			**720**	
840	7.98		**840**	1.73	**840**	0.00		**840**			**840**	
960	8.14	5.14	**960**	1.67	**960**	0.00		**960**			**960**	
1080	8.25		**1080**	1.63	**1080**	0.00		**1080**			**1080**	
1200	8.37	5.11	**1200**	1.59	**1200**	0.00		**1200**			**1200**	
1320	8.55		**1320**	1.55	**1320**	0.00		**1320**			**1320**	
1440	8.67	5.12	**1440**	1.50	**1440**	0.00		**1440**			**1440**	
1560			**1560**		**1560**			**1560**			**1560**	
1680			**1680**		**1680**			**1680**			**1680**	
1800			**1800**		**1800**			**1800**			**1800**	
1920			**1920**		**1920**			**1920**			**1920**	
2040			**2040**		**2040**			**2040**			**2040**	
2160			**2160**		**2160**			**2160**			**2160**	
2280			**2280**		**2280**			**2280**			**2280**	
2400			**2400**		**2400**			**2400**			**2400**	
2520			**2520**		**2520**			**2520**			**2520**	
2640			**2640**		**2640**			**2640**			**2640**	
2760			**2760**		**2760**			**2760**			**2760**	
2880			**2880**		**2880**			**2880**			**2880**	
3000			**3000**		**3000**			**3000**			**3000**	
3120			**3120**		**3120**			**3120**			**3120**	
3240			**3240**		**3240**			**3240**			**3240**	
3360			**3360**		**3360**			**3360**			**3360**	
3480			**3480**		**3480**			**3480**			**3480**	
3600			**3600**		**3600**			**3600**			**3600**	
3720			**3720**		**3720**			**3720**			**3720**	
3840			**3840**		**3840**			**3840**			**3840**	
3960			**3960**		**3960**			**3960**			**3960**	
4080			**4080**		**4080**			**4080**			**4080**	
4200			**4200**		**4200**			**4200**			**4200**	
4320			**4320**		**4320**			**4320**			**4320**	
Total time pumped(min):				1440		**W/L**	**5.44**		**W/L**			**W/L**
Average yield (l/s):				5.12								

KF_BH2

Abbreviations	
EC	Electrical conductivity
mbgl	Meters below ground level
mbch	Meters below casing height
mbdl	Meters below datum level
magl	Meters above ground level
L/S	Litres per second
RPM	Rates per minute
S/W/L	Static water level
µS/cm	Microsiemens per centimeter

ATS

BOREHOLE TEST RECORD

PR0JECT #	P3056
TEAM MEMBERS	PIETER
	KOLEN
	LUKHANYO

CONSULTANT: GEOSS
DISTRICT: BREEDE VALLEY
PROVINCE: WESTERN CAPE
FARM / VILLAGE NAME : ELGIN VILLIERS DORP
DATE TESTED: 31/01/2025

BOREHOLE LOCATION & ACCESS INFORMATION:

BOREHOLE COORDINATES
LATITUDE (SOUTH): 33.92208
LONGITUDE (EAST): 19.38852

COMMENTS ON ACCESS IF ANY:

BOREHOLE NO:	BH 2
TRANSMISSIVITY VALUE:	
TYPE INSTALLATION:	NEW
BOREHOLE DEPTH: (mbg	163

MAINTENANCE RECORD:
Labour hours:
Cost of material:
Travelling (km):

REHABILITATION RECORD:
Jetting hours:
Brushing hours:
Airlifting hours:
Sulphamic Acid KG's
Boresaver KG's
Soda Ash KG's

DIGITAL CAMERA LOGGING:
Camera logged once:
Camera logged twice:
Camera logged three times:
Camera work sent to client:

EQUIPMENT FISHING RECORD
Hours spent:

OTHER COSTS ON PROJECT:
Courier of samples:
Km's for delivery:
Cost of packaging:

COMMENTS:
DID STEPS AT 121M, AS PER INSTRUCTION WE NEED TO LOWER THE PUMP TO 150M.RODS STRIPPED AT 150MIN INTO THE CDT. RE-INSTALLED A SMALL PUMP AND RE-STARTED THE CDT

RECOMMENDATIONS / CORRECTIVE ACTIONS:

SAMPLE INSTRUCTIONS :

Water sample taken	Yes	No	If consultant took sample, give name:		DATA CAPTURED BY	EC
Date sample taken	04/02/2025		If sample courier, to where:		DATA CHECKED BY:	AH
Time sample taken	06H30					

DESCRIPTION:	UNIT	QTY		UNIT	QTY
STRAIGHTNESS TEST:	NO	0	BOREHOLE DEPTH AFTER TEST:	M	163.00
VERTICALLY TEST:	NO	0	BOREHOLE WATER LEVEL AFTER TEST: (mbch)	M	21.71
CASING DETECTION:	NO	1	SAND/GRAVEL/SILT PUMPED?	YES/NO	0
SUPPLIED NEW STEEL BOREHOLE COVER:	NO	0	DATA REPORTING AND RECORDING	NO	1
BOREHOLE MARKING	NO	0	SLUG TEST:	NO	0
SITE CLEANING & FINISHING	NO	1	LAYFLAT (M):	M	100
LOGGERS FOR WATERLEVEL MONITORING	NO	0	LOGGERS FOR pH AND EC:	NO	0

It is hereby acknowledged that upon leaving the site, all existing equipment is in an acceptable condition.

NAME: ______________________ SIGNATURE: ______________________

DESIGNATION: ______________________ DATE: ______________________

FORM 5 E

STEPPED DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3056	Coordinates: SOUTH:	33.92208	PROVINCE:	WESTERN CAPE
BOREHOLE NO:	BH 2	EAST:	19.38852	DISTRICT:	BREEDE VALLEY
ALT BH NO:	0			SITE NAME:	ELGIN VILLIERS DORP
ALT BH NO:	0				
BOREHOLE DEPTH (m)	163.00	DATUM LEVEL ABOVE CASING (m):	0.80	EXISTING PUMP:	0
WATER LEVEL (mbdl):	6.24	CASING HEIGHT: (magl):	0.13	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	121.50	DIAM PUMP INLET (mm):	210.00	PUMP TYPE:	WA 50-2

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1 — RPM 121 — DATE: 31/01/2025 TIME: 12H10

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.25		1	
2	2.67		2	
3	4.71	0.68	3	
5	7.33		5	
7	9.65	1.05	7	
10	12.21		10	
15	14.05	1.03	15	
20	18.40		20	
30	27.69	1.04	30	
40	33.50		40	
50	42.62	1.02	50	
60	46.75		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP	16.10	°C	180	
EC	274	µS/cm	210	

DISCHARGE RATE 2 — RPM 229 — DATE: 31/01/202 TIME: 13H00

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	46.95		1	
2	48.15	1.27	2	
3	49.50	1.44	3	
5	53.98		5	
7	54.04	1.42	7	
10	57.52		10	
15	61.38	1.41	15	
20	65.60		20	
30	71.78	1.43	30	
40	75.58		40	
50	77.26	1.45	50	
60	77.88		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP	16.10	°C	180	
EC	309	µS/cm	210	

DISCHARGE RATE 3 — RPM 314 — DATE: 31/01/202 TIME: 14H10

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	78.10		1	
2	79.34	1.62	2	
3	80.54	1.84	3	
5	81.95		5	
7	82.70	1.81	7	
10	84.29		10	
15	86.38	1.82	15	
20	89.59		20	
30	93.73	1.84	30	
40	95.47		40	
50	96.15	1.81	50	
60	96.45		60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP	16.10	°C	180	
EC	336	µS/cm	210	

DISCHARGE RATE 4 — RPM 387 — DATE: 31/01/2025 TIME: 15H10

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	97.49		1	110.25
2	98.98	1.98	2	98.95
3	100.63	2.42	3	94.87
5	103.06		5	89.63
7	105.38	2.41	7	83.83
10	108.64		10	76.65
15	113.32		15	65.36
	113.32	1.68	20	55.15
	113.32	1.62	30	38.87
	113.32	1.60	40	28.08
			50	23.01
			60	19.39
			70	17.97
			80	17.27
			90	16.90
			100	16.65
			110	16.48
			120	16.17
pH			150	15.97
TEMP		°C	180	15.59
EC		µS/cm	210	15.18
			240	
			300	
			360	

DISCHARGE RATE 5 — RPM — DATE: TIME:

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC		µS/cm	210	
			240	
			300	
			360	

DISCHARGE RATE 6 — RPM — DATE: TIME:

TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1			1	
2			2	
3			3	
5			5	
7			7	
10			10	
15			15	
20			20	
30			30	
40			40	
50			50	
60			60	
70			70	
80			80	
90			90	
100			100	
110			110	
120			120	
pH			150	
TEMP		°C	180	
EC		µS/cm	210	
			240	
			300	
			360	

S/W/L:(mbch) 5.4

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P3056	Coordinates: SOUTH: 33.92208		PROVINCE:	WESTERN CAPE
BOREHOLE NO:	BH 2	EAST: 19.38852		DISTRICT:	BREEDE VALLEY
ALT BH NO:	0			SITE NAME:	ELGIN VILLIERS DORP
ALT BH NO:	0				
BOREHOLE DEPTH:	163.00	DATUM LEVEL ABOVE CASING (m):	0.80	EXISTING PUMP:	0
WATER LEVEL (mbdl):	20.70	CASING HEIGHT: (magl):	0.13	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	151.50	DIAM PUMP INLET(mm):	210	PUMP TYPE:	WA 50-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				**TEST COMPLETED**				
DATE:	03/02/2025	TIME:	07H00	DATE:		TIME:		TYPE OF PUMP: WA 50-2

DISCHARGE BOREHOLE					OBSERVATION HOLE 1			OBSERVATION HOLE 2			OBSERVATION HOLE 3	
					NR: **BH 1**			NR:			NR:	
					Distance(m); 270			Distance(m);			Distance(m);	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME MIN	RECOVERY (M)	TIME: (min)	Drawdown m	Recovery (m)	TIME: (min)	Drawdown (m)	Recovery	TIME: (min)	Drawdown (m)
1	0.90		**1**	59.72	**1**			**1**			**1**	
2	0.92		**2**	55.02	**2**			**2**			**2**	
3	1.00		**3**	49.49	**3**			**3**			**3**	
5	2.05		**5**	47.00	**5**			**5**			**5**	
7	4.26	1.18	**7**	42.41	**7**			**7**			**7**	
10	7.61	1.31	**10**	38.67	**10**			**10**			**10**	
15	12.05	1.51	**15**	30.02	**15**			**15**			**15**	
20	14.52		**20**	23.02	**20**			**20**			**20**	
30	23.12	1.53	**30**	14.60	**30**	0.00		**30**			**30**	
40	29.85		**40**	10.65	**40**			**40**			**40**	
60	36.44	1.52	**60**	5.38	**60**	0.00		**60**			**60**	
90	42.09		**90**	4.39	**90**	0.00		**90**			**90**	
120	47.45	1.50	**120**	4.04	**120**	0.00		**120**			**120**	
150	49.55		**150**	3.93	**150**	0.00		**150**			**150**	
180	53.03	1.53	**180**	3.86	**180**	0.00		**180**			**180**	
210	57.30		**210**	3.80	**210**	0.00		**210**			**210**	
240	59.19	1.53	**240**	3.69	**240**	0.00		**240**			**240**	
300	61.09	1.50	**300**	3.60	**300**	0.00		**300**			**300**	
360	62.67		**360**	3.49	**360**	0.00		**360**			**360**	
420	65.57	1.53	**420**	3.45	**420**	0.00		**420**			**420**	
480	66.28		**480**	3.40	**480**	0.00		**480**			**480**	
540	66.79	1.50	**540**	3.34	**540**	0.00		**540**			**540**	
600	68.58		**600**	3.28	**600**	0.00		**600**			**600**	
720	69.70	1.51	**720**	3.15	**720**	0.00		**720**			**720**	
840	69.84	1.52	**840**	3.08	**840**	0.00		**840**			**840**	
960	69.86	1.53	**960**	2.98	**960**	0.00		**960**			**960**	
1080	69.90		**1080**	2.87	**1080**	0.00		**1080**			**1080**	
1200	69.95	1.50	**1200**	2.79	**1200**	0.00		**1200**			**1200**	
1320	70.01		**1320**	2.70	**1320**	0.00		**1320**			**1320**	
1440	70.07	1.52	**1440**	2.64	**1440**	0.00		**1440**			**1440**	
1560			**1560**		**1560**			**1560**			**1560**	
1680			**1680**		**1680**			**1680**			**1680**	
1800			**1800**		**1800**			**1800**			**1800**	
1920			**1920**		**1920**			**1920**			**1920**	
2040			**2040**		**2040**			**2040**			**2040**	
2160			**2160**		**2160**			**2160**			**2160**	
2280			**2280**		**2280**			**2280**			**2280**	
2400			**2400**		**2400**			**2400**			**2400**	
2520			**2520**		**2520**			**2520**			**2520**	
2640			**2640**		**2640**			**2640**			**2640**	
2760			**2760**		**2760**			**2760**			**2760**	
2880			**2880**		**2880**			**2880**			**2880**	
3000			**3000**		**3000**			**3000**			**3000**	
3120			**3120**		**3120**			**3120**			**3120**	
3240			**3240**		**3240**			**3240**			**3240**	
3360			**3360**		**3360**			**3360**			**3360**	
3480			**3480**		**3480**			**3480**			**3480**	
3600			**3600**		**3600**			**3600**			**3600**	
3720			**3720**		**3720**			**3720**			**3720**	
3840			**3840**		**3840**			**3840**			**3840**	
3960			**3960**		**3960**			**3960**			**3960**	
4080			**4080**		**4080**			**4080**			**4080**	
4200			**4200**		**4200**			**4200**			**4200**	
4320			**4320**		**4320**			**4320**			**4320**	
Total time pumped(min):				1440		**W/L**	**23.81**		**W/L**			**W/L**
Average yield (l/s):				1.50								

Appendix E:
Certificate of Analysis

vinlab H2O
Your partner in quality water analysis

Distillery Road
Stellenbosch
Tel 021-8828866/7
info@vinlab.com
www.vinlab.com
2025-02-07

TEST REPORT

Water

Geoss South Africa (Pty) Ltd
Attn: Alison McDuling
P.O.Box 12412
Die Boord, Stellenbosch
7613
+27218801079

@VinlabSA

Sample Details					
SampleID	W59949	W59950	W59951		
Water Type	Drinking Water	Drinking Water	Drinking Water		
Water Source	Borehole	Not Indicated	Not Indicated		
Sample Temperature					
Description	KF_BH1	KF_BH3	KF_BH4		
Batch Number	KF_BH1	KF_BH3	KF_BH4		
PO Number	3569_M	3569_M	3569_M		
Date Received	2025-02-04	2025-02-04	2025-02-04		
Condition	Good	Good	Good		

Water - Routine	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	4.20	6.39	6.42		
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	40.8	61.1	53.8		
Turbidity (Water)*	ntu			<= 5	4.01	543.00	96.0		
Total dissolved solids (Water)*	mg/L			<= 1200	276.62	414.26	364.76		
Free Chlorine (Water)*	mg/L			<= 5	0.02	<0.02	0.02		
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	8.90%	<= 1.5	<0.15	<0.15	<0.15		
Nitrate as N (Water)	mg/L	VIN-05-MW08	11.00%	<= 11	<1.00	<1.00	<1.00		
Nitrite as N (Water)	mg/L	VIN-05-MW08	4.50%	<= 0.9	<0.05	<0.05	<0.05		
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	10.12%	<= 300	96.17	112.58	113.93		
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	23.04	53.10	20.50		
Fluoride (F) - Water	mg/L	VIN-05-MW08	12.30%	<= 1.5	<0.15	9.15	0.59		
Alkalinity as CaCO3 (Water)*	mg/L				<10.00	61.70	58.40		
Colour (Water)*	mg/L Pt-Co			<= 15	<15	<15	<15		
Total Organic Carbon (Water)*	mg/L			<=10	1.46	3.73	3.60		
Date Tested					2025-02-04	2025-02-04	2025-02-04		

Water - Metals	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		<0.20	8	7		
Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		7	9	7		
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	54	85	85		
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		7	8	7		

Please click here for SANS241-1:2015 drinking water limits

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^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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Doc No V59329 | VIN 09-01 07-05-2024 | Page: 1 of 3 | Visit Vinlab H20

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info@vinlab.com
www.vinlab.com
2025-02-07

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: Alison McDuling

P.O.Box 12412
Die Boord, Stellenbosch
7613
+27218801079

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Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	0.094	0.061	0.145			
Antimony (Sb) - Water*	µg/L			<=20	<13.0	14	<13.0			
Arsenic (As) - Water*	µg/L			<= 10	<10.0	15	<10.0			
Boron (B) Water	µg/L	VIN-05-MW43	11.79%	<= 2400	9	27	19			
Cadmium (Cd) Water	µg/L	VIN-05-MW43	12.26%	<= 3	2	2	2			
Chromium (Cr) - Water	µg/L	VIN-05-MW43	13.03%	<= 50	<4	16	<4			
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	25	15	17			
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	1146	56355	3494			
Lead (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	<8	<8	<8			
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	54	1907	1734			
Nickel (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	10	12	<8			
Selenium (Se) - Water*	µg/L			<= 40	<10.0	<10.0	<10.0			
Aluminium (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	972	4892	238			
Cyanide (CN) - Water*	µg/L			<= 200	<10.0	61.0	10.0			
Mercury (Hg) - Water*	µg/L			<= 6	<1.0	1	2			
Barium (Ba) Water	µg/L	VIN-05-MW43	14.09%	<= 700	254	135	74			
Uranium (U) - Water*	µg/L			<= 30	<28	<28	<28			
Date Tested					2025-02-04	2025-02-04	2025-02-04			

Comments
W59949 Two Samples received, Ion balance = 2.0%
W59950 Two Samples received, Ion balance = 2.9% Recheck: Arsenic(As) = 17.0 µg/l
W59951 Two Samples received, Ion balance = 1.8%

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^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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Distillery Road
Stellenbosch
Tel 021-8828866/7
info@vinlab.com
www.vinlab.com
2025-02-07

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: Alison McDuling

P.O.Box 12412
Die Boord, Stellenbosch
7613
+27218801079

@VinlabSA

Adelize Fourie
Laboratory Manager (Waterlab)
VIN-05-
M01,M02,M03,M04,M05,MO8,M10,M28,
M43, MW01, MW02, MW03, MW04,
MW05, MW06, MW07, MW08/9/10,
MW12, MW13, MW14

Please click here for SANS241-1:2015 drinking water limits

Test results relate only to the items tested as received. This Document shall not be reproduced without the written approval of Vinlab (Pty) Ltd.Opinions and interpretations expressed herein are outside the scope of SANAS accreditation. Results for methods VIN-05-MW12, 13 and 14, are based on Cq values, a positive result (detected) indicates a Cq value <35 and a negative result (non-detected) indicates a Cq value of >35.

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Vinlab is not liable to any client for any loss or damages suffered which could, directly or remotely, be linked to our services Alcohol results are obtained using the most appropriate or a combination of one of the following methods: Py= pycnometer; W=winescan; Al=alcolyzer. W = Winescan. Micro results: Enumeration of yeast: WL nutrient, 3 days unless otherwise specified, 30°C. Samples that have had prior microbiological spoilage or treatment for spoilage should always be sterile filtered at bottling. SO2 additions less than 10 days may depress the growth of microbes in culture although they are viable/active in the wine. Some microbes, especially lactobacilli, may not grow in culture even where viable/potentially active in the wine.

^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

Testing Laboratory T1131

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Distillery Road
Stellenbosch
Tel 021-8828866/7
info@vinlab.com
www.vinlab.com
2025-02-18

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: Alison McDuling

P.O.Box 12412
Die Boord, Stellenbosch
7613
+27218801079

@VinlabSA

Sample Details					
SampleID	W60071				
Water Type	Drinking Water				
Water Source	Not Indicated				
Sample Temperature					
Description	KF_BH2				
Batch Number	KF_BH2				
PO Number	3569_M				
Date Received	2025-02-06				
Condition	Good				

Water - Routine									
	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	5.62				
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	34				
Turbidity (Water)*	ntu			<= 5	1536				
Total dissolved solids (Water)*	mg/L			<= 1200	230.52				
Free Chlorine (Water)*	mg/L			<= 5	0.05				
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	8.90%	<= 1.5	<0.15				
Nitrate as N (Water)	mg/L	VIN-05-MW08	11.00%	<= 11	<1.00				
Nitrite as N (Water)	mg/L	VIN-05-MW08	4.50%	<= 0.9	<0.05				
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	10.12%	<= 300	85.15				
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	14.85				
Fluoride (F) - Water	mg/L	VIN-05-MW08	12.30%	<= 1.5	<0.15				
Alkalinity as CaCO3 (Water)*	mg/L				10.30				
Colour (Water)*	mg/L Pt-Co			<= 15	<15				
Total Organic Carbon (Water)*	mg/L			<=10	7.55				
Date Tested					2025-02-06				

Water - Metals									
	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		<0.20				
Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		6				
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	50				
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		4				

Please click here for SANS241-1:2015 drinking water limits

Test results relate only to the items tested as received. This Document shall not be reproduced without the written approval of Vinlab (Pty) Ltd.Opinions and interpretations expressed herein are outside the scope of SANAS accreditation. Results for methods VIN-05-MW12, 13 and 14, are based on Cq values, a positive result (detected) indicates a Cq value <35 and a negative result (non-detected) indicates a Cq value of >35.

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Vinlab is not liable to any client for any loss or damages suffered which could, directly or remotely, be linked to our services Alcohol results are obtained using the most appropriate or a combination of one of the following methods: Py= pycnometer; W=winescan; Al=alcolyzer. W = Winescan. Micro results: Enumeration of yeast: WL nutrient, 3 days unless otherwise specified, 30°C. Samples that have had prior microbiological spoilage or treatment for spoilage should always be sterile filtered at bottling. SO2 additions less than 10 days may depress the growth of microbes in culture although they are viable/active in the wine. Some microbes, especially lactobacilli, may not grow in culture even where viable/potentially active in the wine.

^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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Stellenbosch
Tel 021-8828866/7
info@vinlab.com
www.vinlab.com
2025-02-18

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: Alison McDuling

P.O.Box 12412
Die Boord, Stellenbosch
7613
+27218801079

@VinlabSA

Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	0.091					
Antimony (Sb) - Water*	µg/L			<=20	<13.0					
Arsenic (As) - Water*	µg/L			<= 10	<10.0					
Boron (B) Water	µg/L	VIN-05-MW43	11.79%	<= 2400	26					
Cadmium (Cd) Water	µg/L	VIN-05-MW43	12.26%	<= 3	<1					
Chromium (Cr) - Water	µg/L	VIN-05-MW43	13.03%	<= 50	<4					
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	34					
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	1891					
Lead (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	10					
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	796					
Nickel (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	16					
Selenium (Se) - Water*	µg/L			<= 40	<10.0					
Aluminium (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	299					
Cyanide (CN) - Water*	µg/L			<= 200	17.0					
Mercury (Hg) - Water*	µg/L			<= 6	1					
Barium (Ba) Water	µg/L	VIN-05-MW43	14.09%	<= 700	250					
Uranium (U) - Water*	µg/L			<= 30	<28					
Date Tested					2025-02-06					

Comments
W60071 Two Samples received, Metal analysis - sample centrifuged prior to analysis Memo Ion balance = 2.9%

AEFourie

Adelize Fourie
Laboratory Manager (Waterlab)
VIN-05-
M01,M02,M03,M04,M05,MO8,M10,M28,
M43, MW01, MW02, MW03, MW04,
MW05, MW06, MW07, MW08/9/10,
MW12, MW13, MW14

Please click here for SANS241-1:2015 drinking water limits

^ - Conductivity <1000mS/m = ±1mS/m , >1000mS/m = ±9mS/m
^^ - COD, LR = ±16mg/L, MR = ±48mg/L, HR = ±477mg/L
^^^ - pH ± 0.1

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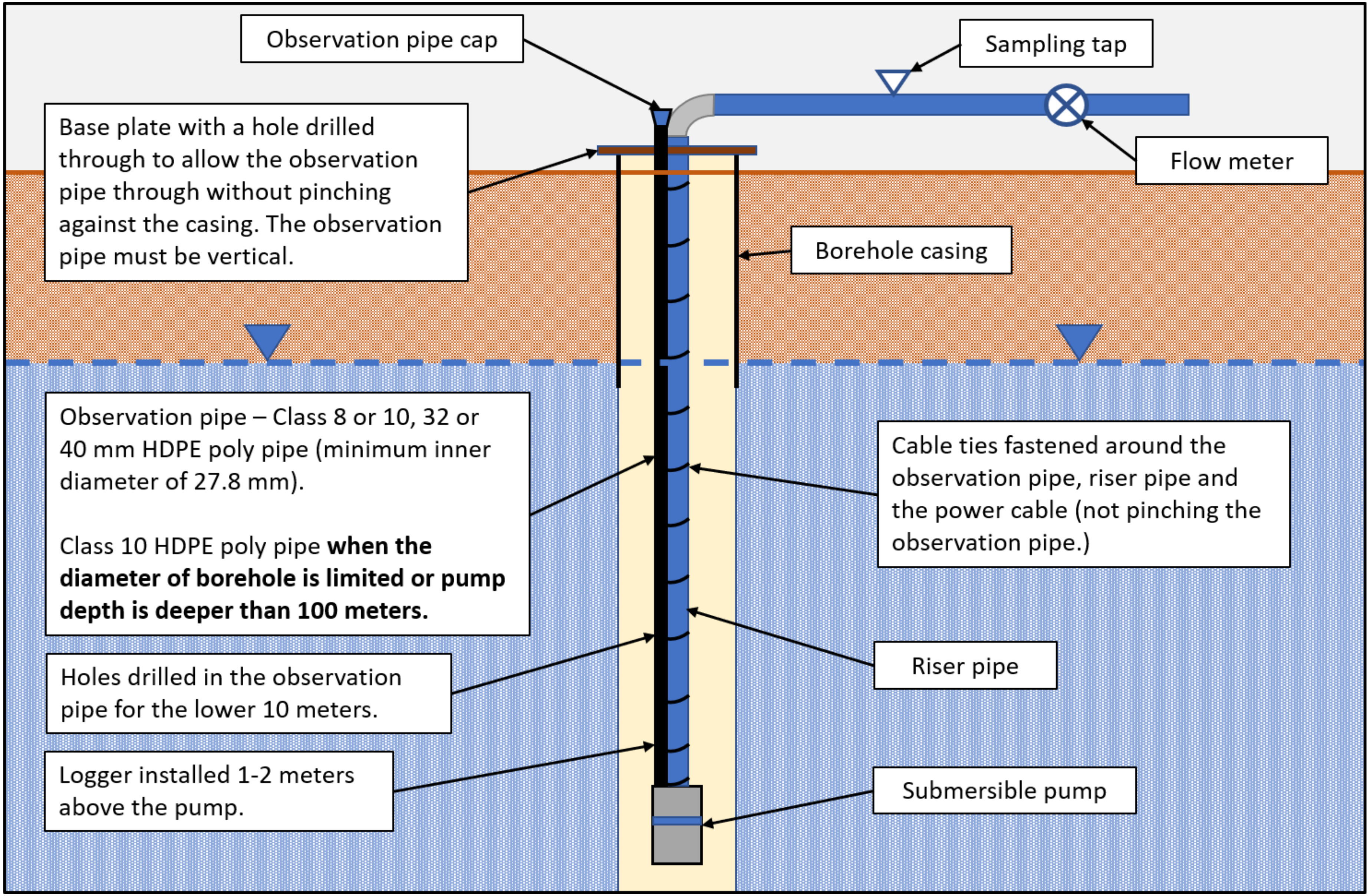
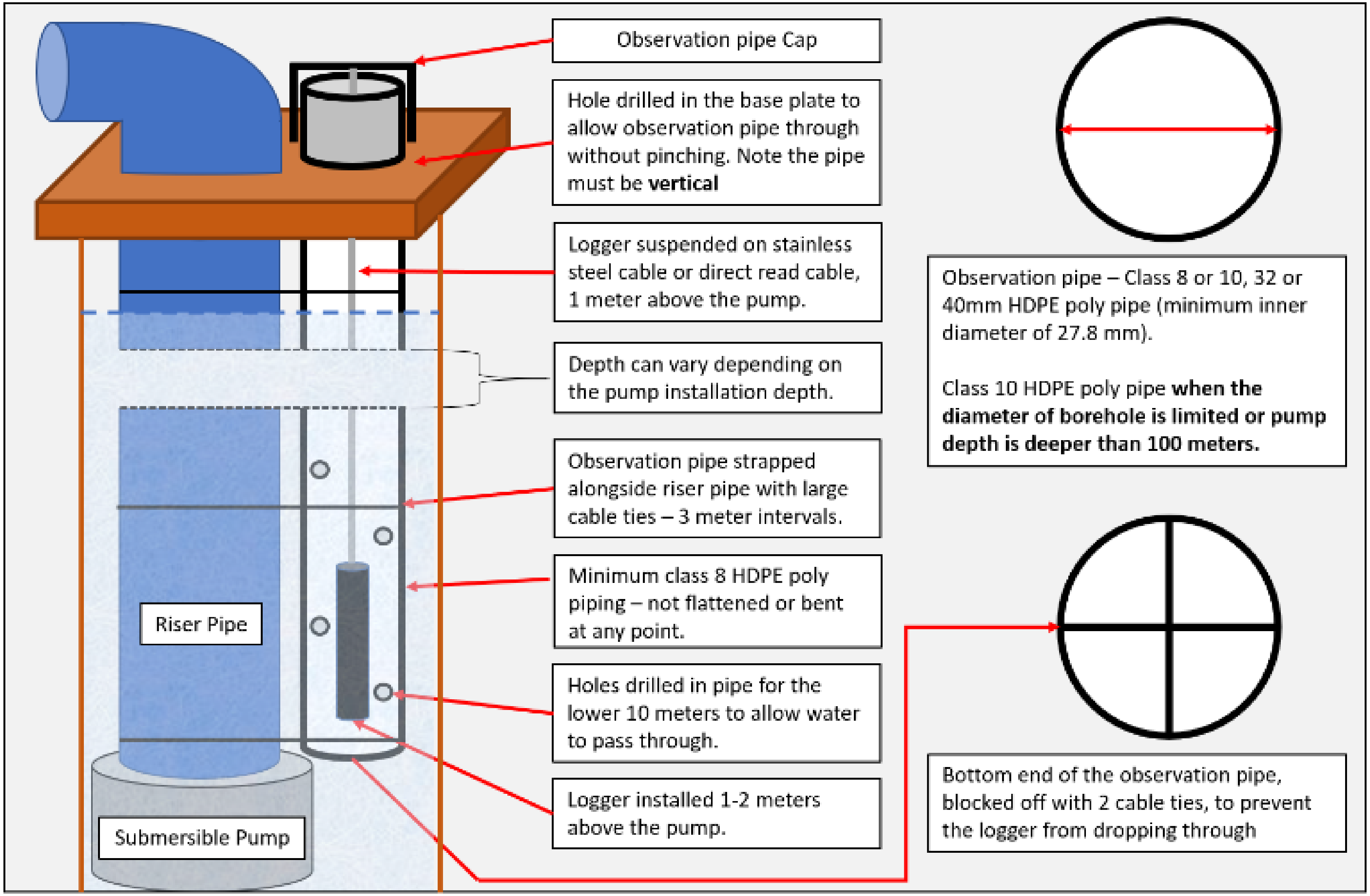
Appendix F:
Risk Rating Criteria

Nature of impact	Description
Positive	Impacts would benefit the receiving environment (including people).
Negative	Impacts would harm the receiving environment (including people).
Type of impact	**Description**
Direct	Impacts that result directly from the causal activity. usually at the same time and in the same space as that activity
Indirect	Secondary impacts may result from direct impacts. generally occurring later in time and may manifest elsewhere in space (e.g. downstream)
Induced	Impacts that may happen as a consequence of the Project (e.g.. migration of people along newly created access routes)
Cumulative	Impacts that add to or magnify existing or reasonably foreseeable future impacts on the same receiving environment or specific resource
Extent Rating	**Description**
Site specific	Impact (and implications) limited to the project site.
Local	Impact extends only as far as the activity. limited to the site and its immediate surroundings. and local assets/ resources.
Regional	Impact extends to a regional scale. and affects provincial resources. e.g. District or Province; Western Cape
National	Impact extends to a national scale. and affects national resources; South Africa.
International	Impact extends across national borders. and affects global resources.
Duration Rating	**Description**
Short term	0 - 5 years
Medium term	5 - 15 years
Long term	Where the impact will cease after the operational life of the activity. either because of natural processes or by human intervention. Generally >15 years but <30 years
Permanent	Where the impact will. for all intents and purposes. endure in perpetuity. That is. it would be regarded as 'irreversible'
Intensity Rating	**Description**
Low	Where the impact affects the environment in such a way that a small or negligible proportion of resources and/or beneficiaries would be affected. Receptors in the receiving environment are not threatened or vulnerable. and affected communities have negligible or very low dependence on affected resources for livelihoods. health and safety.
Medium	Where a sizeable proportion of resources and/ or of beneficiaries would be affected. and natural. cultural and social functions and processes would continue. albeit in a modified way. Receptors in the receiving environment are moderately threatened or vulnerable. and/ or affected communities have some dependence on affected resources for livelihoods. health and safety. affected resources could be substituted.

High	Where most/ a major proportion of resources and/ or beneficiaries would be affected. and natural. cultural and social functions or processes are altered to the extent that they would temporarily or permanently cease. Receptors in the receiving environment are highly threatened or vulnerable (i.e. close to environmental or legal thresholds. standards or targets). and affected communities are highly dependent on affected resources for livelihoods. health and safety. and/ or resources are considered to be irreplaceable (if lost they could not be substituted. and/ or their loss would undermine achieving targets. standards).
Probability Rating	**Description**
Improbable	Where the possibility of the impact materializing is very low. but it could occur e.g. in unplanned / upset conditions
Possible	Where there is a possibility that the impact will occur during normal operations.
Probable	Where the impact is expected to occur during normal operations
Definite	Where the impact will undoubtedly occur.
Confidence Rating	**Description**
High	High confidence in predictions.
Medium	Some uncertainty in predictions e.g. due to information gaps. constraints on study
Low	Little confidence in predictions e.g. due to constraints on study. information gaps. inherent uncertainties
Significance Rating	**Description**
Negligible	Where the receiving environment (including people) would not be materially affected by the proposed activity(ies). There would be no need for mitigation.
Very Low	Where there would be minimal effect on the environment or human wellbeing. and impacts would be well within environmental quality standards or targets. or legal requirements. There would be no need for mitigation.
Low	Where there would be little material effect on the environment or human wellbeing. and impacts would be well within environmental quality standards or targets. or legal requirements. Minor mitigation measures may be required.
Moderate	Where the activity (ies) would have a material effect on the receiving environment (including people). legal requirements would still be met but thresholds of potential concern with regard to environmental quality may be crossed. Mitigation measures – avoidance. minimization and rehabilitation/ restoration. and in some cases offsets/ compensation - would be needed to reduce the impact significance.
High	Where there would be major effects on the receiving environment to the extent where environmental quality standards or targets may be jeopardized. legal requirements may not be met. and the health. safety. livelihoods and/or wellbeing of affected people could be jeopardized. Mitigation measures – preferably avoidance/ impact prevention. minimization. rehabilitation/ restoration. and offsets/ compensation – are essential to reduce the impact significance substantially.
Very High	Where there would be severe or substantial effects on the receiving environment to the extent where environmental quality standards or targets would be undermined/ exceeded. there would be non-compliance with legal requirements or commitments. and the health. safety. livelihoods and/or wellbeing of affected people would be jeopardized. Mitigation measures – avoidance or prevention of impacts as a priority would be required. since impacts are unacceptable. Additional measures to minimize. rehabilitate/ restore. and offset/ compensate for residual impacts would be – are essential to reduce the impact significance substantially

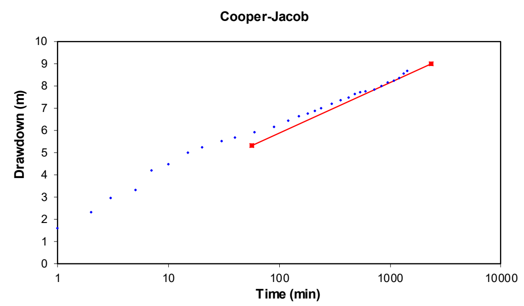
Appendix G: Monitoring Infrastructure


Observation pipe cap
Sampling tap
Base plate with a hole drilled through to allow the observation pipe through without pinching against the casing. The observation pipe must be vertical.
Flow meter
Borehole casing
Observation pipe – Class 8 or 10, 32 or 40 mm HDPE poly pipe (minimum inner diameter of 27.8 mm).
Class 10 HDPE poly pipe **when the diameter of borehole is limited or pump depth is deeper than 100 meters.**
Cable ties fastened around the observation pipe, riser pipe and the power cable (not pinching the observation pipe.)
Riser pipe
Holes drilled in the observation pipe for the lower 10 meters.
Logger installed 1-2 meters above the pump.
Submersible pump


Observation pipe Cap
Hole drilled in the base plate to allow observation pipe through without pinching. Note the pipe must be **vertical**
Logger suspended on stainless steel cable or direct read cable, 1 meter above the pump.
Depth can vary depending on the pump installation depth.
Observation pipe strapped alongside riser pipe with large cable ties – 3 meter intervals.
Minimum class 8 HDPE poly piping – not flattened or bent at any point.
Holes drilled in pipe for the lower 10 meters to allow water to pass through.
Logger installed 1-2 meters above the pump.
Riser Pipe
Submersible Pump
Observation pipe – Class 8 or 10, 32 or 40mm HDPE poly pipe (minimum inner diameter of 27.8 mm).
Class 10 HDPE poly pipe **when the diameter of borehole is limited or pump depth is deeper than 100 meters.**
Bottom end of the observation pipe, blocked off with 2 cable ties, to prevent the logger from dropping through

Appendix H: Yield data analyses report

KF_BH1

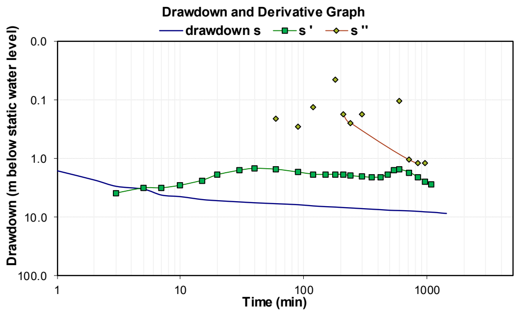


Cooper-Jacob method

T(m²/d) =	35.5	r_e (m)=	0.1
S =	1.49E+00	Q (l/s) =	5.13

	No boundaries	1 no-flow	2 no-flow	Closed
Q_sust	8.21	4.10	2.71	2.05
Avg. Q_sust =		4.27	std. dev =	2.76

Boundaries selected	0 - closed

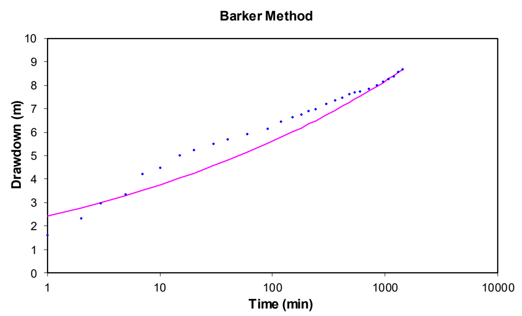


FC method

Extrapolation time in years	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e)	49.2430621	49.24306206	Est. r_e	From r(e) sheet
Q (l/s) from pumping test	5.13	4.22885E-05	S-late	Change r_e
s_a (available drawdown), sigma_s	**24.1**	0	Sigma_s from risk	
Annual effective recharge (mm)	0	24.1	s_available working drawdown(m)	
t(end) and s(end) of pumping test	1440	8.67	End time and drawdown of test	
Average maximum derivative	**2.75**	2.759103159	Estimate of average of max deriv	
Average second derivative	**1.15**	0.025377577	Estimate of average second deriv	
Derivative at radial flow period	2.26586781	2.265867805	Read from derivative graph	
T-early[m²/d]		35.79708217	Aqui. thick (m)	60
T and S estimates	**T-late [m²/d]**	**29.49507491**	Est. S-late	0.0033
	S-late	0.0033		

BASIC SOLUTION

	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	21.26	29.13	37.01	60.63
Q_sust (l/s) =	5.82	4.24	3.34	2.04
Average Q_sust (l/s) =	**3.60**			
with standard deviation=	1.59			
Boundaries selected	0 - closed			

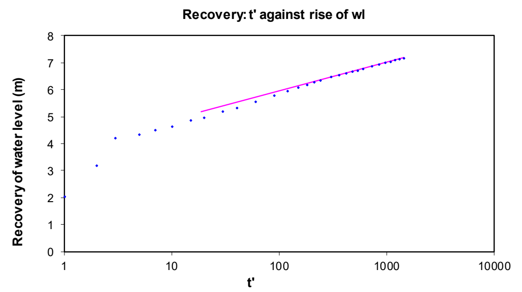


Barker method

	K_f [m/d]	S_f [1/m]	b	n	N
Fit Parameters	54.00	2.00E-03	2.26	1.72	0.1400

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	23.49	39.23	47.11	54.98
Q_sust	5.26	3.15	2.62	2.25

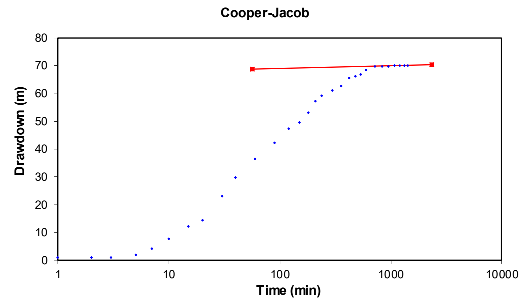
Fractal n = 1.72	**Average Q-sust (l/s)=**	3.15	std. dev =	1.35
	Boundaries selected	0 - closed		



Recovery

T [m2/d]	76.61
CDT Duration	1440
Recovery Duration	1440
Max % Recovery	82.70

KF_BH2

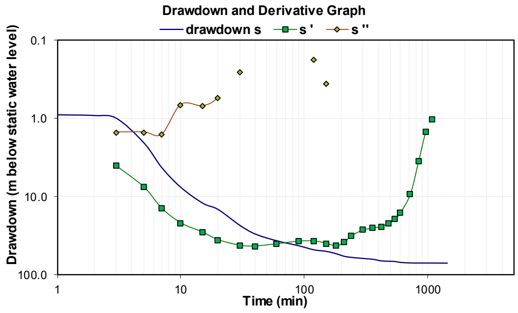


Cooper-Jacob method

$T (m^2/d)$ =	29.6	r_e (m)=	0.1
S =	3.97E-84	Q (l/s) =	1.50

	No boundaries	1 no-flow	2 no-flow	Closed
Q_sust	1.91	0.95	0.63	0.48
Avg. Q_sust =		0.99	std. dev =	0.64

Boundaries selected	0 - closed

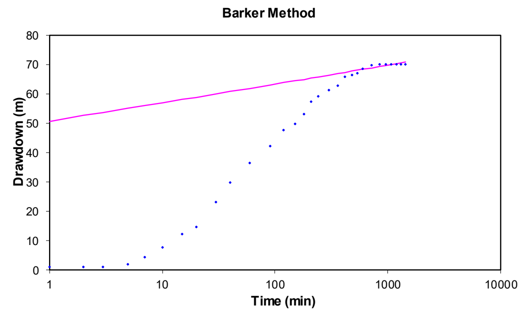


FC method

Extrapolation time in years	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e)	26.4068394	26.40683937	Est. r_e	From r(e) sheet
Q (l/s) from pumping test	1.5	1.32932E-05	S-late	Change r_e
s_a (available drawdown), sigma_s	**92.1**	0	Sigma_s from risk	
Annual effective recharge (mm)	0	92.1	s_available working drawdown(m)	
t(end) and s(end) of pumping test	1440	70.07	End time and drawdown of test	
Average maximum derivative	**3.45**	42.24083805	Estimate of average of max deriv	
Average second derivative	**0**	-0.300237	Estimate of average second deriv	
Derivative at radial flow period	20.3943513	20.39435133	Read from derivative graph	
T-early[m^2/d]		1.16291024	Aqui. thick (m)	60
T and S estimates	**T-late [m^2/d]**	**6.874434783**	Est. S-late	0.0033
	S-late	0.0033		

BASIC SOLUTION

	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	79.95	89.83	99.71	129.34
Q_sust (l/s) =	1.73	1.54	1.39	1.07
Average Q_sust (l/s) =	**1.41**			
with standard deviation=	0.28			
Boundaries selected: 0 - closed				

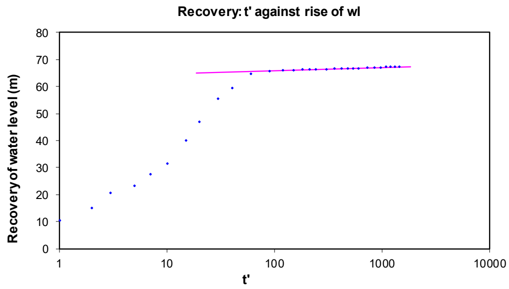


Barker method

	K_f [m/d]	S_f [1/m]	b	n	N
Fit Parameters	215.20	1.00E-07	0.02	1.99	0.0050

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	89.60	109.36	119.23	129.11
Q_sust	1.54	1.26	1.16	1.07

Fractal n = 1.99	**Average Q-sust (l/s)=**	1.25	std. dev =	0.20
	Boundaries selected	0 - closed		



Recovery

T [m2/d]	21.51
CDT Duration	1440
Recovery Duration	1440
Max % Recovery	96.23