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HYDROGEOLOGICAL INVESTIGATION REPORT

PREPARED FOR:

BRENTON COVE

PORTION 152 OF THE FARM UITZIGT 216 FP, WESTERN CAPE PROVINCE

REPORT DATE: 04 AUGUST 2025

REFERENCE NUMBER: HGI_041

DOCUMENT CONTROL

Nature of Signoff	Responsible Person	Signature	Role / Responsibility	Qualifications
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DECLARATION OF INDEPENDANCE

I, Albert Kruger, declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist assessment relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA) and the National Water Act (Act 36 of 1998), regulations and any guidelines that have relevance to the proposed activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this report are true and correct;
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B (1) of the National Environmental Management Act, 1998 (Act 107 of 1998); and
- I understand that any false information published in this document is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

Albert Kruger

EXECUTIVE SUMMARY

EnviroSynergy Specialist Services (Pty) Ltd was appointed by Brenton Cove cc to conduct a hydrogeological investigation as part of a Section 21 water use authorisation for a luxury camping development on Portion 152 of the Farm Uitzigt 216, Brenton on Lake, Western Cape Province. Brenton Cove (hereafter referred to as "the site") is in the process of obtaining authorisation to build luxury tented houses on their property, Portion 152 of the Farm Uitzigt 216. Water will be sourced from the on-site borehole for domestic and garden irrigation purposes. The water will be stored in a large water tank on site and passed through a filtration system before being supplied to the site.

A geophysical investigation was conducted by Rock-Hounds (Pty) Ltd on the 11th of November 2023 to investigate the nature, position and source of possible groundwater drilling positions on the property, Brenton on Lake, as required for household purposes.

One (1) borehole (BC-BH1) was located during the site assessment. Four (4) boreholes that are owned and managed by the municipality was located during the hydrocensus survey. Two hydrocensus boreholes, or spikes (HBH6 and HBH7) were identified during the survey. These spikes/well-points are essentially shallow piezometers from which groundwater is abstracted.

A groundwater sample was collected from BC-BH1 and submitted to an accredited laboratory for analyses. Based on the results, total coliforms exceeded the SANS 241-1:2015 drinking water standards. No Escherichia coli (*E. coli*) was detected in the sample. The groundwater can be classified as near neutral (pH ±7), moderately saline (Total Dissolved Solids: 773 mg/l) and moderately soft (54 mg $CaCO_3$/l).

Based on the aquifer testing results of BC-BH1, a maximum volume of 56.7 m^3/d (20 695.5 m^3/a) is available from the tested borehole. However, based on the discussion with Department of Water Affairs and water demand calculation, only a volume of 9 m^3/day will be applied for.

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Aquifer: A geological formation which has structures or textures that hold water or permit appreciable water movement through them. Appreciable water is usually taken to be enough water to supply a well.

Borehole: Includes a well, excavation or any artificially constructed or improved underground cavity which can be used for the purpose of - (a) intercepting, collecting or storing water in or removing water from an aquifer; (b) observing and collecting data and information on water in an aquifer; or (c) recharging an aquifer;

Catchment: The area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points.

Catchment Management Agency: A statutory body established by the Minister of DWAF responsible for the management of water resources within a defined water management area.

Contamination: The addition of potentially harmful substances to, in this case, groundwater, or an increase in naturally occurring substances to unnatural levels.

Discharge: Water which leaves the aquifer to become surface water, soil water, seawater or atmospheric water vapour.

Discharge area: The area or zone where ground water emerges from the aquifer naturally or artificially. Natural outflow may be into a stream, lake, spring, wetland, etc. Artificial outflow may occur via pumping wells.

Down gradient: Direction toward lesser hydraulic head.

Geohydrology: The scientific study of water that occurs in rocks, specifically aquifers.

Geology: The scientific study of the origin, history, structure and composition of the earth.

Permeability: The capacity of rock or soil to transmit water. The permeability results from the spaces in a rock and the degree to which they are connected to each other. In some aquifers the spaces were formed when the rock was deposited (primary aquifers), in other rocks the spaces were dissolved (e.g. dolomites) or cracked (e.g. faulted sandstone) into the rock after it was formed (secondary aquifers).

pH: A measure of the acidity or alkalinity of the solution (concentration of hydrogen ions)

Potable water: Water, which is safe for human consumption

Primary aquifer: Aquifers in which the water moves through the spaces that were formed at the same time as the geological formation was formed, for instance intergranular porosity in sand (e.g. alluvial deposits).

Recharge: Water that adds to groundwater stored in an aquifer, e.g. – the small proportion of rainfall that seeps through the ground surface and flows through the unsaturated soil until it reaches the water table.

Recharge areas: Areas of land that allow groundwater to be replenished through infiltration or seepage from precipitation or surface runoff.

Saturated zone: The subsurface zone below the water table where all spaces are filled with water. Aquifers are located in this zone.

Secondary aquifer: Aquifers in which the water moves through spaces that were formed after the geological formation was formed, such as fractures in hard rock.
Surface water: Bodies of water, snow, or ice on the surface of the earth (such as lakes, streams, ponds, wetlands, etc.).
Sustainability: The use of resources and the environment by people to meet their present needs in a way which will not compromise the ability of future generations to meet their needs.
Unconfined aquifer: An aquifer which is not restricted by any confining layer above it. Its upper boundary is the water table, which is free to rise and fall. The water level in a well tapping an unconfined aquifer is at atmospheric pressure and does not rise above the level of the water table within the aquifer. An unconfined aquifer is often near to the earth's surface and not protected by low permeability layers, causing it to be easily recharged as well as contaminated.
Unsaturated zone: An area, usually between the land surface and the water table, where the openings or pores in the soil contain both air and water.
Up gradient: Direction toward greater hydraulic head than point of origin, or point of interest.
Water level (groundwater): The level at which groundwater rests in an aquifer, borehole or point of discharge.
Water Management Areas: An area established as a management unit in the national water resource strategy within which a catchment management agency will conduct the protection, use, development, conservation, management and control of water resources
Water table: The top of an unconfined aquifer where water pressure is equal to atmospheric pressure. The water table depth fluctuates with climate conditions on the land surface above and is usually gently curved and follows a subdued version of the land surface topography.

1 PROPERTY DESCRIPTION

EnviroSynergy Specialist Services (Pty) Ltd (henceforth referred to as EnviroSynergy) was appointed by Brenton Cove cc to conduct a hydrogeological investigation as part of a Section 21 water use authorisation for a luxury camping development on Portion 152 of the Farm Uitzigt 216, Brenton on Lake, Western Cape Province. The site is intended to be used as an accommodation facility with a restaurant. The site office is located at the following coordinates: -34.053244° 23.026195° (WGS, 84). (refer to Figure 1-1)

Table 1-1: Property Description

Farm	Portion 152 of the Farm Uitzigt 216 Brenton on Lake
District	Garden Route District Municipality
Local Municipality	Knysna Local Municipality
Nearest Town	Knysna (3.2 km north east)
Province	Western Cape
Catchment	K50B

Brenton-on-Sea is not a local municipality itself. It is a settlement and seaside resort town within the Knysna Local Municipality in the Garden Route District of the Western Cape, South Africa. The Knysna Municipality is a Category B municipality, meaning it is responsible for local services and functions within its defined area, while the Garden Route District Municipality oversees broader regional matters

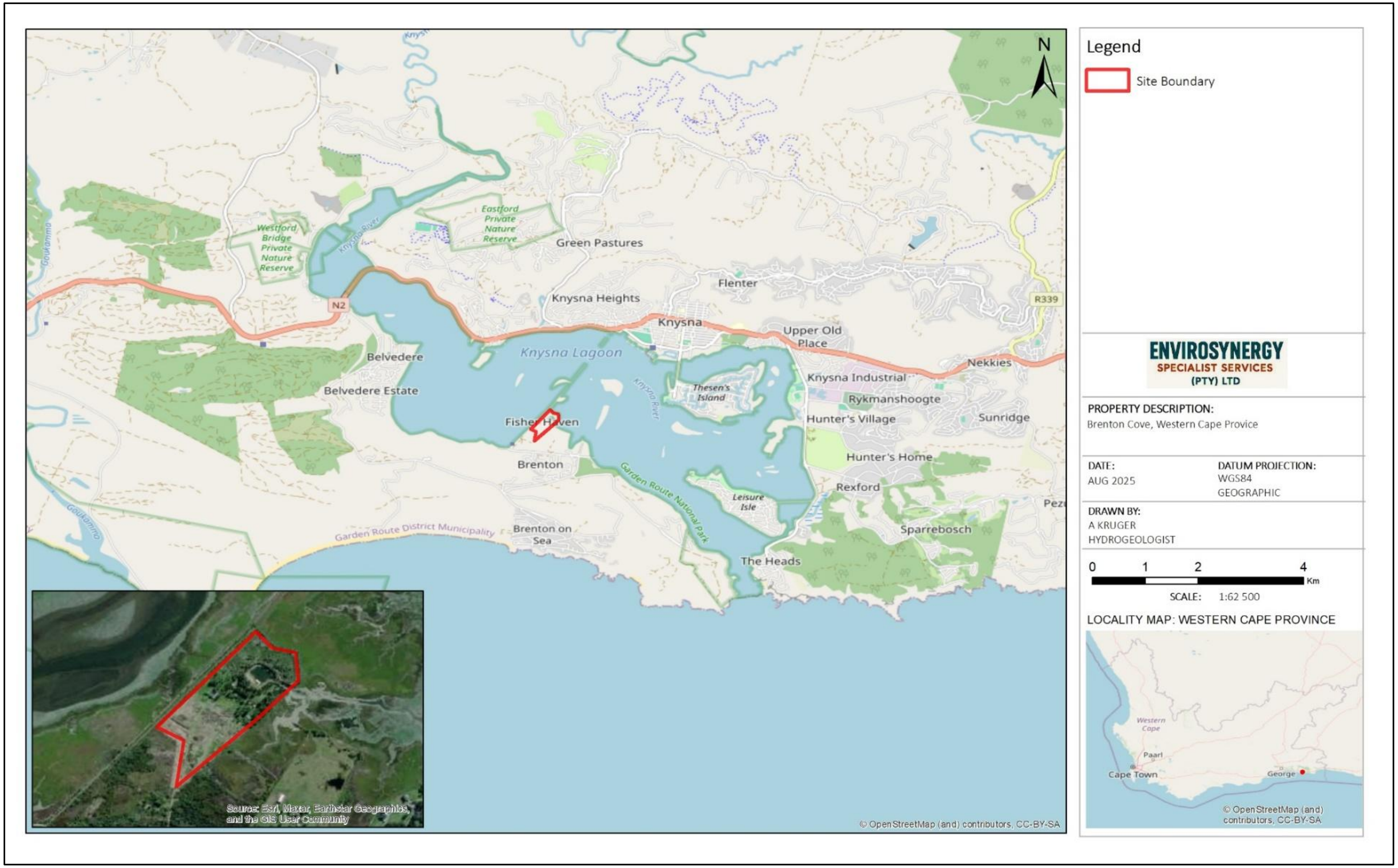

Figure 1-1: Locality Map

2 INTRODUCTION

EnviroSynergy Specialist Services (ESS) was appointed by Brenton Cove CC to conduct a hydrogeological investigation as part of a Section 21 water use authorisation in accordance with the Water Act of 1998.

2.1 OVERVIEW OF PROJECT

Brenton Cove (hereafter referred to as “the site”) is in the process of obtaining authorisation to build luxury tented houses on their property, Portion 152 of the Farm Uitzigt 216. Water will be sourced from the on-site borehole for domestic and garden irrigation purposes. The water will be stored in a large water tank on site and passed through a filtration system before being supplied to the site.

3 GEOGRAPHICAL SETTING

3.1 CLIMATE

The mean annual precipitation of quaternary catchment K50B is 600 millimetre per annum (mm/a). The area receives most of its rain during the summer (August to November). The mean daily maximum temperature for January is 23°C and 17°C in July. The mean daily maximum temperature for January is 17°C and 10°C in July. The average temperatures and rainfall for Knysna is presented in Figure 3-1 (Meteroblue, 2025).

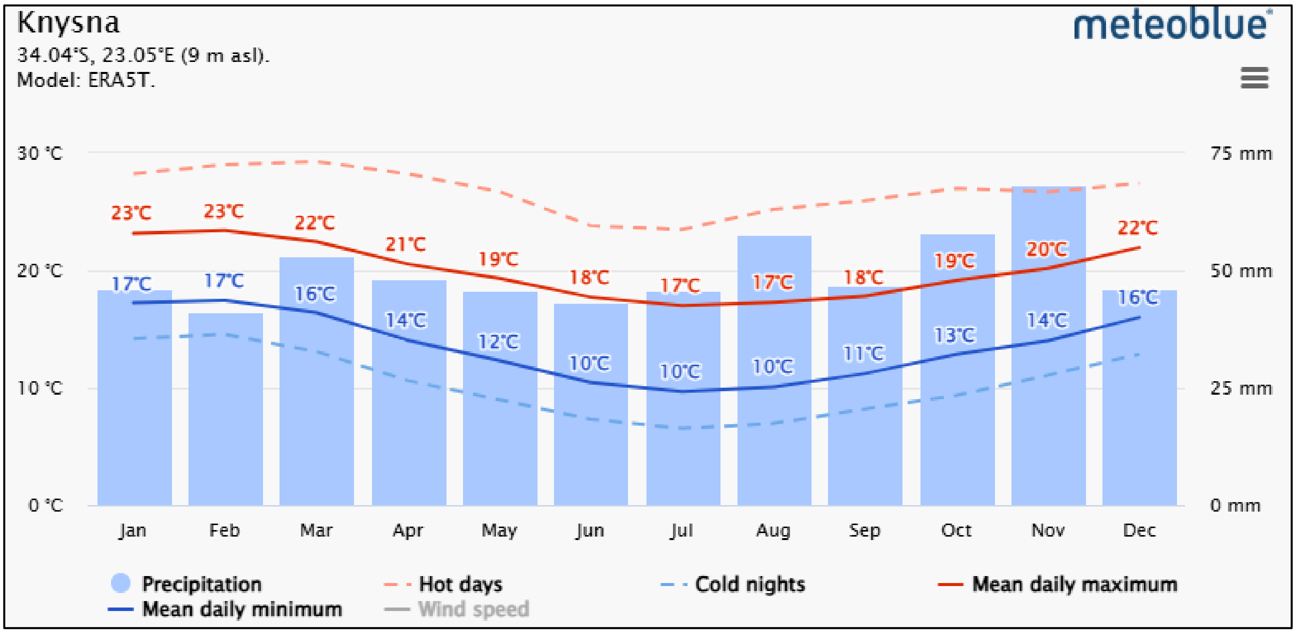

Figure 3-1: Average temperatures and precipitation (*Source: Meteoblue 2025*)

3.2 TOPOGRAPHY AND DRAINAGE

The topography of the study area is relatively flat with elevation ranging between 2.075 and 6.457 meters above mean sea level (mamsl) and slopes in a northerly direction towards the perennial Knysna River, flowing in a south easterly direction into the Indian Ocean. The regional topography forms a topographical high south of the site and surface drainage is presented in Figure 3-2.

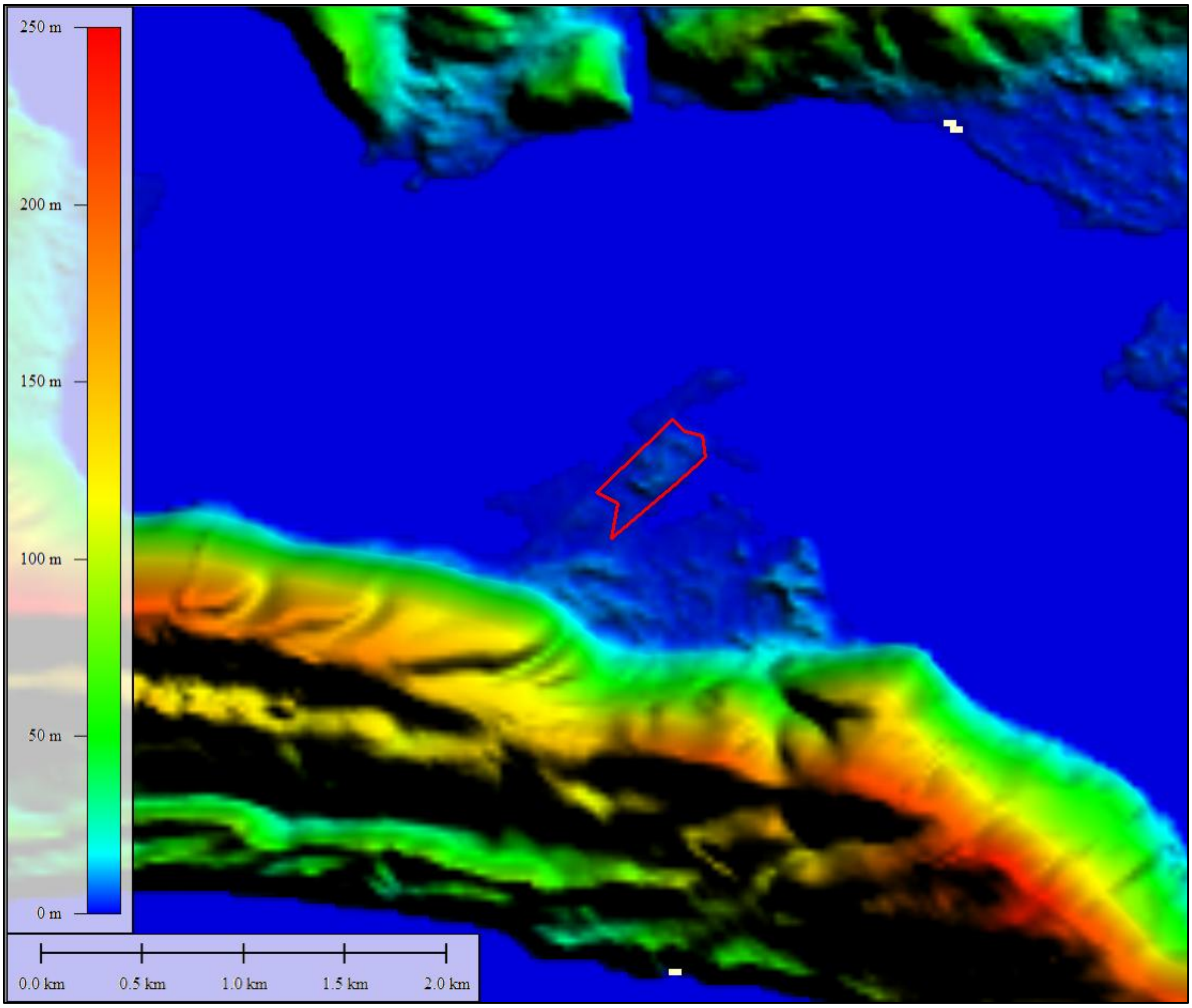

Figure 3-2: Topography of the Study Area

4 SCOPE OF WORK

The Following components are proposed as the scope of work for the Hydrogeological report:

- Detailed desktop study;
- Hydrocensus/neighbouring land survey within a 1km radius of the sub-catchment containing the site, within accessible areas;
- Aquifer test data evaluation;
- Groundwater quality analysis;
- Groundwater reserve determination;
- Monitoring program compilation;
- Compilation of a detailed hydrogeological report.

5 METHODOLOGY

5.1 DESKTOP STUDY

EnviroSynergy assessed all available geological and hydrogeological data prior to the commencement of any fieldwork. All existing groundwater data was reviewed and assessed during the desktop study. The following data sources were used during the study:

- Topographic 1:50 000 maps.
- Geological 1:250 000 map.
- Hydrogeological 1:500 000 map.
- Groundwater Resource Directed Measures (GRDM, 2013) obtained from the Department of Water and Sanitation (DWS).
- Existing hydrogeological reports for the site or in the area.

5.2 HYDROCENSUS

A hydrocensus was conducted within a 1km radius and within the sub-catchment containing the site. The following information was recorded during the hydrocensus:

- GPS co-ordinates and elevation of existing boreholes or springs.
- Water levels of the boreholes, where accessible.
- Estimated abstraction volumes, where provided.
- Any other information regarding the water reliability or quality.
- Identifying surface water bodies and usage.
- Determine groundwater usage and identify groundwater users.

5.3 AQUIFER TEST – DATA ANALYSIS

One (1) borehole was pumped for 24 hours at a constant rate by Magnum pumps on the 28 July 2024. The data was provided by the Client for including in this report. This data was used to determine the aquifer characteristics, such as transmissivity and storage.

5.4 SAMPLING AND CHEMICAL ANALYSIS

A groundwater sample was collected by the client during July 2024, and laboratory certificate provided for inclusion in this report.

5.5 GROUNDWATER RESERVE DETERMINATION

A groundwater balance was prepared for the sub-catchment. This determined how much groundwater is available for abstraction.

5.6 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are made:

- Aquifer test data was conducted by Magnum pumps and supplied to EnviroSynergy by the client. It is assumed that aquifer testing was conducted in accordance with the SANS 10299 standards;
- The groundwater analyses were supplied to EnviroSynergy by the client. The analyses and methods of sampling are assumed to be according to SABS guidelines;
- It is assumed that the information provided by the owner and neighbouring land owners are true and accurate.

6 PREVAILING GROUNDWATER CONDITIONS

6.1 GEOLOGY

According to the 1:250 000 geological map series 3322 Oudtshoorn (Council for Geoscience, 1979), the study area is underlain by intermediate and low level terrace gravel with alluvium deposited along the Knysna Lagoon (refer to Figure 6-1).

Underlying the quaternary age deposits are a thin layer of conglomerate, sandstone, siltstone and clay (Ke) of Enon and similar younger deposits. The Uitenhage Group sediments, coarse Enon deposits are underlain by brownish-weathered sandstone (fine to coarse grained) and shale of the Tchando Formation (St) (Table Mountain Group, Cape Supergroup). This formation dips in a southerly direction at a 35-degree angle with an east to west strike.

6.2 HYDROGEOLOGY

According to the 1:500 000 Hydrogeological map series 3321 Oudtshoorn (Meyer and Rush, 1999) the study area is underlain by two aquifers:

- The estuarine alluvium form shallow, unconfined alluvial aquifers with high hydraulic conductivity which recharge easily from surface streams and rainfall runoff
- At depth, groundwater moves through the fractured Table Mountain Group sandstones, where fractures, joints and faults act as conduits.
    - Mean borehole yields range between 0.5 and 2 Liter per second (L/s).

Along the coastline, the Peninsula Formation quartzites of the Table Mountain Group form the Knysna Heads and nearby terraces. These are folded, fractured and jointed, serving both as bedrock and pathways for groundwater movement.

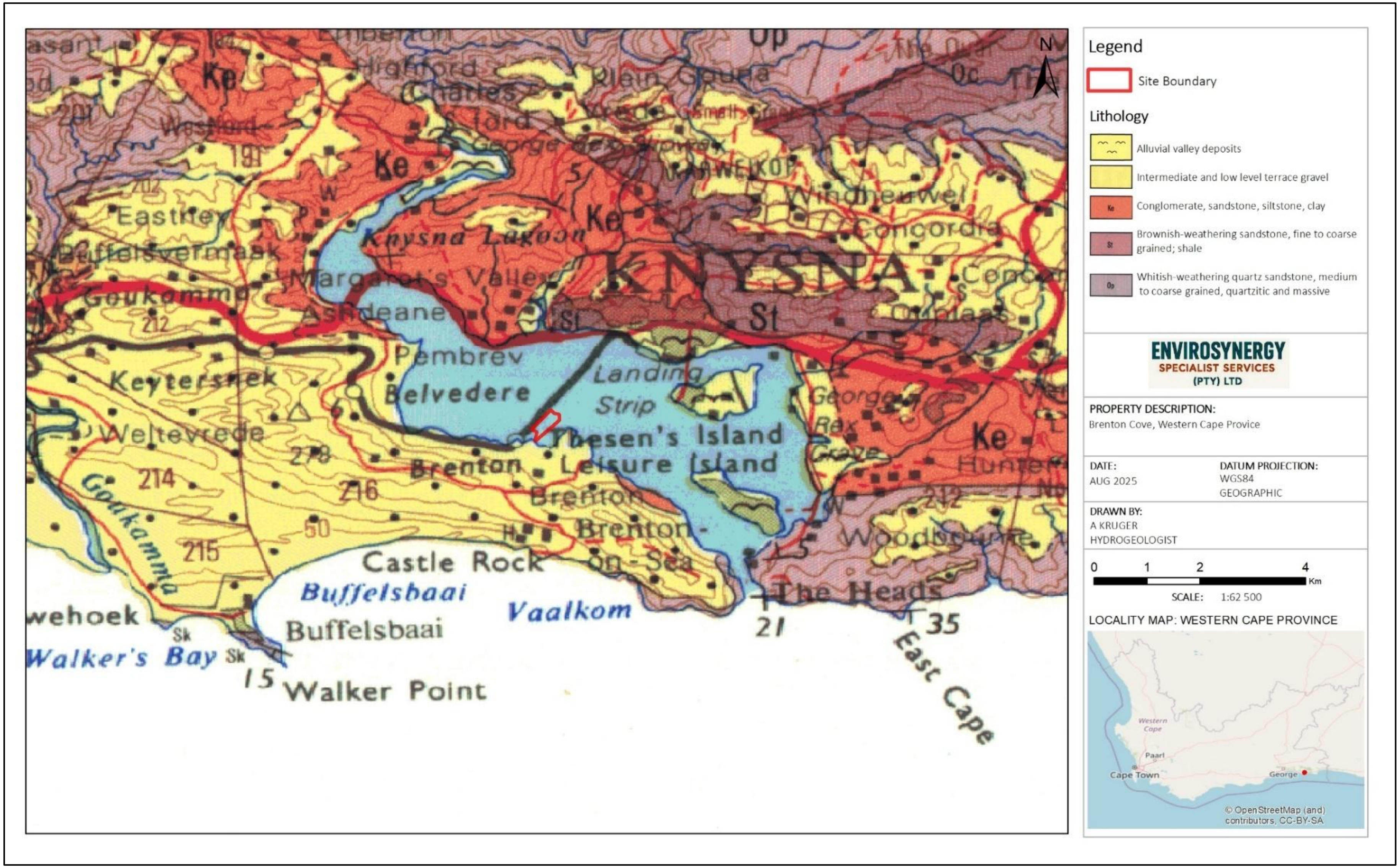

Figure 6-1: Geological Map of the study area (3322 Oudtshoorn, Council for Geoscience: 1979)

6.2.1 GEOPHYSICAL INVESTIGATION

A geophysical investigation was conducted by Rock Hounds (Pty) Ltd on the 11th of November 2023 to investigate the nature, position and source of possible groundwater drilling positions on the property, Brenton on Lake, as required for household purposes. Three survey positions were identified with expected yields to range between 800 and 7 200 liter per hour (L/hr.), (Rock Hounds, 2023). Possible drilling locations are presented in Figure 6-2 and geophysical profiles in Figure 6-3.

Figure 6-2: Possible Drilling locations (Rock Hounds, 2023)

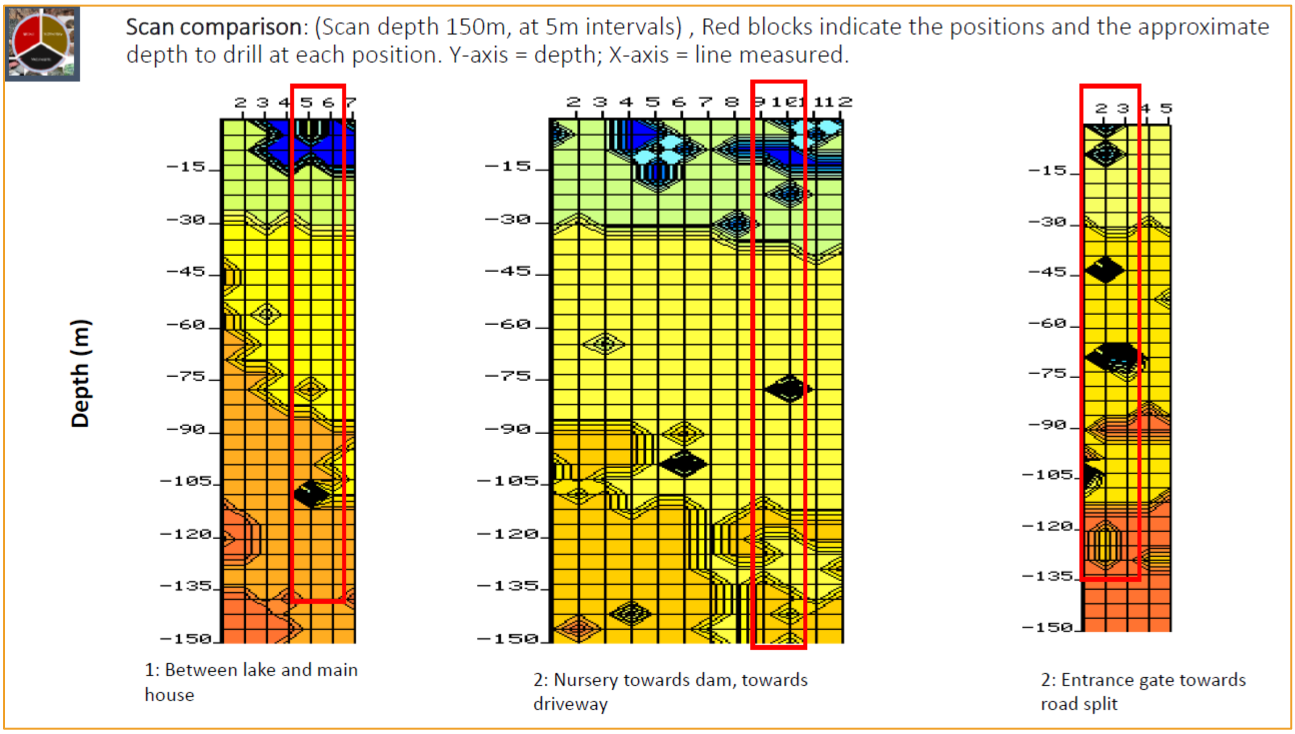

Figure 6-3: Geophysical profiles (Rock Hounds, 2023)

6.2.2 SALTWATER INTRUSION

Saltwater intrusion occurs when saline water migrates into coastal freshwater aquifers. This process degrades water quality of the aquifer system, potentially rendering the water unsuitable for drinking or irrigation.

Saltwater intrusion may occur due to environmental pressures which includes climate change and freshwater flow reduction, which can exacerbate saltwater intrusion. Brenton on sea relies on groundwater for its water supply, making the potential for saltwater intrusion a serious threat to the quality and availability of potable water. Excessive groundwater extraction may lower the water table, creating a gradient that draws in saltwater from the sea, as depicted in Figure 6-4.

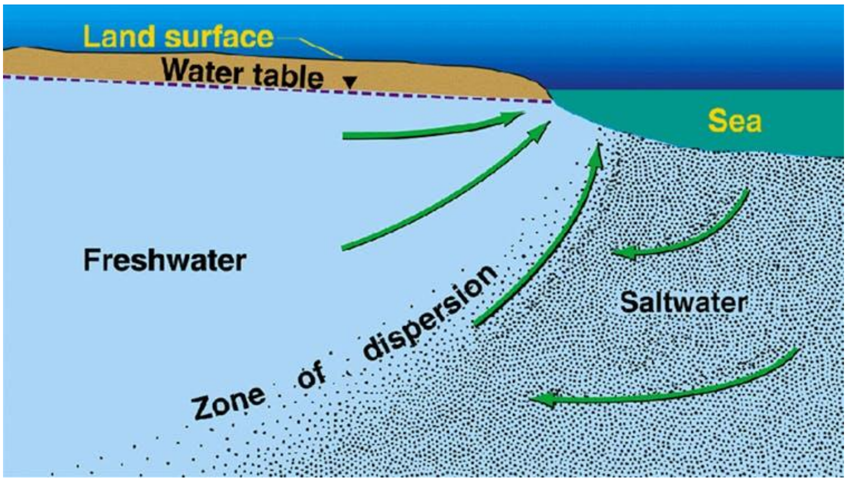

Figure 6-4: Saltwater intrusion schematic

Ghyben and Herzberg (1905) found that the freshwater/seawater interface is governed by the density difference between fresh and seawater, plus the hydraulic gradient of the fresh water to the sea.

The site is located near the Knysna River which flows out into the estuary. The freshwater system may act as buffer against saltwater intrusion. When freshwater recharges inland, it pushes the groundwater seaward, reducing the inland movement of denser saltwater, following the Ghyben–Herzberg–Submarine groundwater discharge system. A perennial river that has a sustained freshwater flow may raise the groundwater level and reduce intrusion. The buffer is however likely to fail when:

- Fresh water flow significantly drops during low rainfall events (droughts); and
- Large volume groundwater extraction.

6.3 GROUNDWATER VULNERABILITY AND AQUIFER CLASSIFICATION

According to Parsons (1995), aquifer classification is based on the aquifer characteristics and the non-technical and water-supply considerations. The classifications and definitions for each aquifer system are summarised in Table 6-1 below.

Table 6-1: Definitions of Aquifer System Management Classes (After Parsons (1995)

Sole source aquifer	An aquifer which is used to supply 50% or more of domestic water for a given area, and for which there are no reasonable available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial
Major aquifer system	Highly permeable formations, usually with a known probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (less than 150 mS/m)
Minor aquifer system	These can be fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability. Although these aquifers seldom produce large quantities of water, they are important both for local supplies and supplying base flow to rivers
Non aquifer system	These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer as unusable. However, groundwater flow through such rocks, although imperceptible, does take place, and needs to be considered when assessing the risk associated with persistent pollutants
Special aquifer system	An aquifer designated as such by the Minister of Water Affairs, after due process

The aquifer system and the aquifer vulnerability are assigned a value as defined in Table 6-2 below. Through multiplying the aquifer system value by the vulnerability value, the Groundwater Quality Management (GQM) index is determined. Based on this value, the level of protective action that must be upheld is recommended.

Table 6-2: Aquifer classification and vulnerability assessment

Aquifer system		Aquifer vulnerability	
Management qualification		**Classification**	
Class	**Points**	**Class**	**Points**
Sole Source Aquifer System	6	High	**3**
Major Aquifer System	**4**	Medium	2
Minor Aquifer System	2	Low	1
Non-Aquifer System	0		
Special Aquifer System	0-6		
GQM INDEX		**Level of protection**	
<1		Limited Protection	
1 to 3		Low Level Protection	
3 to 6		Medium Level Protection	
6 to 10		High Level Protection	
>10		Strictly non-degradation	

The main aquifers were classified in terms of the Aquifer system Management Classes, as detailed in Table 6-3.

Table 6-3: Aquifer Classification Summary

Aquifer of aquitard	Type	Classification (after Parsons, 1995)	Aquifer Vulnerability
Shallow permeable covering material	Porous/weathered	Minor aquifer	Medium
Peninsula Sandstone aquifer	Intergranular and fractured	Major aquifer	High

7 GROUNDWATER INVESTIGATION

7.1 BOREHOLE DETAILS

One (1) borehole (BC-BH1) was identified on site during field investigation conducted between 17 and 18 June 2025. Borehole BC-BH1 was used for domestic use and garden irrigation (refer to Table 7-1).

Four (4) hydrocensus boreholes owned and managed by the municipality were identified during the site visit. These boreholes supply domestic water to Brenton on Sea and are stored in two cement reservoirs. The borehole locations are presented in Figure 7-1.

Two hydrocensus boreholes, or spikes (HBH6 and HBH7) were identified during the survey. These spikes/well-points are essentially shallow piezometers from which groundwater is abstracted. The Riser pipe is connected to a centrifugal pump located on the surface. The water is usually used for localised supply to irrigate gardens or in some cases domestic use (depending on the quality).

Table 7-1: Borehole Co-ordinates and Owner Details

BH ID	Co-ordinates (WGS, 1984)		Owner	Address	Comments
	Longitude	Latitude			
BC-BH1*	-34.055854	23.023791	Rudi Neethling	152/21	Active borehole used for domestic water and garden irrigation of the main house
HBH1	-34.062200°	23.030530°	Municipality	118/216	Active borehole, used for water supply to Brenton on Sea
HBH2	-34.062547°	23.029804°	Municipality	118/216	Active borehole, used for water supply to Brenton on Sea
HBH3	-34.062160°	23.027485°	Municipality	0/216	Active borehole, used for water supply to Brenton on Sea
HBH4	-34.062425°	23.030869°	Municipality	118/216	Filled with rocks
HBH5	-34.057464	23.023385	Lee Naidoo	192/216	Non-active borehole
HBH6	-34.057160°	23.017001°	Mark Dell	163/216	Spike
HBH7	-34.058319°	23.029468°	Lake Brenton	0/216	Spike
HBH8	-34.058212°	23.027363°	N/A	91/216	No Access

The static groundwater level within production borehole BC-BH1 was 10.4 meters below ground level (mbgl). Groundwater from the borehole was used for domestic and garden irrigation purposes at the main house. Groundwater from BC-BH1 is proposed to be utilised for the camping site, restaurant and garden irrigation.

Residential properties within the area made use of municipal water for domestic use. The municipal water is mainly sourced from surface water sources (Knysna River) and groundwater. Three (3) boreholes (HBH1 – HBH3) feeding two concrete reservoirs were located during the site assessment (refer to Table 7-2). No access to the municipal water could be obtained. HBH5 was not equipped.

Table 7-2: Hydrocensus Borehole Details

BH ID	Depth	SWL	Known yield	Pump type	Reservoir	Volume of water abstracted	Water used for	Comments
	[m]	[mbgl]	[L/hr]	[-]	[Kl]	[L/day]	[-]	
BC-BH1	120	10.4	15 000	5kl Submersible	1 x 10Kl Damsak reservoir	~9 000	Domestic and garden irrigation	Borehole to supply water for domestic and garden irrigation purposes
HBH1	50	-	7 000	Submersible	2 x concrete reservoirs	Unknown	Domestic	The borehole supplies the Brenton on sea with water
HBH2	50	37.54	7 000	Submersible		Unknown	Domestic	
HBH3	55	-	12 000	Submersible		Unknown	Domestic	
HBH4	Filled with rocks							
HBH5	100	10.65	5 000	Not equipped	None	Borehole not equipped		
HBH6	8	-	Unknown	Centrifugal	4 x 5Kl	10 000	Domestic and garden irrigation	Spike
HBH7	6	-	Unknown	Centrifugal	1 x 5Kl	5 000	Garden irrigation	Spike
HBH8	-	-	-	-	-	-	No Access	

(m) meter

(mbch) meter below collar height

(mbgl) meter below ground level

(L/s) Litre per second

(Kl) Kilolitre

(L/day) Litre per day

Figure 7-1: Spatial Distribution of Borehole

7.2 RESERVOIRS

The co-ordinates of the water storage tank located on site are included in Table 7-3. RES1 is fed by borehole BC-BH1. Raw water will be stored in the 100kl water tank before being filtrated.

Table 7-3: Reservoir Details

Reservoir ID	Co-ordinates		Size	Fed by
	Latitude	Longitude	[KL]	[-]
RES1	-34.053580°	23.026140°	100	BC-BH1

7.3 AQUIFER TESTING

One (1) borehole was pumped for 24 hours at a constant rate by Magnum pumps on the 28 July 2024. The data was provided by the Client for including in this report. Constant rate aquifer testing was conducted for a period of 24-hours on BC-BH1 (refer to Table 7-4). The results of the aquifer test are illustrated in Figure 7-2.

Table 7-4: Aquifer Test Borehole Details

BH ID	SWL	Borehole depth	Pump Depth	Available drawdown *	Test Duration	Recovery Duration
	[mbgl]	[m]	[mbgl]	[m]	[hrs]	[hrs]
BC-BH1	10.4	120	80	69.6	24	24

*Water strike depth unknown

[mbgl] meter below ground level

[m] meter

[hrs] hours

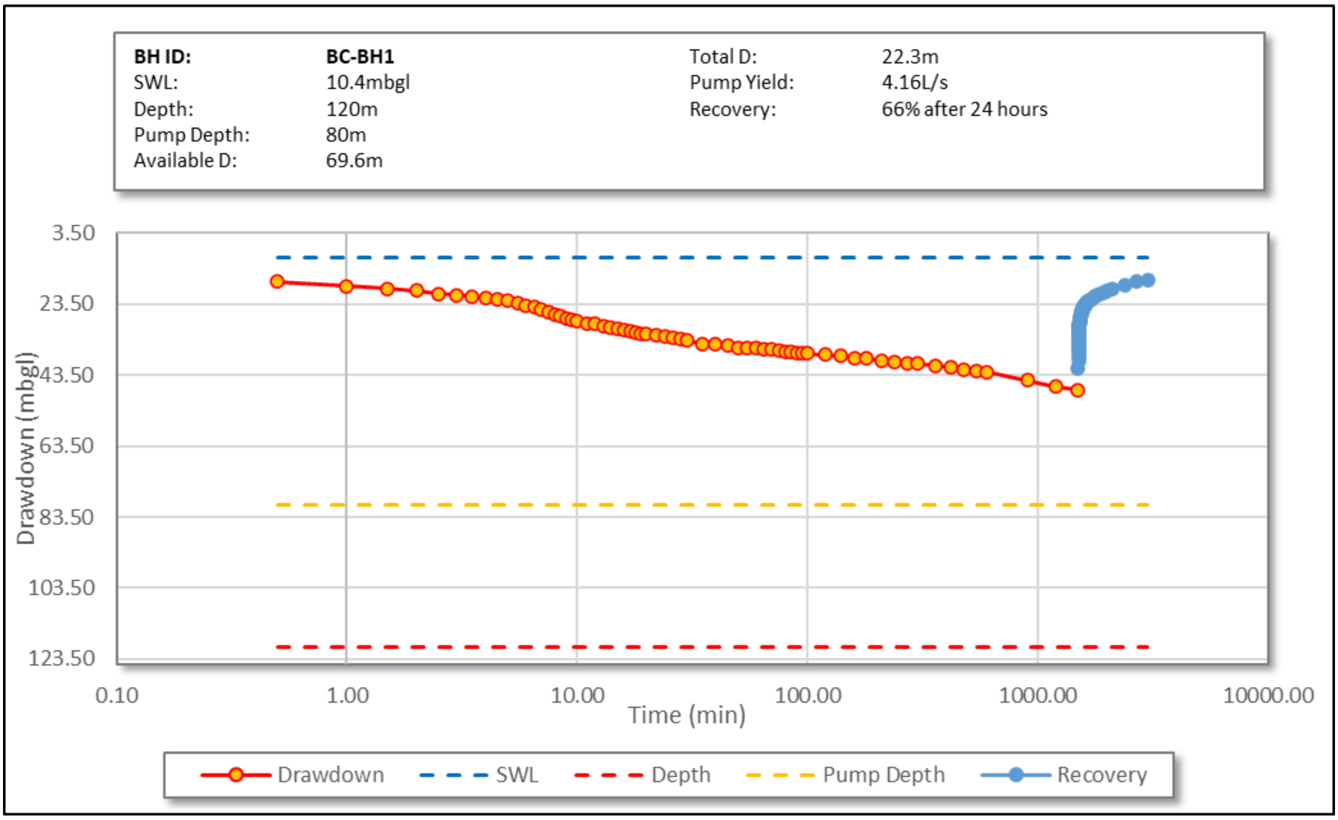

Figure 7-2: Aquifer Test Results – BC-BH1

7.3.1 SUSTAINABLE YIELD

Based on the aquifer testing results, a maximum volume of 56.7 m³/d (20 695.5 m³/a) can be sustainable abstracted from the tested borehole (refer to Table 7-5). A pump schedule of 7-hours per day is recommended at a lowered yield of 2.25 L/s to ensure minimum drawdown and a sufficient recovery period. The average transmissivity value for the borehole was calculated as 7.6 m²/day.

Table 7-5: Constant Rate Aquifer Test Results

BH ID	Pump Yield	Average Transmissivity	Recommended maximum abstraction					
			Yield		Pump schedule	Recovery	Volume	
	[L/s]	[m²/day]	[L/s]	[L/hr]	(hours)	(hours)	[m³/day]	[m³/a]
BC-BH1	4.16	7.6	2.25	8 100	7	17	56.7	20 695.5

[%] percentage
[L/s] Litre per second
[m²/day] square meters per day
[m³/day] cubic meter per day
[m³/a] cubic meter per annum

However, based on the discussion with Department of Water Affairs and water demand calculation, only a volume of **9 m³/day (3 285 m³/a)** will be applied for.

7.4 GROUNDWATER QUALITY

A groundwater sample was collected from BC-BH1 by the client and submitted to an accredited laboratory for inorganic analysis (refer to Table 7-6). The laboratory certificate is attached in Appendix **I**I.

The groundwater is proposed to be used for garden irrigation and domestic purposes and was therefore compared to the SANS 241-1:2015 drinking water quality standards (SABS, 2015).

Table 7-6: Groundwater Laboratory Results

Constituent (mg/l)	SANS 241-1:2015	BC-BH1
pH at 25 °C	> 5 - < 9.7	7.13
Electrical Conductivity (EC)	*170*	121
Turbidity (NTU)	*Operational: <1* *Aesthetic: <5*	0.92
Total dissolved solids (TDS)	*<1200*	773
Alkalinity	-	114
Total Hardness ($CaCO_3$)	-	54
Colour	*<15*	2
Chloride (Cl)	*<300*	298
Sulphate (SO_4)	*Acute Health: <500* *Aesthetic: <250*	22
Fluoride (F)	*<1.5*	0.56
Aluminium (Al)	*<0.3*	0
Calcium (Ca)	*<32**	14.8
Iron (Fe)	*Chronic health: <2* *Aesthetic: <0.3*	0.03
Magnesium (Mg)	*<30**	4.9
Manganese (Mn)	*Chronic health:<0.4* *Aesthetic: <0.1*	0.047
Bacteriological parameters		
E. coli (colonies/100ml)	*ND*	**0**
Total Coliforms (colonies/100ml)	*ND*	**330**

*SAWQG for domestic use
[mS/m] Milli siemens per meter
[mg/l] Milligram per litre
ND Not Detected

The groundwater can be classified as near neutral (pH ±7), moderately saline (Total Dissolved Solids (TDS): 773 mg/l) and moderately soft (54 mg $CaCO_3$/l).

All inorganic constituents analysed were compliant with the SANS standards.

The total coliform concentration of 330 colonies/100ml detected, exceeded the SANS standard. No *Escherichia coli (E. coli)* was detected in the sample. The total coliforms comprise of a large collection of different bacteria that include disease and non-disease-causing organisms. Coliform bacteria can be found in the environment, soil or vegetation. Total coliforms may also be present in the intestines of warm-blooded living species such as humans. The presence of Total Coliforms may indicate that water may be vulnerable to contamination and may therefore indicate the presence of disease-causing pathogens.

8 GROUNDWATER RESERVE DETERMINATION

A preliminary Groundwater Reserve Determination was compiled for sub-catchment containing the site. The Groundwater Reserve Determination considers the following parameters:

- Effective Recharge from Rainfall and specific geological conditions.
- Basic Human needs for the site.
- Groundwater contribution to surface water (baseflow).
- Existing abstraction.
- Surplus Reserve.

8.1 QUATERNARY CATCHMENT

Data from relevant hydrogeological databases including, the Groundwater Resource Directed Measures (GRDM) was obtained from the Department of Human Settlements, Water and Sanitation (DHSWS). The site extends over quaternary catchment: K50B as indicated in Table 8-1.

Table 8-1: Summarised Quaternary Catchment Information (GRDM, 2013)

Quaternary Catchment	Total Area	Recharge	Current use	Rainfall	Baseflow	Population
	[km^2]	[mm/a]	[L/s]	[mm/a]	[mm/a]	[-]
K50B	202.9	238.9	4.5	881.9	12.89	14 745

[km^2] square kilometers
[mm/a] millimeters per annum
[L/s] Liter per second

8.2 WATER MANAGEMENT AREA

Quaternary Catchment K50B is located within Breede - Gouritz Management Area (WMA). The Brenton on Sea sub-area is largely residential land use. Groundwater availability is limited and is an important source of supply in the sub-area for domestic use.

Based on the National Integrated Water Information System (NIWIS) (2025), the reserve within quaternary catchment K50B is not stressed (GRA2), and a surplus is available for groundwater (GWR) abstraction (refer toTable 8-2).

Table 8-2: Quaternary Catchment Reserve (July 2024)

Quaternary Catchment	Available (GRA2)	Recharge (GWR)	Reserve (GWR)	Abstracted (WARMS)	Surplus (GRA2)	Surplus (GWR)
	[m^3/a]	[m^3/a]	[m^3/a]	[m^3/a]	[m^3/a]	[m^3/a]
K50B	4 652 940	14 400 000	1 055 000	2 430 310	2 222 630	10 914 690

[m^3/a] cubic meters per annum

8.3 SUB-CATCHMENT DELINEATION

In order to delineate a sub-catchment for the site within the quaternary catchment ArcGIS is used (which provides a method to describe the physical characteristics of a surface). Using a digital elevation model as input, it is possible to delineate a drainage system and then quantify the characteristics of that system. The tools in the extension let you determine, for any location in a grid, the upslope area contributing to that point and the down slope path water would follow. The delineated sub-catchment size is 8.31km^2.

Figure 8-1: Delineated Sub-catchment

8.4 GROUNDWATER USE

8.4.1 RECHARGE

Literature review

Based on the literature review, the following recharge values were calculated:

GRDM (2013) = 238.9 mm/a

NIWIS2 (2025) = 28.04 mm/a

Chloride Mass Balance (CMB) Method

Environmental tracers such as chloride (Cl) are produced naturally in the earth's atmosphere and are used to estimate recharge rates. Input of chloride occurs in the soil both in rainfall and as dry fallout.

Most plant species do not take up significant quantities of the chloride from soil water, thus chloride is concentrated by evapotranspiration in the root zone. In the simplest case of groundwater flow in the unsaturated zone, the chloride concentration in soil water should increase through the root zone to a constant value. Under steady state conditions, the flux of chloride at the surface is equal to the flux of chloride beneath the root zone, thus:

$$R = \frac{PC_p}{C_s}$$

R is the mean annual recharge (mm).

P is the mean annual precipitation; and

$\mathbf{C_p}$ and $\mathbf{C_s}$ is the chloride concentrations in precipitation and groundwater respectively.

The mean annual precipitation (MAP) is 881.9 mm/a with the chloride concentration in the rainwater estimated at 6 mg/l (based on the distance from coast and regional data available). The average chloride concentration in the groundwater is 298 mg/l. The local recharge is calculated as 17.76 mm/a**.**

Based on the literature review and CMB method – and to allow for prolonged drought periods – a conservative average recharge of **17.76 mm/a** was proposed for the calculations.

Registered Abstraction

A WARMS database search was compiled for registered groundwater users within the area in order to identify additional boreholes. No WARMS boreholes were located within the area.

Groundwater users

According to the media release statement by the Knysna Municipality in 2016, all boreholes, spikes within the Greater Knysna must be registered with the Breede Gouritz Catchment Management Agency (BGCMA). According to the statement 316 well-points were registered. These well-points can yield between 500 and 1500 l/h (Johnstone, 2009). An average garden size of 100m^2 was used for the calculation. The average garden is irrigated for 30 weeks a year with 25mm/ week.

The total abstraction of groundwater by means of "spikes" equates to 15.93 m^3/day.

On-site Abstraction

Based on the discussion with Department of Water Affairs and water demand calculation, a volume of 9 m^3/day will be applied for.

8.5 GROUNDWATER BALANCE

A preliminary groundwater balance was calculated for the sub-catchment, as presented in Table 8-3.

Table 8-3: Water Balance Calculation

Sub-catchment	Reserve Determination
Size	8.31 km^2 (8 310 000m^2)
Groundwater Recharge	17.76 mm/a (0.01776m/a) = 0.01776 x 8 310 000 m^2 = 147 585.6 m^3/a = 404.34m^3/day
Basic Human Need (25L water per person per day)	72.2 people per km^2 = 72.2 x 8.31 km^2 = 599.982 people x 0.025m^3/day = 15 m^3/day
Groundwater contribution to baseflow	12.89mm/a = 293.47 m^3/day
Existing abstraction	Hydrocensus Boreholes/spikes: 61.2 m^3/day Spikes: 15.93 m^3/day
Proposed Abstraction	BC-BH1: 9 m^3/day (3 285 m^3/a)
Total use	379.07 m^3/day
Surplus amount	25.27 m^3/day
Scale of abstraction	94% of recharge (Class B Medium scale abstraction >60% & <100% of recharge)

From the sub-catchment preliminary water balance calculation, medium scale abstraction (category B) is proposed.

8.6 WATER QUANTITY

The recent status of a groundwater resource unit can be assessed in terms of sustainable use, observed ecological impacts or water stress. Since no information about ecological impacts of groundwater abstraction is available, the concept of water stress was applied for the classification process.

The concept of stressed water resources is addressed by the National Water Act but is not defined. Part 8 of the Act gives some guidance by providing the following qualitative examples of 'water stress':

- Where demands for water are approaching or exceed the available supply.
- Where water quality problems are imminent or already exist; or
- Where water resource quality is under threat.

To provide a quantitative means of defining stress, a groundwater stress index was developed by dividing the volume of groundwater abstracted from a groundwater unit by the estimated recharge to that unit (Parsons and Wentzel, 2007).

Stress Index = Groundwater Abstraction / (Recharge – Baseflow)

= 85.6 m^3/day / (404.34 – 293.47) m^3/day

= 0.77

The stress-index and classes described in Table 8-4 is a guide for determining the level of stress of a groundwater resource unit, based on abstraction, baseflow and recharge (modified after Parsons and Wentzel, 2007).

Table 8-4: Guide for determining the level of stress of a groundwater resource unit.

Present Status Category	Description	Stress Index
A	Unstressed or low level of stress	<0.05
B		0.05-0.2
C	Moderate levels of stress	0.2 – 0.5
D		0.5 – 0.75
E	Stressed	**0.75 – 0.95**
F	Critically stressed	>0.95

Due to the current and proposed abstraction, the groundwater resource unit is classified as stressed, monitoring is therefore necessary to ensure that no detrimental impact on the underlying resource occurs.

9 RISK ASSESSMENT

9.1 GROUNDWATER IMPACT ASSESSMENT

The impact assessment methodology assists in evaluating the overall effect of the proposed operations on the underlying aquifer. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

9.2 DETERMINATION OF SIGNIFICANCE OF IMPACT

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e., site, local, national, or global), whereas intensity is defined by the severity of the impact e.g., the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 9-1.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

9.3 IMPACT RATING SYSTEM

The impact assessment must take account of the nature, scale, and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Where necessary, the proposal for mitigation or optimisation of an impact should be detailed.

A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

9.4 RATING SYSTEM USED TO CLASSIFY IMPACTS

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue, the criteria (including an allocated point system) as presented in Table 9-1, was used.

Table 9-1: Rating of impact criteria

ENVIRONMENTAL PARAMETER
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g., Surface Water).
ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g., oil spill in surface water).
EXTENT (E)

This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible, and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost because of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact because of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e., whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		

1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component, and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible, rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.** The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact Significance Rating	Description
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

9.5 KEY CHARACTERISTICS OF THE RISK ASSESSMENT

The key aquifer characteristics that were considered in the risk assessment included the following:

- The Table Mountain Group aquifer is very vulnerable to contamination due to the fact that no buffer exists due to its highly permeable recharge zones. Its slow recharge, fractured structure and interconnection amplify the risks.
- Following the hydrocensus, it was determined that groundwater users were located surrounding the study area;

- Susceptibility to saltwater intrusion. Coastal drawdown may trigger seawater intrusion—salinizing aquifer and reducing abstraction quality and availability;
- Ecological stress may exist due to over abstraction. Lowering of the regional water table may impact wetland fauna and flora dependant on subsurface flow;
- Non-compliant total coliforms were detected in BC-BH1;
- Based on the groundwater reserve calculations it was determined that the proposed groundwater abstraction is medium, and the aquifer is stressed.

The potential groundwater impacts from the site, direct and indirect, is summarised in Table 9-2. In summary these potential impacts contribute to overall groundwater impacts and include:

- Potential alteration in groundwater quality; and
- Aquifer destruction / over abstractions of groundwater.

Table 9-2: Summary of potential groundwater impacts

Major Aspect	Key Environmental Issues/ Potential Issues
Aquifer destruction /over abstractions of groundwater	The sustainable use of groundwater is important to avoid water being pumped from the aquifer faster than it is being replenished. It is therefore crucial to adhere to the sustainable safe yield and abstraction programs to ensure the aquifer is not overstressed.
Aquifer destruction /over abstractions of groundwater	Excessive abstraction of groundwater may cause the intrusion of saline water into the freshwater aquifer.
Contamination of aquifer	Sewage discharge and faulty infrastructure may cause sewage spills

9.6 CUMULATIVE IMPACTS

Based on the overall impact assessment conducted in this report, the majority of consequences can be avoided through proper management of water resources.

The potential impact of abstraction emphasizes the need to manage water abstraction and implement on-site practices to prevent detrimental impact on the surrounding sensitive receptors (surrounding groundwater users).

9.7 OVERALL IMPACT RATING

Table 9-3 sets out the detailed potential groundwater impacts.

Table 9-3: Rating of impacts and mitigations – Operational Phase

Potential Environmental Impact	Environmental Impact Before Mitigation			Recommended Mitigation Measures	Environmental Impact After Mitigation		
	Total	Status (+ Or -)	S		Total	Status (+ Or -)	S
Aquifer destruction /over abstractions of groundwater	**25**	-	**M**	It is expected that without mitigation a medium risk can be expected. Mitigation will include: • Developing a sustainable abstracting programme from the aquifer testing results and calculated sustainable yield. • Groundwater level monitoring should be conducted • Comparison between the static and dynamic levels should be done over time in order to ensure the sustainability of the groundwater unit. The water level data should be interpreted by a Hydrogeologist on an annual basis. • All boreholes intended to be used for water supply will be licenced. The significance of the impact after mitigation is likely to decrease.	**12**	-	**L**
Saltwater intrusion	**43**	-	**H**	It is expected that without mitigation a high risk can be expected. Mitigation will include: • Installation of monitoring boreholes; • Installation of telemetric water level sensors; • Installation of EC and chloride sensors • Strict adherence to pumping schedules; • Monthly water sampling.	**22**	-	**L**
Aquifer contamination from wastewater containment systems	**25**		**M**	It is expected that without mitigation a medium risk can be expected. Mitigation will include: • Only use closed system effluent containment (e.g. septic tanks); • Tanks should never exceed 70 – 80%; • Inspect tanks every 1 – 2 years; • Compile and adhere to maintenance schedule.	**13**	-	**L**

10 GROUNDWATER MONITORING SYSTEM

It is recommended that the groundwater levels of the production borehole be monitored using automated monitoring equipment (e.g., data-loggers) to allow for the frequent monitoring of groundwater levels. Comparison between the static and dynamic levels should be done over time in order to ensure the sustainability of the groundwater unit. The water level data should be interpreted by a Hydrogeologist on an annual basis.

Furthermore, it is recommended that groundwater quality monitoring also be conducted on borehole, BC-BH1. The groundwater sample that is collected on site must be submitted to a SANAS accredited laboratory where analyses are carried out in accordance with the methods prescribed by the South African Bureau of Standards.

The sample should be analysed as per Table 10-1. The frequency of laboratory analysis should be bi-annually, while field parameters (pH, TDS and EC) should be conducted monthly to act as early detection of potential saltwater intrusion.

Table 10-1:Monitoring Programme

Monitoring point	Frequency	Analysis
Proposed production borehole	Bi-annually	SANS 241-1:2015 drinking water quality parameters
	Monthly	pH, Electrical Conductivity and Total dissolved solids by means of field probe.

11 CONCLUSION AND RECOMMENDATIONS

Based on the findings of this investigation, the following conclusions are made:

- One (1) borehole (BC-BH1) is proposed to be used as production borehole:
    - Based on the aquifer testing results, a maximum volume of 56.7 m^3/d (20 695.5 m^3/a) is available from the borehole;
    - According to the water balance, medium scale abstraction is taking place (>60% but less than <100% of recharge) and the aquifer is stressed;
    - Based on the discussion with Department of Water Affairs and water demand calculation, only a volume of 9 m^3/day will be applied for.
- A groundwater sample was collected from BC-BH1 by the client and submitted to an accredited laboratory for inorganic analysis:
    - The groundwater can be classified as near neutral (pH ±7), moderately saline (TDS: 773 mg/l) and moderately soft (54mg $CaCO_3$/l);
    - The total coliforms detected in BC-BH1 exceeded the SANS standard;
        - The presence of Total Coliforms may indicate that water may be vulnerable to contamination and may therefore indicate the presence of disease-causing pathogens.
- A hydrocensus was conducted between 17 and 18 June 2025:
    - Three (3) municipal hydrocensus boreholes (HBH1 – HBH3) and one destroyed borehole (HBH4) were identified;
        - Boreholes, HBH1 – HBH3 were used for water supply to the town Brenton on Sea.
    - Borehole HBH5 was located adjacent to BC-BH1 but was not equipped;
    - HBH6 and HBH7 were well-points (spikes) and HBH8 could not be accessed;
    - Water is mainly supplied by the Knysna Municipality within the area;
    - Groundwater levels ranging between 10.65 and 37.54 mbgl were measured in HBH2 and HBH5.

The potential groundwater impacts from the site, include:

- Potential alteration in groundwater quality; and
- Aquifer destruction / over abstractions of groundwater.

Recommendations

The following recommendations were made:

- Based on total coliform detected in BC-BH1, treatment is recommended. Options are available and should be discussed with a water purification service provider. However, it is recommended that resampling should be done to confirm the elevated levels seeing that development of the borehole will decrease the total coliform levels;

- Strict adherence to the recommended abstraction rates and pumping schedules should be maintained in order to ensure that over exploitation of the borehole does not exist.
- Groundwater level monitoring should be conducted as well as groundwater chemical analyses.
  - Data should be interpreted by a hydrogeologist in order to establish trends in the groundwater levels and chemical data.
  - Groundwater sampling is essential in monitoring the water quality (especially salinity) over time to ensure that saltwater intrusion does not occur.
- Daily groundwater abstraction volumes should be recorded;
- All boreholes intended to be used for water supply should get the necessary licencing;
- Installation of monitoring borehole downgradient of the production borehole to assess groundwater level fluctuations and potential salinity changes.
- Mitigation measures, as per Table 9-3 should be implemented.

12 REFERENCE

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13 APPENDIXES

Appendix 1: Photographic Log

	
Photo nr. 1	**Photo nr. 2**
Description: View of the location of BC-BH1	**Description:** View of the borehole HBH1
	
Photo nr. 3	**Photo nr. 4**
Description: View of the borehole HBH2	**Description:** View of the borehole HBH3

	
Photo nr. 5	**Photo nr. 6**
Description: View of the borehole HBH4	**Description:** View of the borehole HBH5
	
Photo nr. 7	**Photo nr. 8**
Description: View of hydrocensus borehole HBH6	**Description:** View of hydrocensus borehole HBH7

Photo nr. 9

Description: View of hydrocensus borehole HBH8. The property was not accessible

Appendix 2: Laboratory Certificates

WESTERN CAPE LABORATORY SERVICES
WESKAAP LABORATORIUM DIENSTE

RUBY CRESCENT 9
TAMSUI INDUSTRIA
GEORGE
CELL: 0828217569
errol.weslab@gmail.com

Certificate of Analysis

Client	Rudi Neethling
Reference	Brenton Cove
Date of Certificate	15-Jul-24
Sample Type	Drinking water

Parameters	Test Methods	Sample 1		SANS 241 Drinking Water Standard
pH	HANNA HI8424	7.13		5.0 - 9.5
Electrical Conductivity (mS/m)	WTW LF330	121		<150
Turbidity (NTU)	HACH 2100P	0.92		< 1.0
Colour	HACH Method 8225	2		< 20
Iron (mg/L as Fe)	HACH Method 8008	0.03		0.20
Aluminium (mg/L as Al)	HACH Method 8012	0.000		0.30
Total Hardness (mg/L as CaCO3	HACH Method 8226	54		<500
Calsium (mg/L as CaCO3)	HACH Method 8222	37		<150
Calsium as Ca	Calculated	14.8		< 150
Magnesium (mg/L as MgCO3)	HACH Method 8222	17		<70
Magnesium as Mg	Calculated	4.9		< 70
Total Dissolved Solids (mg/l)	Calculated	773		< 1200
Alkalinity (mg/ L)	Titrations	114		<500
Sulphate Mg/L)	Sulfaver 4 Method 8051	22		< 400
Manganese (Mn) (mg/ L)	HACH Method 8149 PAN Method	0.047		0.100
Chloride (mg/l)	Method 8225, Silver Nitrate Method, Buret Titration	298		< 300
Fluoride (mg/ L)	Hach Method SPADNS Method	0.56		< 1.0
Total Coliforms (Count/100ml)	Membrane filtration	330		0
E.Coli Count/100ml)	Membrane filtration	Nill		0

The values in red prevented the water to comply with the SANS 241 Drinking Water Standards.

Instrument calibration are done daily with appropriate standards
Laboratory Chemical Analysis Code: Western Cape Laboratory Services SABS Lab Code: B211
Instrument Calibration: Group 1 – 3 / Heavy Metals/Nutrients/Major Constituents

This report relates only to the samples analysed by the consultancy. It does not accept responsibility for any matter arising from further use of these results, other than that recommended in the report.

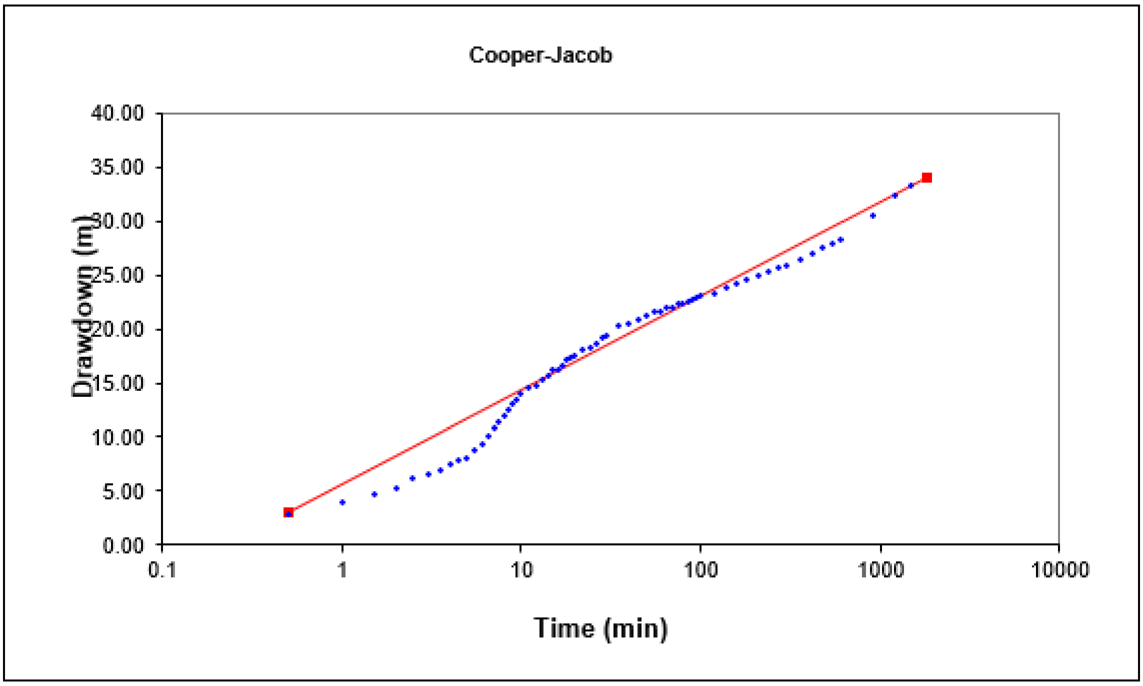
Appendix 3: Aquifer Test Data

Cooper-Jacob method	Main	Theis	Cooper-Jacob 2

BC-BH1

$T(m^2/d)$ =	7.6	r_e (m)=	0.98	0.98
S =	2.78E-03	Q (l/s) =	4.16	

	No boundaries	1 no-flow	2 no-flow	Closed	
Q_sust	4.33	2.17	1.43	1.08	including influence of bh's
Avg. Q_sust =		2.25	std. dev =	1.46	



Borehole Test Record Sheet					
BH NO	BC-BH1			Date	
Depth (m)	120		m	BH Diameter (Inside Casing_mm)	165
Water Level (mbgl)	10.4		mbgl	Casing Height (mbgl)	0
Depth of pump (m)	120		m	Pump Diameter (mm)	6"
Constant Rate Test and Recovery				Recovery	
Time	Water Level	Displacement	Yield	Time	Recovery
(min)	(mach)		(l/s)	(min)	(mach)
0.50	17.20	6.80	4.16	0.50	41.80
1.00	18.40	8.00		1.00	39.45
1.50	19.10	8.70		1.50	38.30
2.00	19.70	9.30		2.00	37.80
2.50	20.60	10.20		2.50	36.95
3.00	20.90	10.50		3.00	36.35
3.50	21.40	11.00		3.50	35.70
4.00	21.80	11.40		4.00	35.15
4.50	22.30	11.90		4.50	34.70
5.00	22.40	12.00		5.00	34.10
5.50	23.10	12.70		5.50	33.55
6.00	23.80	13.40		6.00	33.05
6.50	24.50	14.10		6.50	32.60
7.00	25.20	14.80		7.00	32.30
7.50	25.80	15.40		7.50	32.05
8.00	26.40	16.00		8.00	31.75
8.50	26.90	16.50		8.50	31.47
9.00	27.40	17.00		9.00	31.32
9.50	27.90	17.50		9.50	31.07
10.00	28.40	18.00		10.00	30.92
11.00	28.90	18.50		11.00	30.74
12.00	29.15	18.75		12.00	30.51
13.00	29.60	19.20		13.00	30.39
14.00	30.00	19.60		14.00	30.24
15.00	30.60	20.20		15.00	30.06
16.00	30.70	20.30		16.00	29.93
17.00	31.05	20.65		17.00	29.77
18.00	31.50	21.10		18.00	29.47
19.00	31.80	21.40		19.00	29.21
20.00	31.95	21.55		20.00	29.00
22.00	32.40	22.00		22.00	28.60
24.00	32.70	22.30		24.00	28.35
26.00	33.10	22.70		26.00	28.05
28.00	33.50	23.10		28.00	27.80
30.00	33.80	23.40		30.00	27.60
35.00	34.70	24.30		35.00	26.90
40.00	34.95	24.55		40.00	26.37
45.00	35.30	24.90		45.00	26.13
50.00	35.70	25.30		50.00	25.78
55.00	35.95	25.55		55.00	25.50
60.00	36.05	25.65		60.00	25.25
65.00	36.35	25.95		65.00	25.05
70.00	36.40	26.00		70.00	24.75
75.00	36.70	26.30		75.00	24.60
80.00	36.80	26.40		80.00	24.40
85.00	37.00	26.60		85.00	24.27
90.00	37.15	26.75		90.00	24.14
95.00	37.35	26.95		95.00	24.04
100.00	37.48	27.08		100.00	23.90
120.00	37.75	27.35		120.00	23.47
140.00	38.20	27.80		140.00	23.06
160.00	38.60	28.20		160.00	22.84
180.00	38.90	28.50		180.00	22.46
210.00	39.35	28.95		210.00	22.16
240.00	39.70	29.30		240.00	21.81
270.00	40.05	29.65		270.00	21.51
300.00	40.30	29.90		300.00	21.23
360.00	40.80	30.40		360.00	20.83
420.00	41.35	30.95		420.00	20.24
480.00	41.85	31.45		480.00	19.98
540.00	42.30	31.90		540.00	19.51
600.00	42.70	32.30		600.00	19.20
900.00	44.95	34.55		900.00	18.15
1200.00	46.80	36.40		1200.00	17.20
1500.00	47.65	37.25		1500.00	16.70