Project Name:

Elgin Free Range Chickens WULA: Geohydrological Report

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1 Introduction and Scope

1.1 Appointment

H_2 cOnsulting (Pty) Ltd was appointed by the Elgin Free Range Chickens to conduct a geohydrological study at their Lottershof farm (Klein Steenboks Rivier P5/ 487) near Caledon. The following work was required:

- Site visit and hydrocensus; and
- Geohydrological report to support the Water Use License Application (this report).

1.2 Background

The Elgin Free Range Chickens currently utilize ground and surface water in various aspects at the farm with a current water demand of 89 994 m^3/annum (**Table 1**). The existing water supply is 49 680 m^3/annum (**Table 2**) that leaves a shortfall of 40 314 m^3/annum (**Table 3**). The existing water usage is already licensed with the DWS.

The General Authorization for catchment G40K (**Table 4**) is 15 267 m^3/annum. The additional planned groundwater abstraction will be more than the GA and therefore a water use license will be required. The WUL Application is for the additional abstraction of 40 314 m^3/annum groundwater from boreholes LFBH1 and LFBH3 (**Figure 1**).

Table 1: Current water demand

Description	Volume (m^3/annum)	Source of water
Irrigation of areas outside houses during summer	15 700	Surface water
Irrigation of vegetables and grazing	18 064	Surface water
Sheep watering	730	Surface water
Domestic use	10 000	Borehole
Misters and high pressure washing	5 000	Borehole
Houses- watering of birds	40 000	Borehole
Mobile houses	500	Borehole
Total Surface water	**34 494**	**Surface water**
Total Borehole	**55 500**	**Borehole**
Total	**89 994**	

Table 2: Current water sources

Source	Name	Volume (m^3/annum)	Registration Number	Water Use Number
Groundwater	LF BH1	7 593	29011275	1
Groundwater	LF BH2	7 593	29011275	2
Surface water	Klein Steenboks River	34 494	29011275	3,4,5,6,7
Total		49 680		

Table 3: Water balance

Water Balance	
Demand	89 994 (m^3/annum)
Current supply	49 680 (m^3/annum)
Shortfall	40 314 (m^3/annum)

Table 4: General authorization for catchment G40K

Property Size (Ha)	General Authorization (m^3/ha/a)	Available Supply (m^3 /a)
203,56	75	15 267

Currently LF BH2 is blocked and not being used. The GA of 7 593 m^3/a of groundwater abstraction will be moved to LF BH1. The total GA abstraction from LF BH1 will then be 15 186 m^3/a. The borehole was yield tested in 2023 (**Appendix A**) with a reported yield of 126 290 m^3/a with the demand well below the safe abstraction rate.

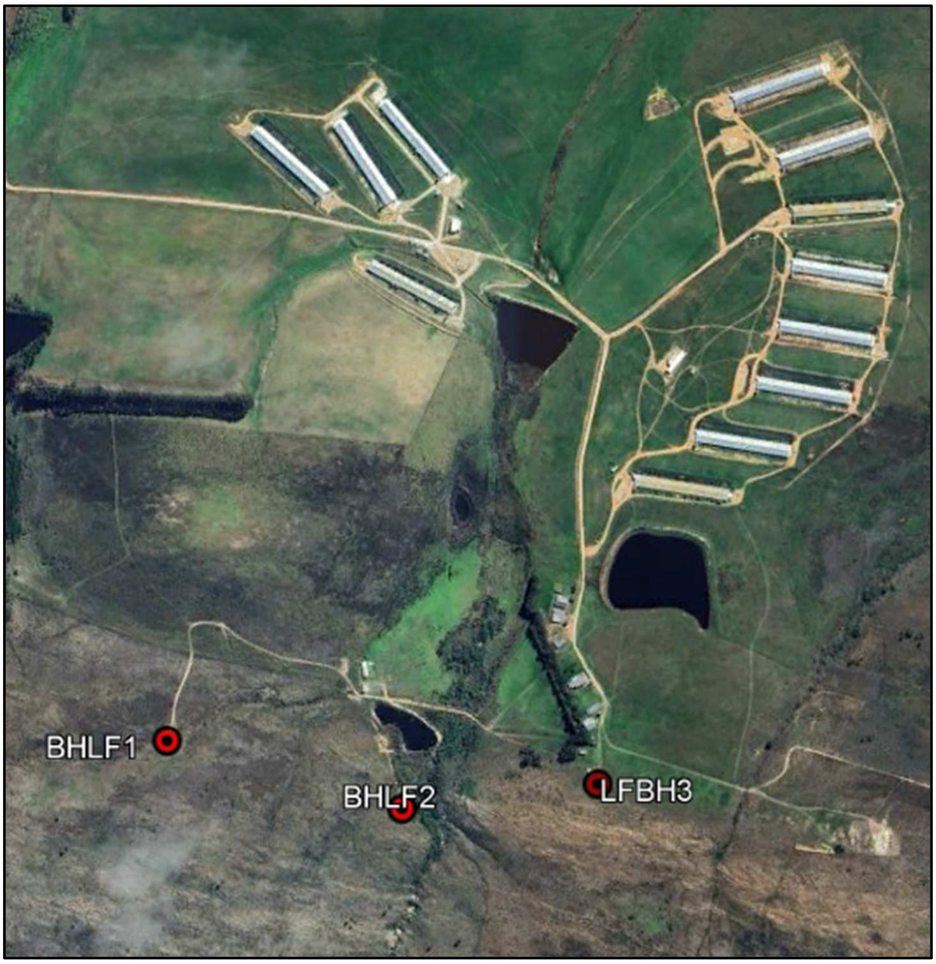


Figure 1: Borehole layout

2 Geographical Setting

2.1 Site Description

Lottershof is situated 10km southeast of Caledon (**Figure 3**). The farm is located in catchment G40K. The farm has a slope from southwest to northeast with the highest elevation of 320 mamsl. The Klein Steenboks River flow north of the farm and drain in an easterly direction.

2.2 Climate

The site falls in the Western Cape winter-rainfall region, which is typically Mediterranean, with warm, dry summers and mild, wet winters.

The mean annual precipitation (MAP), as provided by GRAII (DWAF GRA-2, 2005), for quaternary drainage region G40K, is 495.8 mm/a. The average monthly rainfall values are shown in **Figure *2***.

Most rain falls from June to August, i.e. winter months. The mean annual evaporation is *c*.1 430 mm (DWAF GRA-2, 2005).

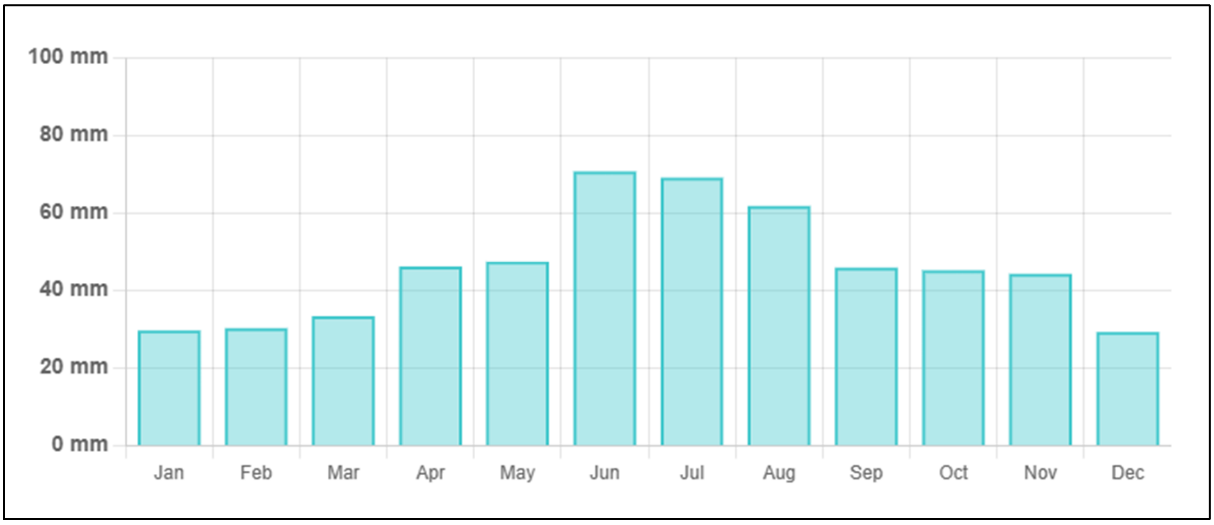
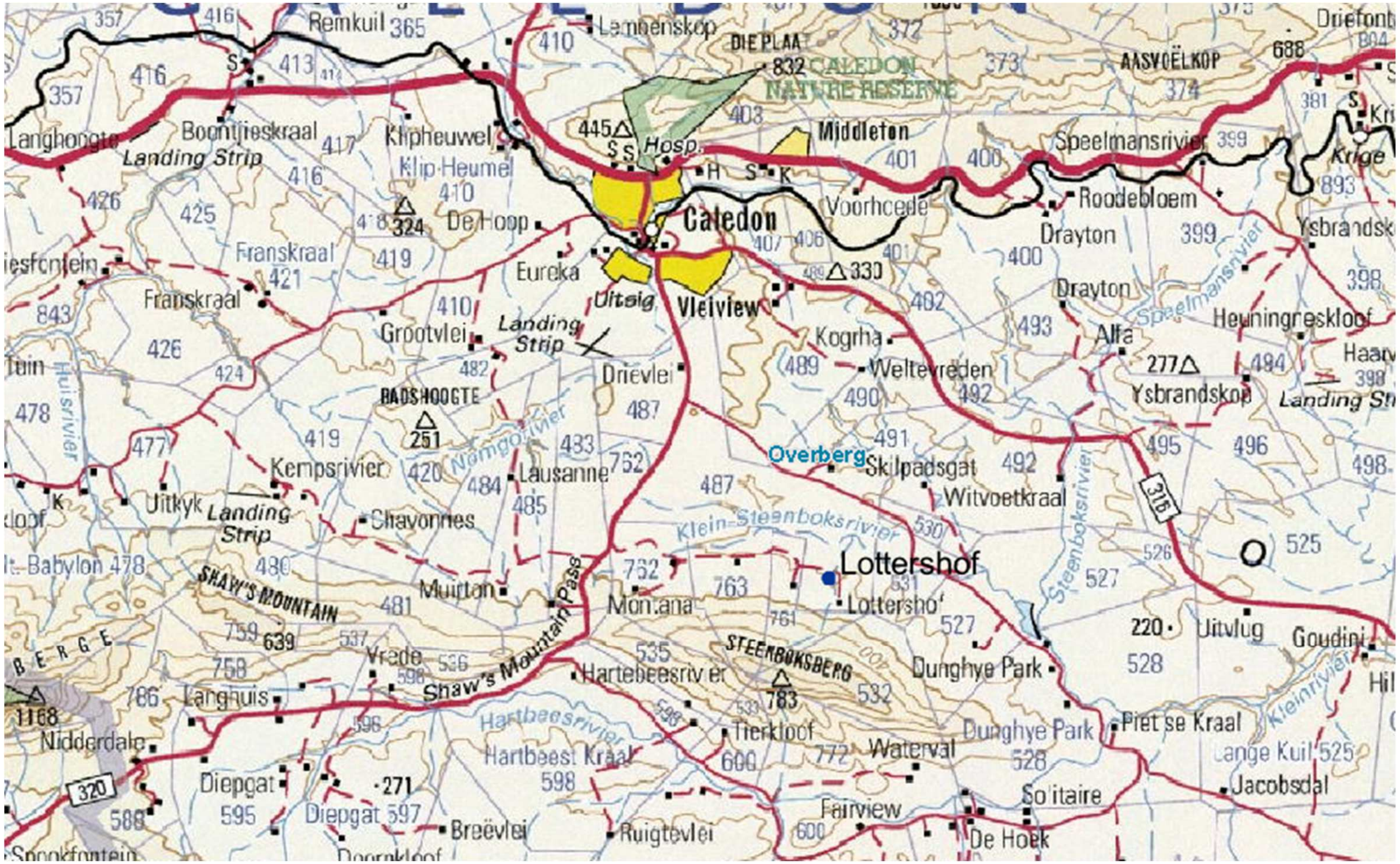


Figure 2: Rainfall (https://weather-and-climate.com)



Elgin Free Range Chickens WUL Application	
Figure 3	**Locality map**

Figure 3: Locality map

3 Methodology

3.1 Desk Study

For the hydrogeological desk study of the site the following reports and information were collated and assessed:

- The Department of Water and Sanitation's National Groundwater Archive (NGA);
- DWAF's 2005 National Groundwater Resource Assessment Phase 2 database;
- The DWAF's 2002 1:500 000 Hydrogeological Map Sheet Cape Town 3317; and
- Farm Mapper (https://gis.elsenburg.com/apps/cfm/)

The following datasets were sourced from the DWS' NGA:

- Borehole ID;
- Co-ordinates;
- Water use;
- Borehole depth;
- Field measurements, i.e. Electrical Conductivity (EC) and pH;
- Water level measurements; and
- Yield and discharge data.

Several data points were received which are close to Lottershof. The borehole positions are displayed in **Figure 4**. There are also a number of boreholes on the adjacent farms. The data received and collected will be discussed under the relevant sections.

3.2 Hydrocensus

A borehole survey was conducted at neighbouring farms (**Figure 4** and **Table 5**). Three boreholes were located on Farm Nooitgedacht Fick. Currently the farm uses one borehole to supply the farmhouse with water. The other two boreholes have been abandoned.

There are number of boreholes and springs on the SAB Maltings farm. The main groundwater abstraction is from CD_BH01 which supply water to their plant in Caledon. The abstraction volumes range from 153 425 m^3/a to 219 640 m^3/a. This groundwater abstraction is licensed with the DWS and all boreholes and springs are monitored using data loggers.

Table 5: Hydrocensus results

BH ID	Latitude	Longitude	Water Use	Water Level
BHLF1	-34.307336	19.465878	Domestic	20,6
BHLF2	-34.308220	19.469567	Blocked	-
BHLF3	-34.307900	19.472640	To be used	8,23
BH1	-34.305357	19.459380	Domestic Us	Not Measured
BH2	-34.305327	19.459335	Not in Use	Not Measured
BH3	-34.304751	19.460795	Not in Use	Artesian
CD_BH01	-34.316430	19.487970	In SAB plant	10,45
CD_BH01_A	-34.316430	19.487990	-	11,2
Mon_BH02	-34.319790	19.494800	-	5,56
Mon_BH01	-34.319300	19.518900	-	4,29
SP01	-34.326165	19.510911	-	-
SP02	-34.328600	19.524500	-	-

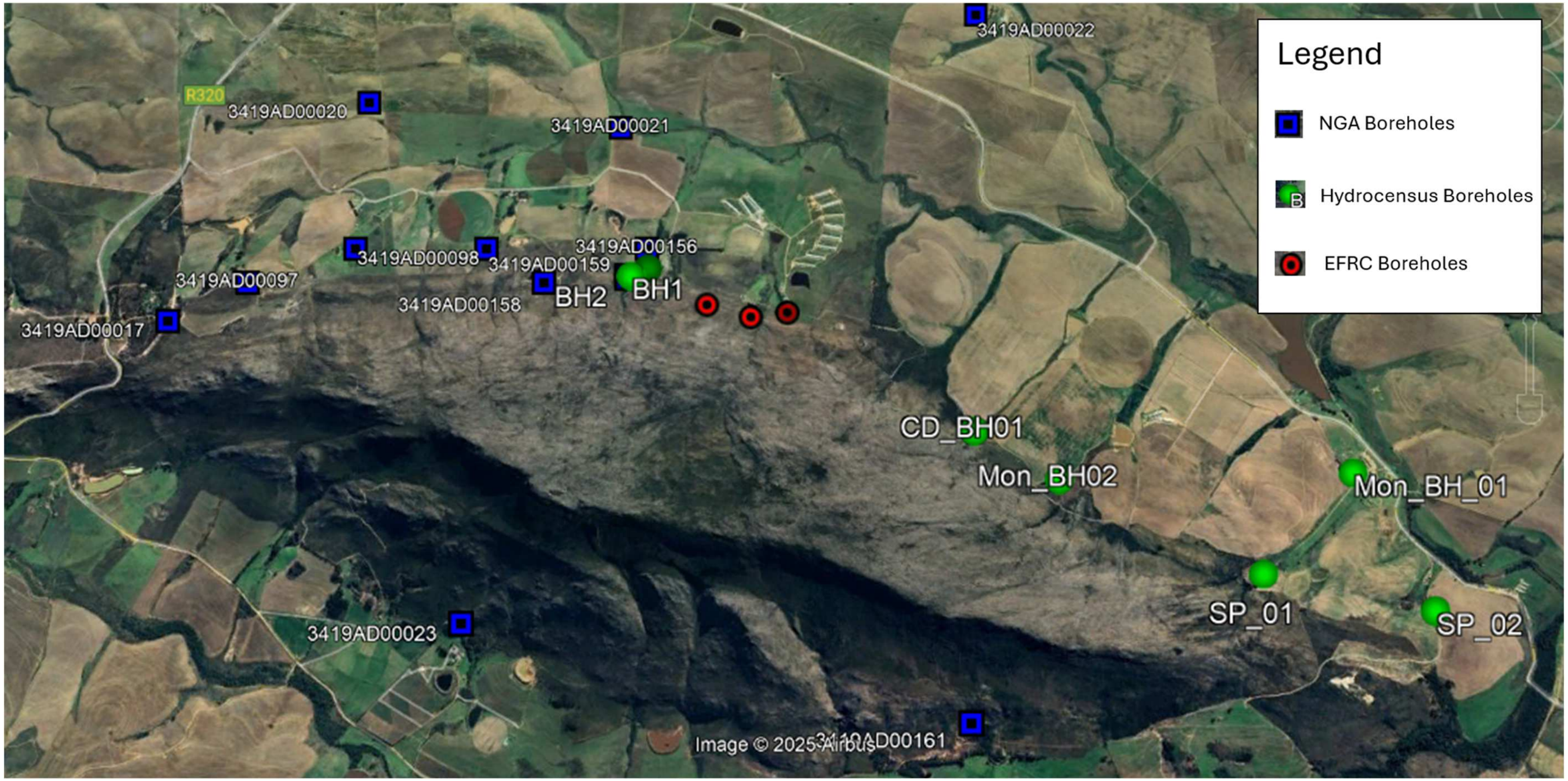


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Figure 4	**NGA data**

Figure 4: NGA and Hydrocensus boreholes

3.3 Geophysical Survey and Results

No geophysical survey was done.

3.4 Drilling of Borehole

The drilling of LFBH3 was completed on 15 Aug 2024. The borehole was drilled to 138 m by means of air-percussion method. The drilling intersected 6 m of surface sand and was sealed off by steel casing. The rest of the borehole was drilled into quartzitic sandstones of the Rietvlei Formation. A final blow-yield of 16.6 L/s was measured.

The details of the borehole construction and log are presented in **Table 6** and **Table 7.**

Table 6: Borehole construction

LF BH3 Borehole Construction		
BH Depth (m)	BH Diameter (mm)	Casing Type and Diameter
0-6	254	6 m 219 mm steel
6-25	203	25 m 177 mm steel Slotted
25-138	177	Open borehole
		Final blow yield: 16.6 L/s

Table 7: Borehole log

LF BH3 Borehole Log	
Depth (m)	Type
0-6	Overburden and Sand
6-25	Weathered Sandstone
25-138	Sandstone

3.5 Aquifer Yield Testing

Borehole LF BH3 were yield tested from 30th July to 4th August 2024. The yield test was supervised by GEOSS and the yield test report is presented in **Appendix B.** Summaries of the yield test results are given in **Table 8** (step tests) and **Table 9** (CDTs).

Four step tests were conducted on LF BH3. Constant Discharge Tests (CDT) were conducted for a period of 16 hours, to gain an understanding of the “safe” yield of the borehole.

The steps tests on LF BH3 were conducted at 8, 13, 18, 8 and 22 L/s. The drawdown at the end of the last step was 83.86 m. After water level recovery, borehole LF BH3 was pumped for 16 h at a constant discharge rate of 15 L/s. The borehole obtained a final drawdown of 94 m by the end of the CDT and took 24 h to recover to 4.63 m (95%).

Table 8: Step yield tests

Borehole No.	Borehole Depth	Pre-Pumping Water Level	60 min Step Discharge Rates L/s					Max. Drawdown at Last Step
	mbgl	mbgl	Step 1	Step 2	Step 3	Step 4	Step 5	m
LF BH3	138.6	8.94	8.04	13.12	18.06	22.28	-	83.86

Table 9: Constant discharge tests

Borehole No.	Borehole Depth	Pre-Pumping Water Level	16 hr Constant Discharge Test	
	mbgl	mbgl	Pump Rate L/s	Final Drawdown m
LF BH3	138.6	9.28	15	94.98

To estimate the maximum long-term pumping rate the test pumping data were analysed using an Excel based software package developed by Van Tonder et al (2002) (**Table 10)**. The proposed pumping rates and yearly abstraction volumes are presented in **Table 11**. It should be noted the recommended safe abstraction volumes are more than the actual water demand.

Table 10: Yield test results LF BH3 (Geoss 2024)

ECA_BH1			
Method	**Sustainable Yield (L/s)**	**Late *T (m^2/d)**	***AD used (m)**
Basic FC	1.88	5.8	54.0
FC inflection point	1.89		58.0
Cooper-Jacob	2.19	6.1	54.0
FC Non-Linear	0.71	3	54.0
Barker	0.79		54.0
Average Q_sust (L/s)	**1.49**		
Recommended Abstraction			
Abstraction Rate (L/s)	**Abstraction Duration (hours)**		**Recovery Duration (hours)**
1.5	24		0

Table 11: Abstraction recommendations

Pumping Rate (L/s)	Daily Pump Hours (h)	Daily Volume(kl/day)	Annual Volume (kl/a)
1.5	24	129.6	47 304

3.6 Chemical Analysis

Presented in **Table 12** is a summary of the laboratory analysis of groundwater from LF BH3. The groundwater is of very low salinity and slightly elevated Fe. High iron levels can lead to staining on walls and infrastructure, and they increase the risk of iron biofouling The laboratory test certificates are attached in **Appendix B**.

The groundwater from LF BH3 are corrosive (**Table 13**) and would require some form of treatment before being used. The groundwater could corrode plumbing ect.

Table 12: Chemical results

Parameter	Result	SANS 241 Limit
EC (mS/m)	28	<170
pH	6.0	5-9.7
Cl (mg/L)	64.43	<300
Fe (mg/L)	0.549	0.3
NH_4-N	<0.15	<1.5
N (mg/L)	<0.1	<11
E.coli	0	0

Table 13: Corrosiveness of groundwater

Description	Units	LF BH3
Date sampled		
INORGANICS		
pH Value @ 25°C		6
Conductivity mS/m @ 25°C	mS/m	28
Total Dissolved Solids	mg/l	189,84
Calcium, Ca	mg/l	7
Ca Hardiness	mg/l	17,5
Magnesium, Mg	mg/l	4
Mg Hardness	mg/l	16,47572016
Sodium, Na	mg/l	37
Potassium, K	mg/l	4
Total Hardness	mg/l	33,97572016
Total Alkalinity as $CaCO_3$	mg/l	25,1
Bicarbonate, HCO_3	mg/l	30,622
Carbonate, CO_3	mg/l	15,06
Chloride, Cl	mg/l	64,43
Sulphate, SO_4	mg/l	6,86
Ortho Phosphate as PO4	mg/l	0
Nitrate, NO_3	mg/l	1
Nitrate as N	mg/l	1
Fluoride, F	mg/l	0,16

$CaCO_3$ Hardness	mg/l	18
AI = pH + Log_{10}(AH) pHs = (9.3 + A+B)-(C+D) A = B = C = D =		8,6 9,7 0,128 2,146 0,445 1,400
Langelier Index = (pHa-pHs) Effects (positive = scaling; negative = corrosive)		-3,73 Corrosive
Aggressiveness Index (pH+log(AH) A = Total alkalinity H = Ca Hardness ≥12 = Non-aggressive 10 - 11.9 = Moderately aggressive ≤10 = Highly aggressive Effects on Asbestos Cement		8,6 Non-aggressive

3.7 Groundwater Recharge

The groundwater recharge of 19.72 mm/a (wet season) was obtained for G40K from the GRA-2 dataset (DWAF, 2005). The dry season recharge is 13.636 mm/a.

3.8 Groundwater Modelling

No groundwater modelling required.

3.9 Groundwater Availability Assessment

Presented in **Table 14** is the recommended production pumping rates, schedules and management details for LF BH1 and LF BH3. **Table 15** provide the summarised groundwater information for Quaternary Catchment G40K**.**

The current estimated groundwater abstraction from G40K 28 400 m^3/a. There is 66 575 m^3/km^2 stored groundwater in the aquifers of which 6 067 m^3/km^2 is available for abstraction.

Table 14: Recommended production pumping rates, schedules and management details

Borehole ID	Borehole Depth	Rest Water Level	Recommended Pump Intake Depth	Available Drawdown	Recommended 24h/d Safe Pumping Rate		Water Demand	Maximum Water Demand	Maximum Pumping Rate (12 hours)	Max. Pumping Water Level Not to Exceed
	mbgl	mbgl	mbgl	m	L/s	m^3/d	m^3/annum	m^3/d	L/s	mbgl
LF BH1	114.6	20.6	50	29.4	4	346	38 850	112	2,59	48
LF BH3	138.6	8.23	66	54.77	1.5	129.6	16 650	48	1,11	63

Table 15: Summary of groundwater information for Quaternary Catchment G40K

Information Piece	Unit	Amount
Extent	km^2	429
Estimated Groundwater Storage of Aquifers	m^3/km^2	66 575
Mean Recharge to Groundwater	$m^3/km^2/a$	16 678
Drought Index	Years	1
Mean Groundwater River Baseflow Contribution	$m^3/km^2/a$	4 672 610
Estimated Groundwater Abstraction	m^3/a	28 400
Utilisable Groundwater Exploitation Potential	$m^3/km^2/a$	6 067

4 Prevailing Groundwater Conditions

4.1 Geology

The main stratigraphic units in the area belong to the Table Mountain (TMG) and Bokkeveld Groups (**Figure 5 and Table 16)**. The Steenboks Mountain are formed by rocks of the TMG Group and the valley from rocks of the Bokkeveld Group,

The long hiatus and non-conformity between the Bokkeveld Group and overlying strata of the Bredasdorp Group represent an interval of nearly 350 million years, during which time the TMG was deformed by folding and thrust-faulting, followed by extensional-strike-slip faulting and some igneous activity, e.g. dyke intrusion. As a result of this folding and its resistant nature, the TMG forms steep, rugged topography.

The Bokkeveld Group predominantly consists of argillaceous layers of shale and siltstone with minor sandstone layers. The Bokkeveld Group Aquifer is considered to be an aquifer of lesser importance because of lower borehole yields and poorer groundwater quality. Due to its argillaceous nature, the Bokkeveld Group may act as an aquitard.

The geological map shows a fault along the Skurweberg and Rietvlei formations contact. Most of the boreholes target this zone of fracturing.

Lottershof are underlain by the Rietvlei and Gydo formations (**Figure 6**). The boreholes were drilled into the Rietvlei Formation. The boreholes from SAB Maltings were drilled into the Skurweberg and Gydo Formations.

Table 16: Stratigraphy and lithology of the area surrounding Lottershof (after1:250 000 Geological Series sheet 3319 Worcester)

Super Group	Group	Subgroup	Formation	Symbol	Description
Cape Super Group	Bokkeveld	Ceres	Tra-Tra	Dt	Sandy shale and mudstone
			Hex River	Dh	Light grey feldspathic sandstone and siltstone
			Voorstehoek	Dv	Dark grey shale and mudstone
			Gamka	Dga	Feldspathic sandstone and siltstone
			Gydo	Dg	Shale, mudstone and siltstone
	Table Mountain	Nardouw	Rietvlei	Dr	Light grey quartzitic sandstone
			Skurweberg	Ss	Light grey quartzitic sandstone
			Goudini	Sg	Quartzitic sandstone and siltstone
			Cederberg	O-Sc	Shale and siltstone
			Pakhuis	Opa	Greyish blue sandstone
			Peninsula	Ope	Quartzitic sandstone

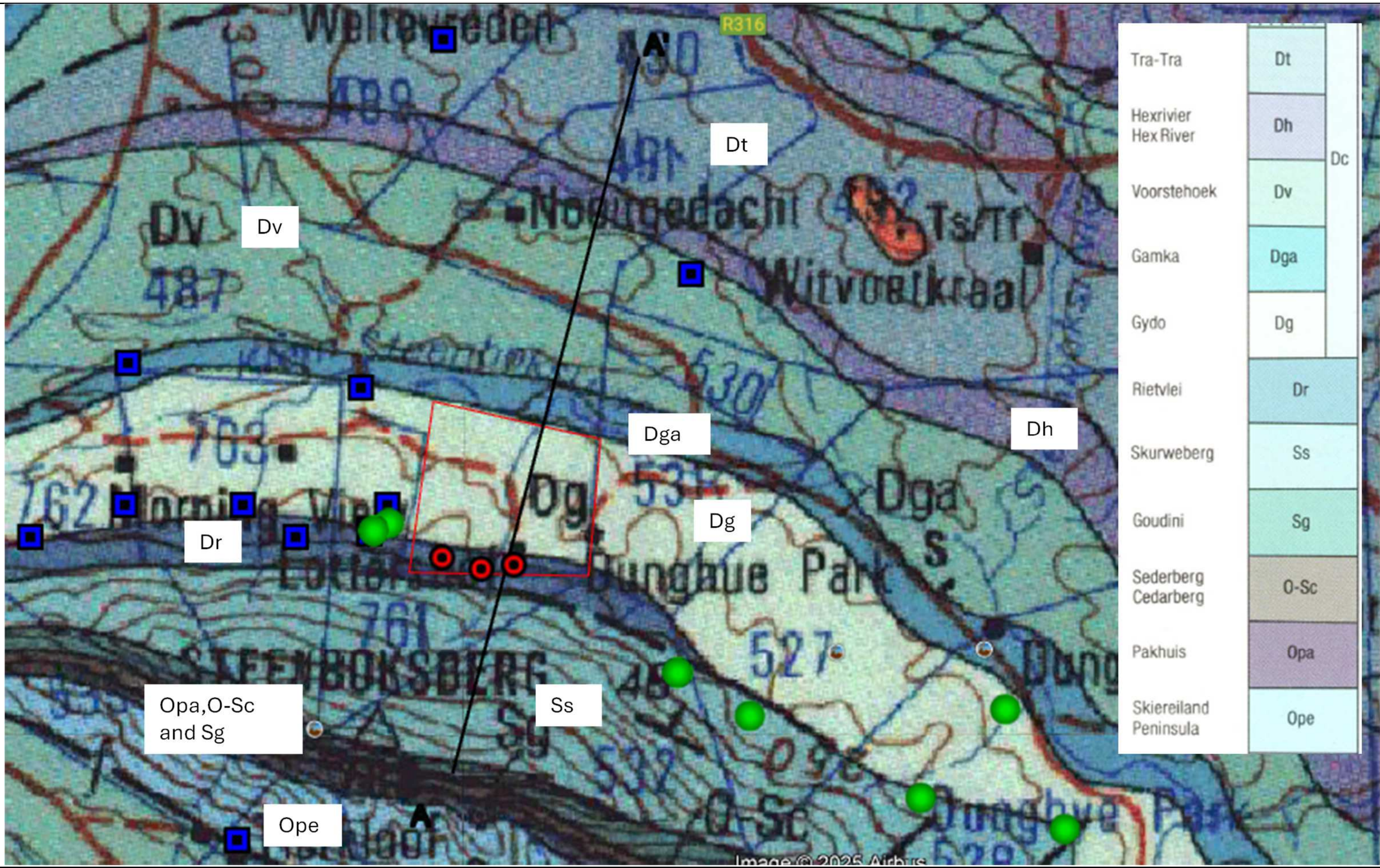

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Figure 5	**Regional geology**

Figure 5*:* Regional geology (after 1:250 000 Geological Series sheet 3319 Worcester)

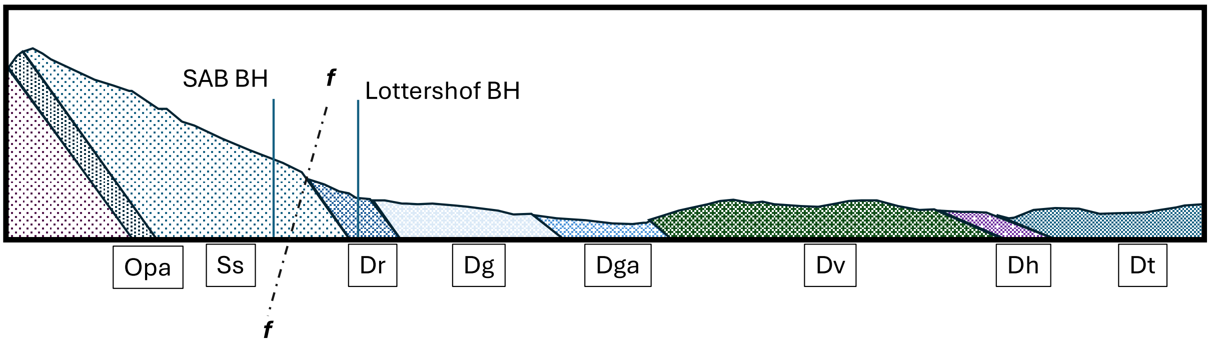


Figure 6: Geological X-Section

4.2 Hydrogeology

According to the DWAF 1:500 000 hydrogeological map (**Figure 7**) the site is underlain by a fractured aquifer. Expected borehole yields vary between 0.5 and 2 L/s. The yields from the NGA data have a range of between 0 and 2 L/s with some of the hydrocensus boreholes having yields of > 3 L/s.

Expected electrical conductivity is <70 mS/m (**Figure 8**). Data from the NGA range between 19 and 188 mS/m with the higher EC associated with the Gamka Formation.

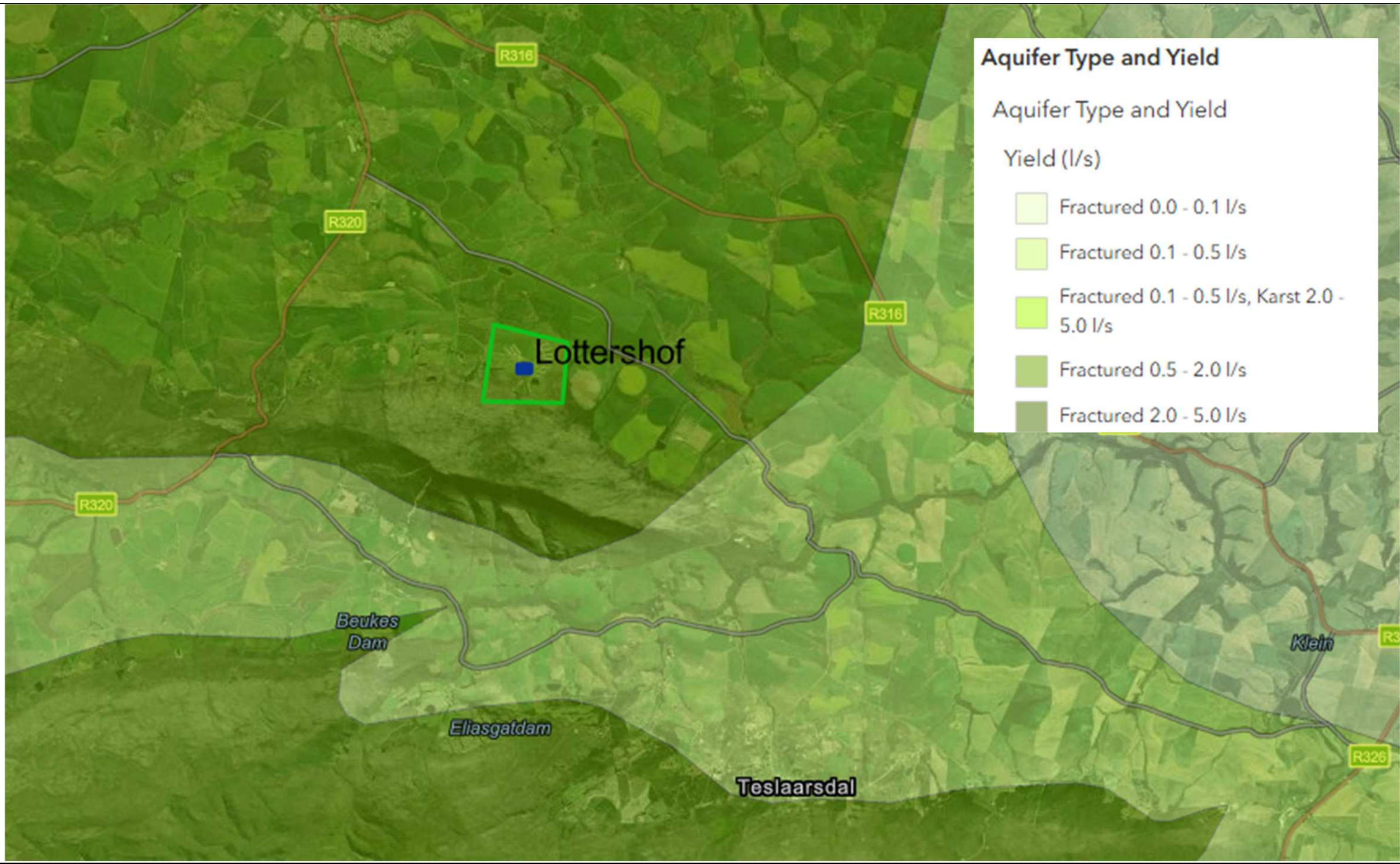
According to **Figure 9** the aquifer is classified as a minor aquifer. Locally it can be seen as a major aquifer if boreholes are drilled into fault zones.

Ground water vulnerability was considered in terms of the 'DRASTIC' method of assessment of the intrinsic vulnerability of an aquifer to contamination from the surface (Aller *et. al*., 1987) and is shown in **Figure 10**. The method considers the following factors, which control the vulnerability of an aquifer to contamination from surface:

- Depth to water table (D)
- Recharge (R)
- Aquifer material (A)
- Soils (S)
- Topography and slope (T)
- Impact of the vadose (unsaturated) zone (I)
- Hydraulic conductivity (C)

Aquifer vulnerability is defined as the likelihood for contamination to reach a specified position in the groundwater system after being introduced at some point above the uppermost aquifer.

According the DWAF's aquifer vulnerability map (DWAF, 2013), the site's vulnerability rating is 'Least'.



Elgin Free Range Chickens WUL Application	
Figure 7	**Borehole Yields**

Figure 7: Expected Borehole yields

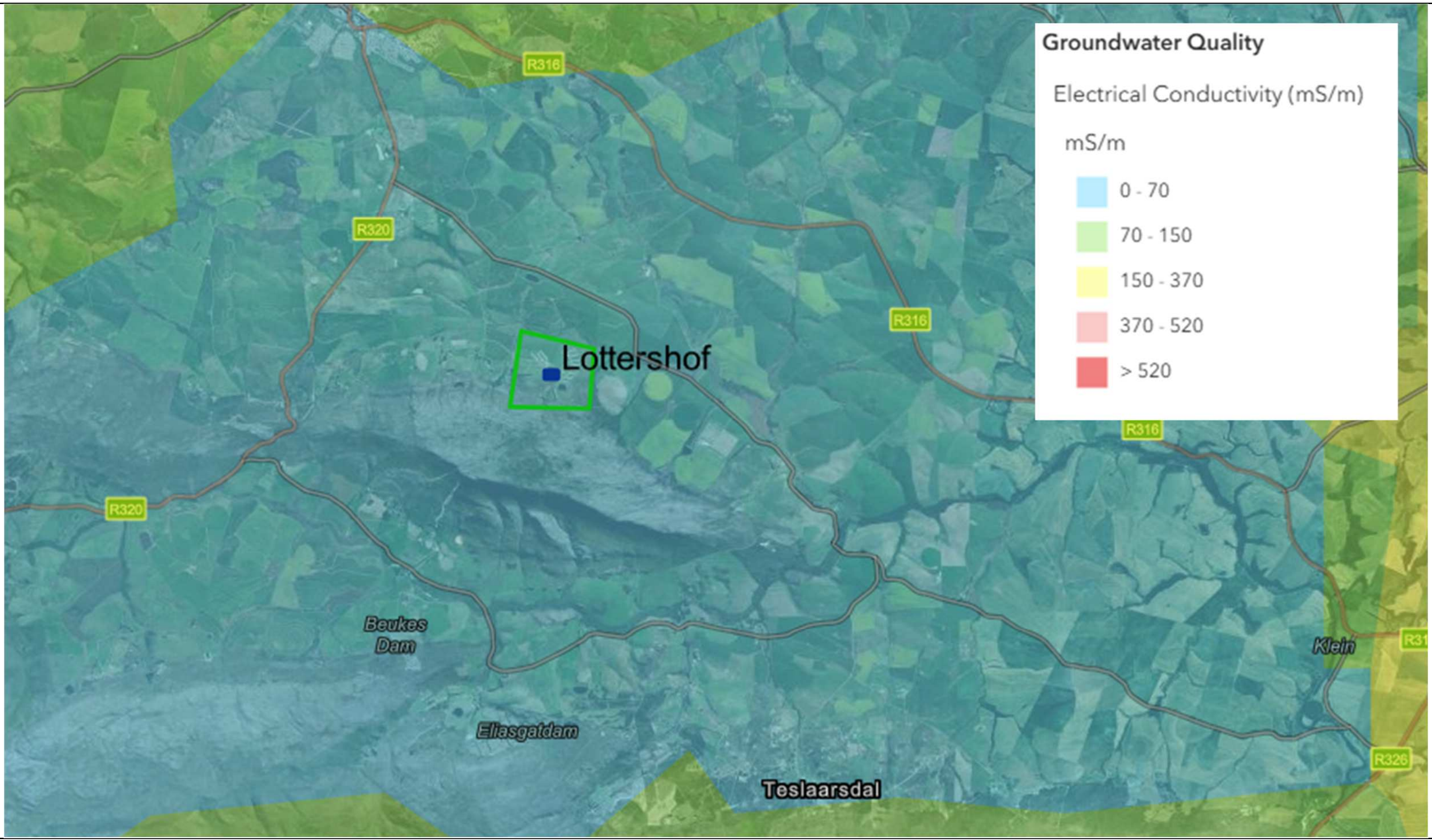


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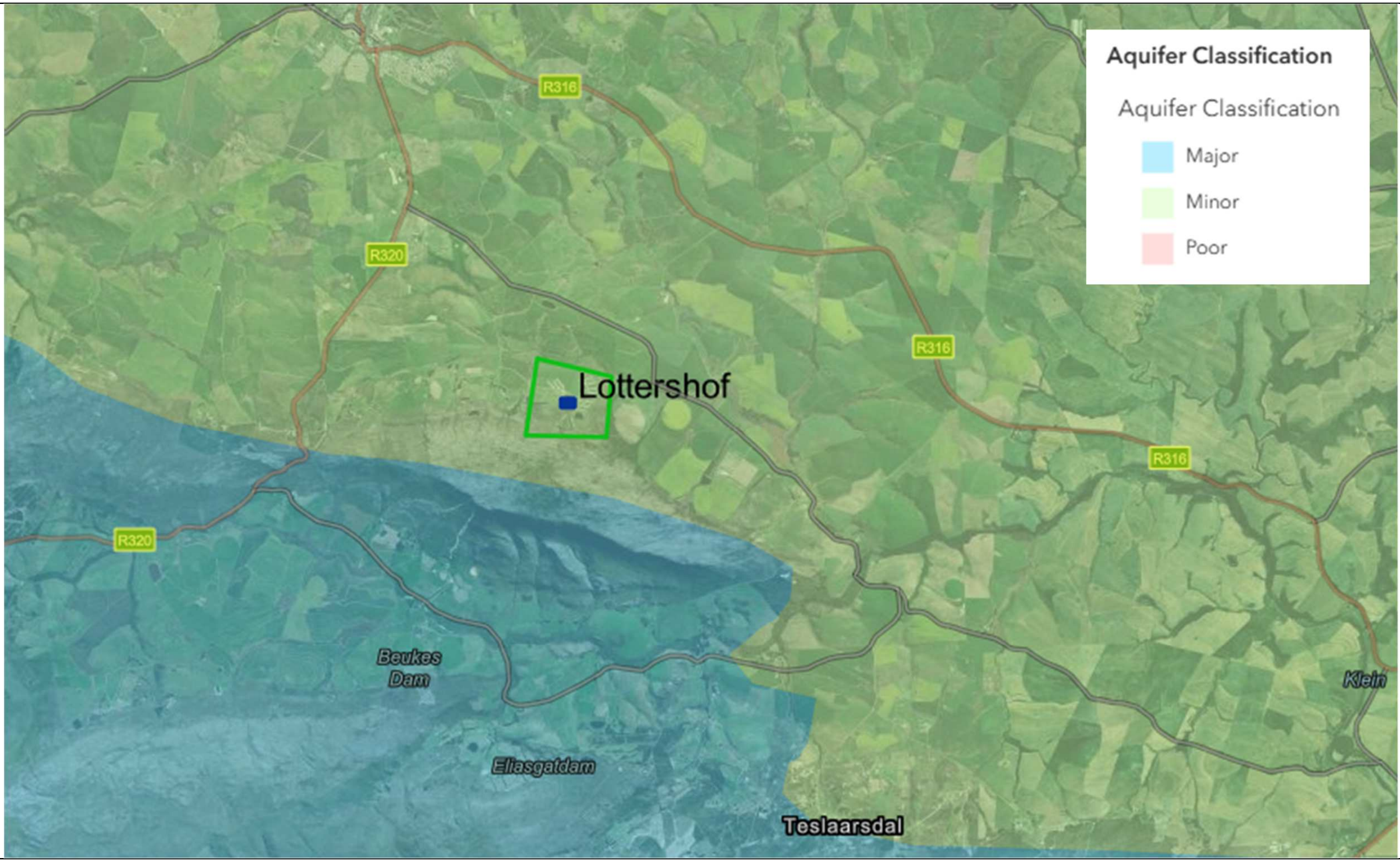
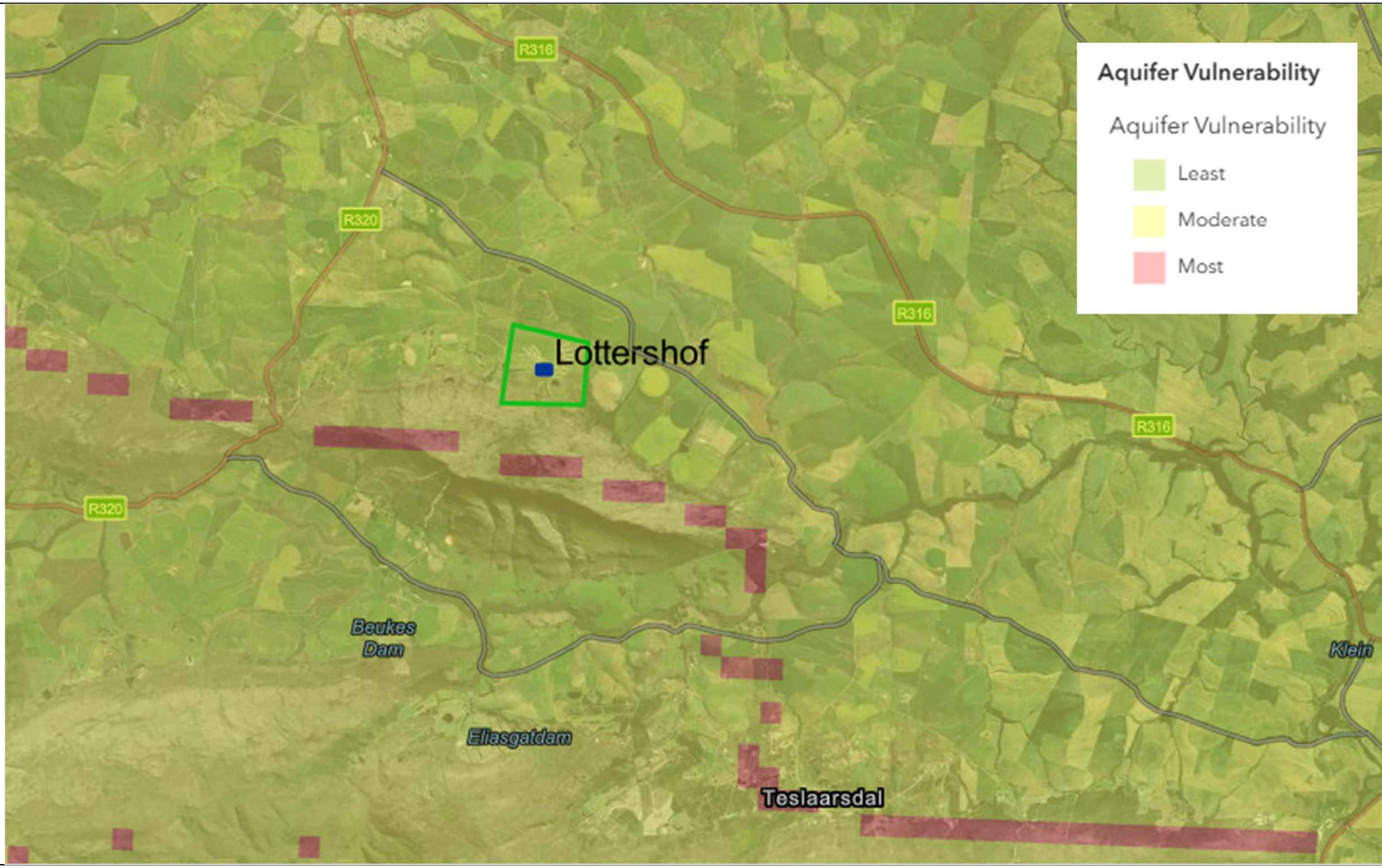
Figure 8	**Expected Quality**

Figure 8: Expected Quality



Elgin Free Range Chickens WUL Application	
Figure 9	**Aquifer Classification**

Figure 9: Aquifer classification



Elgin Free Range Chickens WUL Application	
Figure 10	Aquifer Classification

Figure 10: Aquifer Vulnerability

4.3 Groundwater Levels

Groundwater levels measured during pump tests and hydrocensus are presented in **Table 17**.

Table 17: Water levels

BH ID	Water Level (mbgl)
LFBH1	20.6
LFBH3	8.23
BH3	artesian
CD_BH01	10.45

It is expected that groundwater flow will mimic topography and flow in a northeastern direction locally and easterly regionally.

The influence of pumping both LFBH1 and LFBH3 on each other can be calculated using Cooper-Jacob modelling of radius of influence. The equation is:

$s = 2.3Q / (4\pi T) * \log10(2.25Tt / R^2S)$, where

Q = Daily abstraction (68 m^3)

T = Transmissivity (6.1 m^2/d)

t = 730 days (2 years)

R = Distance between boreholes (620 m)

S = Storativity of 0.0005

The above values were determined from the yield tests.

Based on the above calculation the impact of pumping at LFBH3 on LFBH1 would be an additional 2.5 m drawdown over two years. This impact is seen as minimal due to:

- The aquifer is not homogenous, and impact should be less; and
- Both boreholes will be pumped at a rate well below the sustainable rates calculated by the yield test analyses and the operating water levels will be above the critical levels recommended from the yield tests.

4.4 Surface Water

Concerns were raised that groundwater abstraction could impact a nearby wetland and a small perennial stream (**Figure 11).** Borehole LFBH3 is drilled within the 500 m buffer zone of the wetland.

Based on the following no impact on the wetland is expected:

- The borehole has 6 m of 219 mm steel casing installed to seal off the overburden;
- 25 m of 177 mm steel casing was installed to seal off the weathered sandstone;
- The two sets of casing therefore act as a seal between the wetland and the groundwater;
- The borehole is drilled into the Rietvlei Formation and the wetland is situated on the Gydo Formation. There is therefore no hydraulic link between the two formations; and

- The stream origin is in the Skurweberg Formation and the borehole abstracts groundwater from the Rietvlei Formation.

Based on the above no impact on the wetland or stream is foreseen due to groundwater abstraction from LFBH3. It is however recommended that the streamflow be monitored.

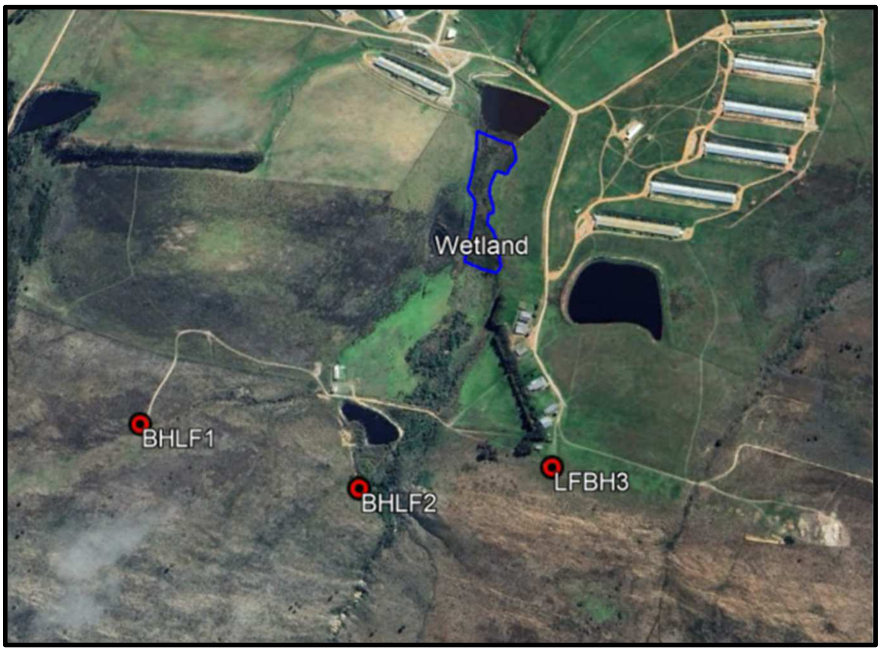


Figure 11: Position of wetland

5 Groundwater Modelling

Not Applicable.

6 Assessment of Potential Geohydrological Impacts

6.1 Construction Phase

Not applicable for this study

6.2 Operational Phase

6.2.1 Impacts on Groundwater Quantity

The following impacts have been identified that could potentially impact on the groundwater quantity:

- Abstraction of groundwater from the borehole might result in drawdown in the local fractured-rock aquifer and possibly influence other users; and
- Over abstraction from boreholes with a result of water level dropping below the recommended levels.

Too limit such impacts the proposed pumping rates and times are kept to the minimum. Such reduced pumping hours and rates will allow the water level to recover and is likely to reduce the significance of the impact to very low. See impact rating below in **Table 18**.

Table 18: Impact rating assessment Groundwater Quantity – Operational Phase

<table>
<tr><th>Mitigation</th><th>Impact no</th><th>Extent</th><th>Intensity</th><th>Duration</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Status</th><th>Confidence</th></tr>
<tr><td>Without</td><td>1</td><td>Local
1</td><td>Medium
2</td><td>Long-term
3</td><td>Medium
6</td><td>Possible</td><td>Low</td><td>–</td><td>Medium</td></tr>
<tr><td colspan="10">Essential mitigation measures:
• Implement proposed pumping rates and regimes.
• Keep water demand below the safe abstraction volumes.
• Pump water level must be above the recommended levels.

Best practise measures:
• Implement a groundwater monitoring system to monitor groundwater quality, volumes abstracted and water levels.
Natural mitigation:
• Annual recharge and storage potential of the aquifers naturally mitigate the negative effects of abstraction on the aquifers of this area.</td></tr>
<tr><td>With</td><td>1</td><td>Local
1</td><td>Low
1</td><td>Long-term
3</td><td>Low
5</td><td>Improbabl
e</td><td>Very Low</td><td>–</td><td>High</td></tr>
</table>

6.3 Impacts on Groundwater Quality

Not applicable

6.4 Groundwater Management

The following groundwater management measures are recommended:

- Install the production pump at recommended depth;
- Limit abstraction to recommended volumes;
- Include the borehole in a groundwater monitoring programme to include:
  - The borehole must be equipped with a conduit pipe (25 – 35 mm ID class 6 HDPE pipe) attached to the pump's rising pipes and installed to *c.*1 m above the pump inlet.
  - The water level and volumes abstracted must be recorded on at least a monthly basis. Best results are obtained if automatic flow meters and water level recorders set to take hourly readings are installed; and
  - A SACNASP registered hydrogeologist should evaluate the monitoring data on an annual basis and compile a monitoring report.

Implement all the essential mitigation measures included in ***Table 18***

6.5 Decommissioning Phase

Not applicable

6.6 Post-Operational Phase

Not applicable

7 Groundwater Monitoring System

7.1 Introduction

A groundwater monitoring plan as indicated in previous sections must be implemented as early as possible. This information will inform the ongoing implementation and development of a water management strategy and management of impacts within the site area and on downstream or down gradient water users.

The results of monitoring, and any changes to the water management strategies, must be reported to management and DWS as per the WUL for specific items, and a detailed monitoring report submitted to the DWS on an annual basis. The report serves to notify DWS of areas of reduction in water supply and the actions implemented, in progress or planned to address the identified impacts including source identification and control.

7.2 Groundwater Monitoring Network

Install monitoring equipment in all three boreholes. The monitoring should include the following:

- Water level monitoring;
- Water quality (EC, pH, Fe) monitoring every 4 months;
- Abstraction volumes.

7.3 Source Plume, Impact and Background Monitoring

Not applicable

7.4 Monitoring Frequency

- Monitoring frequency should be monthly and reviewed every six months;
- Monitoring must commence as soon as possible; and
- Water levels in the borehole should be measured on a weekly basis, preferably daily. Best practise is to install an automatic recorder (logger) in the borehole to measure the water level, temperature and electrical conductivity (salinity) hourly.

8 Groundwater Environmental Management Programme

8.1 Current Groundwater Conditions

These are summarised in the Sections above.

8.2 Predicted Impacts of Facility

As per previous sections.

8.3 Mitigation Measures

As per previous sections.

9 Post Closure Management Plan

Not applicable to this application.

10 Conclusions and Recommendations

Based on the data and information discussed in this report, the following is recommended regarding the groundwater resources at Elgin Free Range Chickens:

- Borehole LF BH3 was drilled into the Rietvlei formation which is a secondary aquifer;
- LF BH3 can be pumped at 1.11 L/s and to a maximum of 48 m^3/day;
- LF BH1 can be pumped at 2.59 L/s and to a maximum of 112 m^3/day;
- The maximum daily demand is 160 m^3 and well below the daily recommended abstraction volumes;
- Groundwater quality is good with slightly elevated iron levels. The water is corrosive;
- A groundwater monitoring and management plan must be implemented; and
- All essential mitigation measures listed in this report must be implemented.

11 References

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12 Appendices

Appendix A: Yield Test Report – LFBH01

Borehole Management
Recommended Pumping Regime

Parsons & Associates
specialist groundwater consultants cc
CK 96/27895/23

Borehole Information

Project No.	AD0267
Locality	Lottershof
Borehole No.	BH01
Latitude	S34.307336
Longitude	E19.465878
Elevation (mamsl)	275
Contractor	AB Pumps
Supervisor	Michael Bekker
Start of step drawdown test	17/01/2023 16:00
Start of constant discharge test	18/01/2023 07:00
Borehole depth (m)	114.6
Borehole diameter (mm)	-
Depth of casing (m)	-
Equipment in borehole	Existing pump
Depth of installation (m)	-
Water level (mbc)	20.6
Pump inlet depth (mbc)	90.2
Available drawdown - test (m)	69.6
Step drawdown test	4 x 1hr, with 4 hr recovery monitoring
Constant discharge test rate (L/s)	3.3
Constant discharge test duration (hrs)	24 - with equivalent recovery monitoring
Observation boreholes	None

Recommendations

Pump inlet depth (m)	50
Operational yield (L/s)	4.0
Duration (hrs/d)	24
Daily yield (m3/d)	346
Long-term yield (L/s)	4.0
Duration (hrs/d)	24
Sustainable yield (m3/d)	346
Monitoring required	yes
Water level - frequency	see comments
Water quality - frequency	quarterly i.e. every 3 months
Water quality - parameter	pH, electrical conductivity (EC), iron (Fe), manganese (Mn)

Comments

1 In the absence of a borehole log, it is interpreted that borehole BH01 was drilled into rocks belonging to the Table Mountain Group (TMG).

2 Both the step drawdown test and constant discharge test induced limited drawdown. The available drawdown amounted to 69.6 m, while the maximum drawdown induced during the tests was only 11.29 m.

3 No significant turbulence losses where observed during the step drawdown test. In hindsight one or two additional steps would have been useful.

4 A 24 hr CD test was conducted at 3.3 L/s. Fracture flow and dewatering is evident in both the drawdown and recovery data. Because of the limited drawdown induced during testing, a conservative approach is required in setting the recommended

5 On completion of the CD test, the borehole recovered to within 7.9% of the rest water level.

6 Groundwater quality was relatively stable during testing, with electrical conductivity (EC) being in the order of 23 mS/m.

7 The groundwater quality is characteristic of groundwater from TMG Aquifers. The water has a low salinity, is slightly acidic and has slightly elevated iron (Fe) and manganese (Mn) concentrations (see attached laboratory analysis). The water is also aggressive to cement and corrosive to steel.

8 Both Fe and Mn are below health limits, but above aesthetic limits. This could negatively affect the taste and colour of the water.

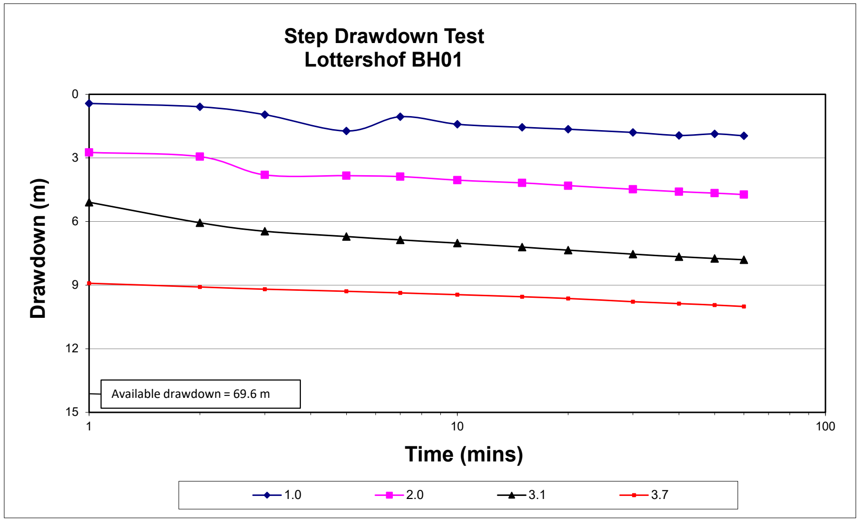
9 Based on the information available, the recommended pumping rate of BH01 is set at 4.0 L/s when pumped continuously. This equates to a daily yield of 346 KL/d.

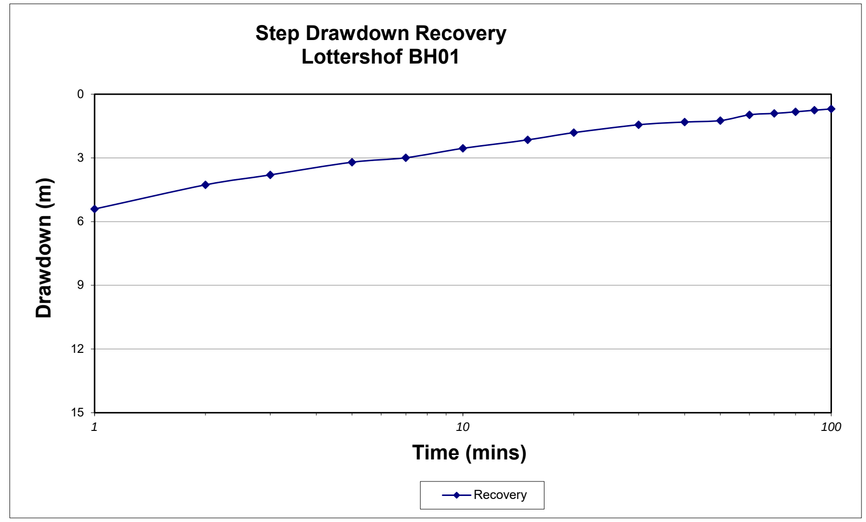
10 Because of the limited drawdown induced during testing and the observed fracture flow, it is strongly recommended that a data logger be installed 1 m above the pump inlet and set to record a water level every 3 hrs. The data should be downloaded every quarter and the performance of the borehole reviewed,

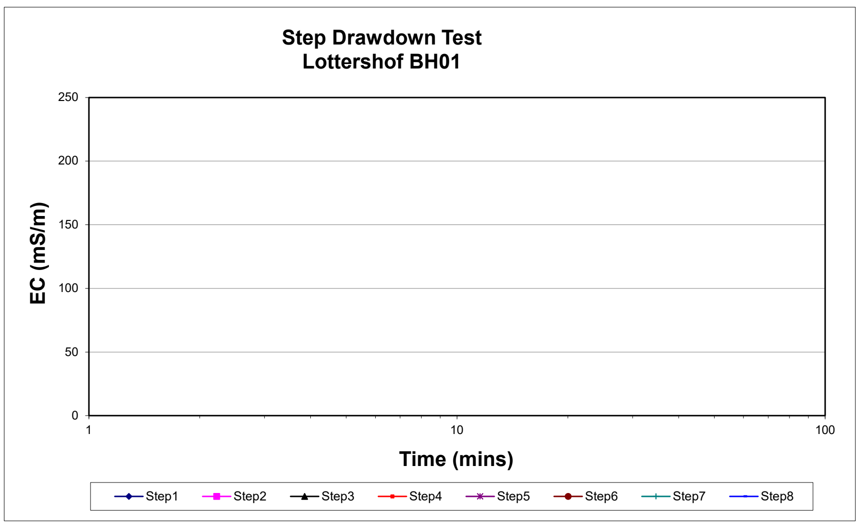
11 While groundwater level monitoring can be done manually, this approach typically provides a level somewhere between a rest level and a dynamic level. This data is not useful in assessing the long term sustainable yield of the borehole.

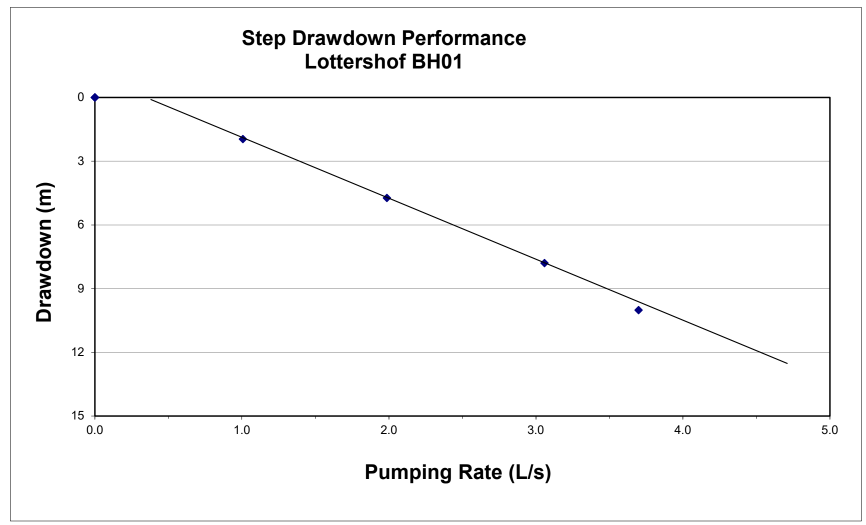
Because Fe and Mn concentrations are at or above aesthetically acceptable levels, treatment of the water to remove Fe and Mn should be considered. The stabilisation to prevent corrosion is also recommended.

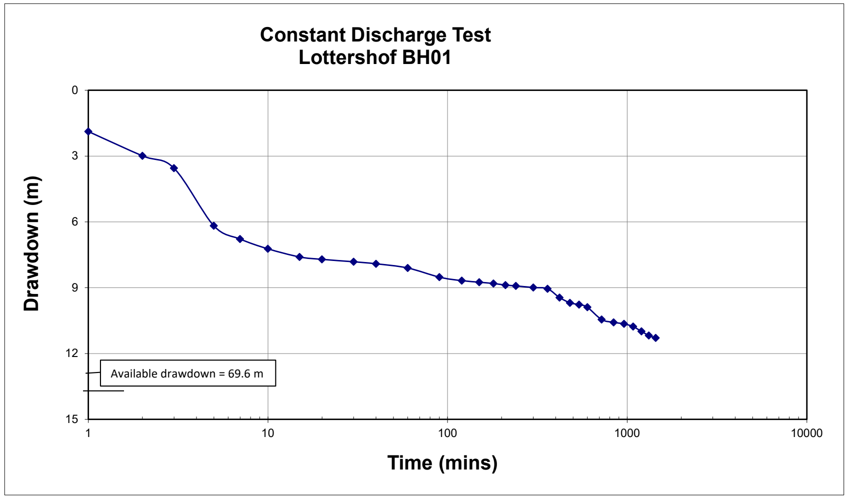
Dr Roger Parsons
Ph.D (U.F.S) Pr.Sci.Nat.
cell 083-310-6504
email roger@pasgc.co.za

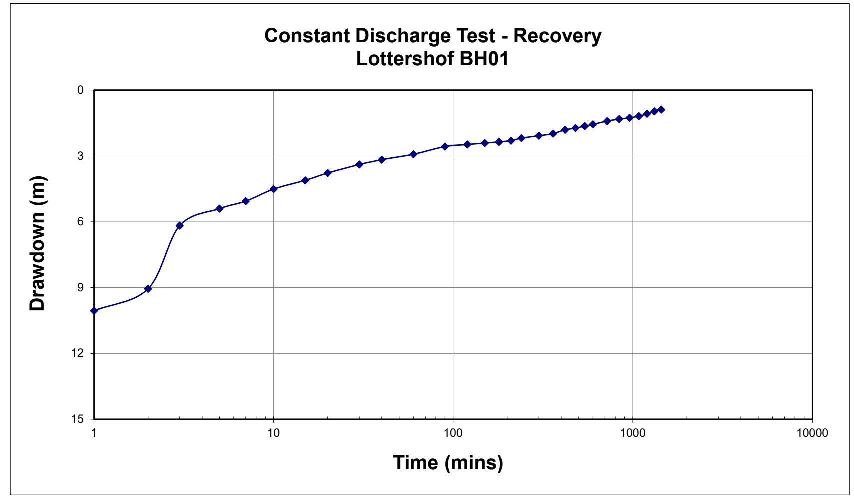

Step Drawdown Test
Lottershof BH01
Drawdown (m)
Time (mins)
Available drawdown = 69.6 m
1.0
2.0
3.1
3.7

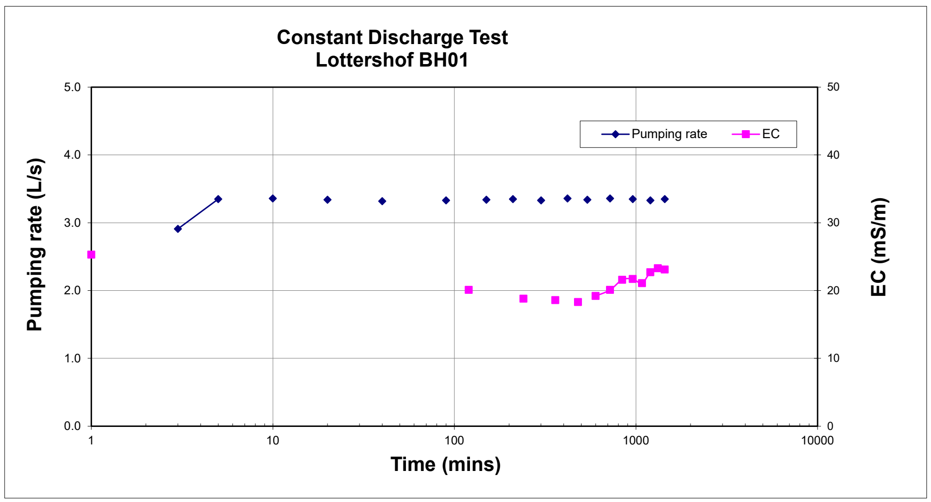

Step Drawdown Recovery
Lottershof BH01
Drawdown (m)
Time (mins)
Recovery

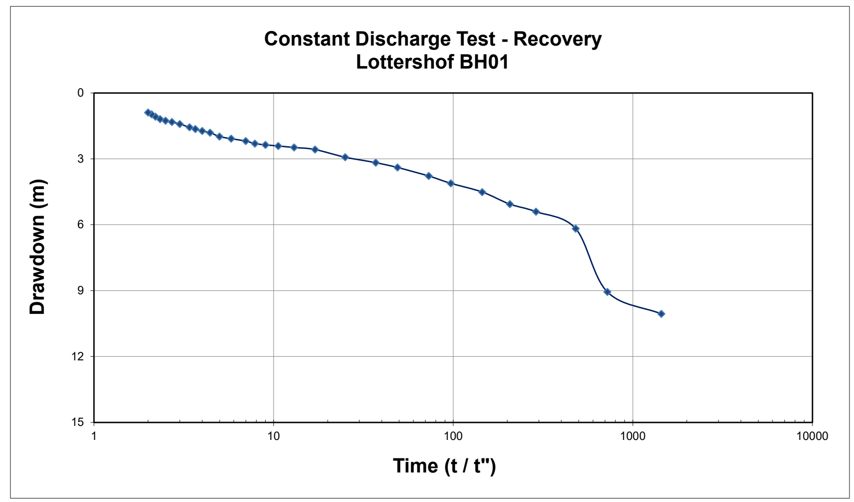

Step Drawdown Test
Lottershof BH01
EC (mS/m)
Time (mins)
Step1
Step2
Step3
Step4
Step5
Step6
Step7
Step8


Step Drawdown Performance
Lottershof BH01
Drawdown (m)
Pumping Rate (L/s)


Constant Discharge Test
Lottershof BH01
Drawdown (m)
Time (mins)
Available drawdown = 69.6 m


Constant Discharge Test - Recovery
Lottershof BH01
Drawdown (m)
Time (mins)


Constant Discharge Test
Lottershof BH01
Pumping rate (L/s)
EC (mS/m)
Pumping rate
EC
Time (mins)


Constant Discharge Test - Recovery
Lottershof BH01
Drawdown (m)
Time (t / t")

Distillery Road
Stellenbosch
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info@vinlab.com
www.vinlab.com
2023-01-27

vinlab H2O
Your partner in quality water analysis

TEST REPORT

Water

Groundwater Solutions cc t/a AB Pumps

Attn: - Ailene

@VinlabSA

-
East London
-
-
27828397258

Sample Details					
SampleID	W34930				
Water Type	Drinking Water				
Water Source	Borehole				
Sample Temperature					
Description	Borehole Water				
Batch Number	P2770 Elgin Lottershof				
PO Number	23039				
Date Received	2023-01-24				
Condition	Good				

Water - Routine

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	5.41				
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	21.3				
Turbidity (Water)*	ntu			<= 5	8.15				
Total dissolved solids (Water)*	mg/L			<= 1200	144.41				
Free Chlorine (Water)*	mg/L			<= 5	0.02				
Ammonia (NH4) as N (Water)	mg/L	VIN-05-MW08	2.5%	<= 1.5	<0.15				
Nitrate as N (Water)	mg/L	VIN-05-MW08	10%	<= 11	<1.00				
Nitrite as N (Water)	mg/L	VIN-05-MW08	10%	<= 0.9	<0.05				
Chloride (Cl-) - Water	mg/L	VIN-05-MW08	2.73%	<= 300	49.72				
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	7.02				
Fluoride (F) - Water	mg/L	VIN-05-MW08	9.74%	<= 1.5	<0.15				
Alkalinity as CaCO3 (Water)*	mg/L				<10.00				
Colour (Water)*	mg/L Pt-Co			<= 15	<15				
Total Organic Carbon (Water)*	mg/L			<=10	1.76				
Date Tested					2023-01-24				

Water - Metals

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		3				

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
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<35 and a negative result (non-detected) indicates a Cq value of >35.

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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

sanas Testing Laboratory
T0885

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Stellenbosch
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2023-01-27

TEST REPORT

Water

Groundwater Solutions cc t/a AB Pumps

Attn: - Ailene

@VinlabSA

-
East London
-
-
27828397258

Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		4				
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	27				
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		3				
Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	0.076				
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	31				
Cadmium (Cd) Water	µg/L	VIN-05-MW43	12.26%	<= 3	6				
Chromium (Cr) - Water	µg/L	VIN-05-MW43	13.03%	<= 50	5				
Copper (Cu) - Water	µg/L	VIN-05-MW43	11.57%	<= 2000	5				
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	950				
Lead (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	14				
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	406				
Nickel (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	<8				
Selenium (Se) - Water*	µg/L			<= 40	<10.0				
Aluminium (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	155				
Cyanide (CN) - Water*	µg/L			<= 200	<10.0				
Mercury (Hg) - Water*	µg/L			<= 6	<1.0				
Barium (Ba) Water	µg/L	VIN-05-MW43	14.09%	<= 700	58				
Uranium (U) - Water*	µg/L			<= 30	<28				
Date Tested					2023-01-25				

Water - Micro

	Unit	Method	Uncertainty	Limits	Results	Results	Results	Results	Results
Total Coliforms (Water)	cfu/100mL	VIN-05-MW09		<= 10	nd				
E-Coli (Water)	cfu/100mL	VIN-05-MW09		not detected	nd				
Heterotrophic plate count*	cfu/mL			<= 1000	600				
Date Tested					2023-01-24				

Comments

W34930
Two Samples received,

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

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2023-01-27

TEST REPORT

Water

Groundwater Solutions cc t/a AB Pumps

Attn: - Ailene

-
East London
-
-
27828397258

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

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

Appendix B: Yield Test Report – LFBH03

Borehole Yield and Quality Testing at Elgin Free Range Chickens Agri Operations, Lottershof Farm, Caledon

Prepared by
GEOSS
15 August 2024

GROUNDWATER AND EARTH SCIENCES
GEOSS
SOUTH AFRICA (Pty) Ltd

Executive Summary

GEOSS South Africa (Pty) Ltd was appointed by Willie Benson from Elgin Free Range Chickens Agri Operations to conduct yield and groundwater quality testing of one borehole at Lottershof farm, Caledon. The yield testing was undertaken by ATS under the management and supervision of GEOSS SA from the 30th of July to the 3rd of August 2024. This included a Step Test, CDT and Recovery Test at the borehole and sampling of the groundwater for chemical analysis. It is recommended that groundwater abstraction occur within the below-mentioned parameters from the tested borehole. Aquifer over-abstraction is unlikely to occur if these rates are adhered to and if the borehole is managed through long-term monitoring data.

Borehole Details				
Borehole Name	**Latitude (DD, WGS84)**	**Longitude (DD, WGS84)**	**Borehole Depth (m)**	**Inner Diameter (mm)**
ECA_BH1	-34.30790°	19.47264°	138.6	177
Abstraction Recommendations				
Borehole Name	**Abstraction rate (L/s)**	**Abstraction Duration (hrs)**	**Recovery Duration (hrs)**	**Possible Volume Abstracted (L/d)**
ECA_BH1	1.5	24	0	129 600
Pump Installation Details				
Borehole Name	**Pump Installation Depth (mbgl)**	**Critical Water Level (mbgl)**	**Dynamic Water Level (mbgl)***	**Rest Water Level (mbgl)**
ECA_BH1	66	63	29	8.23

* Typical water level expected during long-term production

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 borehole is 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.

From the laboratory results, groundwater from ECA_BH1 is of poor quality for potable use. The primary issue is elevated turbidity, measured at 27.3 NTU, which exceeds the SANS 241-1:2015 aesthetic standard. This level of turbidity is likely due to fine sediments entering the borehole, and it causes aesthetic issues such as cloudiness in the water. Although some of the turbidity may clear up during borehole development, the presence of elevated iron (0.549 mg/L) poses additional concerns. High iron levels can lead to aesthetic problems like red staining on walls and infrastructure, and they increase the risk of iron biofouling. If not managed properly, biofouling could clog the borehole and associated abstraction infrastructure.

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 129 600 L/d be required, it is recommended to decrease the pumping rate and not the pumping duration. By pumping continuously instead of on a stop-start schedule, iron oxidation in the borehole is minimized, decreasing the amount of iron precipitation inside the boreholes and pumps.

To facilitate monitoring and informed management of the borehole, it is recommended to equip borehole with the following monitoring infrastructure and equipment:

- 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)

This report is an important document for obtaining the legal compliance with regard to the use of the groundwater with the Department of Water and Sanitation, but does not constitute a Geohydrological Assessment report in support of a WULA, which would need to incorporate information from this report.

Client Information:

Prepared for	Elgin Free Range Chickens Agri Operations
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Contact Email	willieb@efrc.co.za
Contact Number	072 587 4537

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Document Information and History:

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Report No	2024/08-19		
Suggested Citation	GEOSS (2024). Borehole Yield and Quality Testing at Elgin Free Range Chickens Agri Operations, Lottershof Farm, Caledon. GEOSS Report Number: 2024/08-19. GEOSS – South Africa (Pty) Ltd. Stellenbosch, South Africa.		
GEOSS Project Number	2019_06-3569_L		
Cover Photo	Cover photo taken during yield testing		
Issue	Version	Date	Reviewed by
1	1.0	15 August 2024	Ashleigh Lakshuman

Principal Author(s) and Reviewer(s):

	Principal Author	Principal Reviewer
		A.Lakshuman
Name	Reuben Lazarus	Ashleigh Lakshuman
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SACNASP No.	120711	131887
Registration	Earth Science (Pr.Sci.Nat)	Earth Science (Can.Sci.Nat)

Table of Contents

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Abbreviations

AD	Available Drawdown
bh	Borehole
CDT	Constant Discharge Test
CGS	Council for Geoscience
DD	Decimal degree
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
GRF	Generalised Radial Flow
IARF	Infinite Acting Radial Flow
ID	inner diameter
L/d	litres per day
L/s	litres per second
m	metres
m^2/d	meters squared per day
mamsl	metres above mean sea level
mbch	metres below collar height
mbgl	metres below ground level
mg	milligram
mg/L	milligram per litre
mm	millimetres
nd	not detected
OD	outer diameter
RWL	rest water level below ground level
SANS	South African National Standard
T	Transmissivity
TDS	total dissolved solids
WGS84	Since the 1st January 1999, the official co-ordinate system for South Africa is based on the World Geodetic System 1984 ellipsoid, commonly known as WGS84
WL	water level
WULA	Water Use Licence Assessment

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)].
available drawdown	available drawdown in a borehole is the difference between the rest water level or piezometric surface and the depth that the water level may drop to (typically major water baring unit, boundary inflection or pump depth).
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 [from National Water Act (Act No. 36 of 1998)].
confined aquifer	an aquifer confined between two impermeable beds
dynamic water level	the stabilised water level in the borehole during production over long periods of time.
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.
intergranular aquifer	an aquifer in which groundwater is stored in and flows through open pore spaces in the unconsolidated Quaternary deposits.
rest water level	the groundwater level in a borehole not influenced by abstraction or artificial recharge.
sustainable yield	sustainable yield is defined as the 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.
transmissivity	the rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient.
unconfined aquifer	an aquifer which has free water surface - which means the water table exists for this type of aquifer; primarily recharged by the infiltration of precipitation from the ground surface

SPECIALIST EXPERTISE

CURRICULUM VITAE – Reuben Lazarus

GENERAL

Nationality:	South African
Profession:	Hydrogeologist
Specialization:	Groundwater development, yield testing, geochemistry and camera logging
Position in firm:	Hydrogeologist, Business Unit Leader: Yield and Water Quality Testing at GEOSS South Africa (Pty) Ltd
Date commenced:	October 2017
Year of birth & ID #:	1992 – 9207075195083
Language skills:	Afrikaans (mother tongue) English (excellent)

KEY SKILLS

- Groundwater component of Catchment Management Strategies and other Groundwater Resource Directed Measures.
- 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.
- Groundwater contamination assessments – geochemical analysis.
- Writing of hydrogeological reports
- ArcMap / Geochemist's Workbench / WISH and typical software skills.

EDUCATIONAL AND PROFESSIONAL STATUS

Qualifications

2018	BSc (Geology – Environmental Geochemistry)	University of Stellenbosch, South Africa
2016	BSc (Hons) (Earth Science)	University of Stellenbosch, South Africa
2015	BSc (Earth Science)	University of Stellenbosch, South Africa

Courses and symposiums

2023	VFD Level 1 and Level 2 (ElectroMechanica)
2023	PLC Level 1 and Level 2 AS 200 (ElectroMechanica)
2023	Basic hydraulics & Pumps (Dudley Willer)
2022	Environmental Sampling Workshop (Van Walt)
2019	SA remediation workshop (Enviro Workshops)

Memberships/Organisations

- South African Council for National Scientific Professions (SACNASP)- Mem. No. Pr.Sci.Nat: 120711
- Groundwater Division of the Geological Society of South Africa UID 9661/21
- Geological Society of South Africa Mem. No. 970021

EMPLOYMENT RECORD

June 2021 – present:	GEOSS South Africa (Pty) Ltd, Stellenbosch *Project Hydrogeologist: Yield and Water Quality Testing Business Unit Leader*
October 2018 – June 2021:	GEOSS South Africa (Pty) Ltd, Stellenbosch *Project Hydrogeologist*
October 2017 – October 2018:	GEOSS - Geohydrological and Spatial Solutions International (Pty) Ltd *Student Hydrogeologist*

SPECIALIST DECLARATION

I, Reuben Lazarus, as the appointed independent specialist(s) hereby declare that we:

- 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, and
- 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 South African National Standard (SANS 10299-4:2003, Part 4 – Test pumping of water boreholes);
- have and will not have no vested interest in the proposed activity proceeding;
- 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

Reuben Lazarus
GEOSS South Africa (Pty) Ltd
SACNSAP – Pr.Sci.Nat:
15 August 2024

1 Introduction

GEOSS South Africa (Pty) Ltd was appointed by Willie Benson from Elgin Free Range Chickens Agri Operations to conduct yield and water quality testing of one borehole at Lottershof farm, Caledon.

The borehole was tested by ATS under the management and supervision of GEOSS SA from the 30th of July to the 3rd of August 2024, details of this are presented in this report. The borehole's details are presented in **Table 1** below and spatially in **Map 1**. A borehole drill log is presented in **Appendix A.** The geological setting of the area indicates that the borehole is drilled through the sandstone of the Rietvlei formation (**Map 2**).

Table 1: Borehole Details.

Borehole	Latitude (DD, WGS84)	Longitude (DD, WGS84)	Depth (m)
ECA_BH1	-34.30790°	19.47264°	138.6

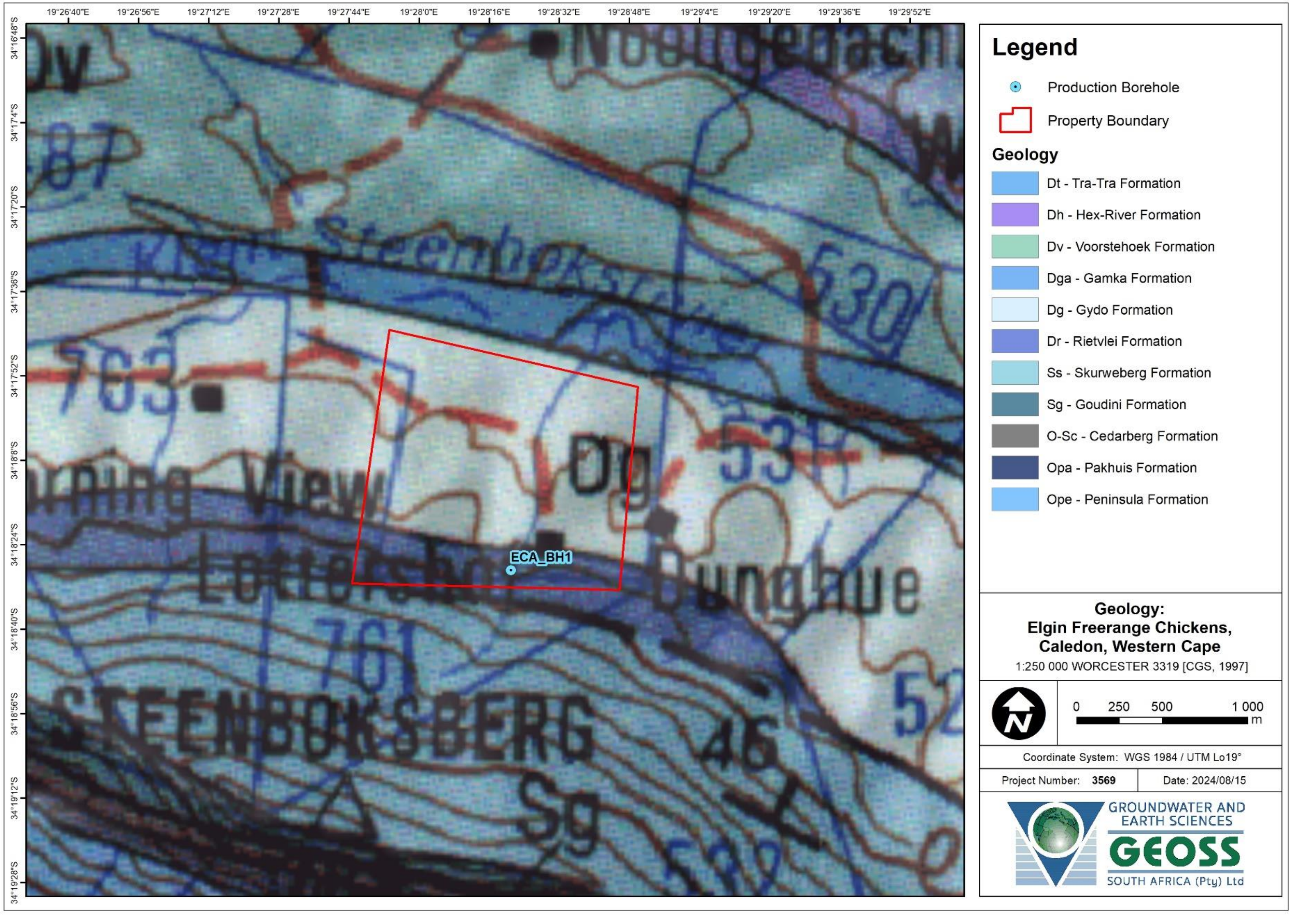
Figure 1: ECA_BH1 during (left) and after (right) testing.

2 Yield Testing

2.1 Methodology

The yield testing was undertaken by ATS under the management and supervision of GEOSS SA from the 30th of July to the 3rd of August 2024 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 borehole is 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 B**.

Map 1: Borehole Locality Map.



Map 2: Geological Map with Property Boundary and Tested Borehole Position (1:250 000 Geological Map Series, 3319 Worcester) (CGS, 1997).

The yield test data was analysed using the excel-based FC program, developed by the IGS (Institute for Groundwater Studies) in Bloemfontein. The sustainable 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 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 ECA_BH1 this was 54 m (63 mbgl), based on an inflection point observed in the test data corresponding to a fracture observed during drilling. 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 test and submitted for inorganic chemical analyses.

2.2 Yield Testing at AB_BH1

The yield testing was conducted between the 30th of July and the 3rd of August 2024. The borehole was measured to a depth of 138.6 meters below ground level (mbgl). The test pump was installed at a depth of 118.5 mbgl. The rest water level (RWL) at the start of the test was 8.23 mbgl.

During the step test, the water level was drawn down 83.86 meters below the rest water level (92.8 mbgl) during the 4th step at a rate of 25 L/s. 10 minutes into the final step the pump broke down due to sand ingress. **Figure 2** shows the time-series drawdown for the Step Test.

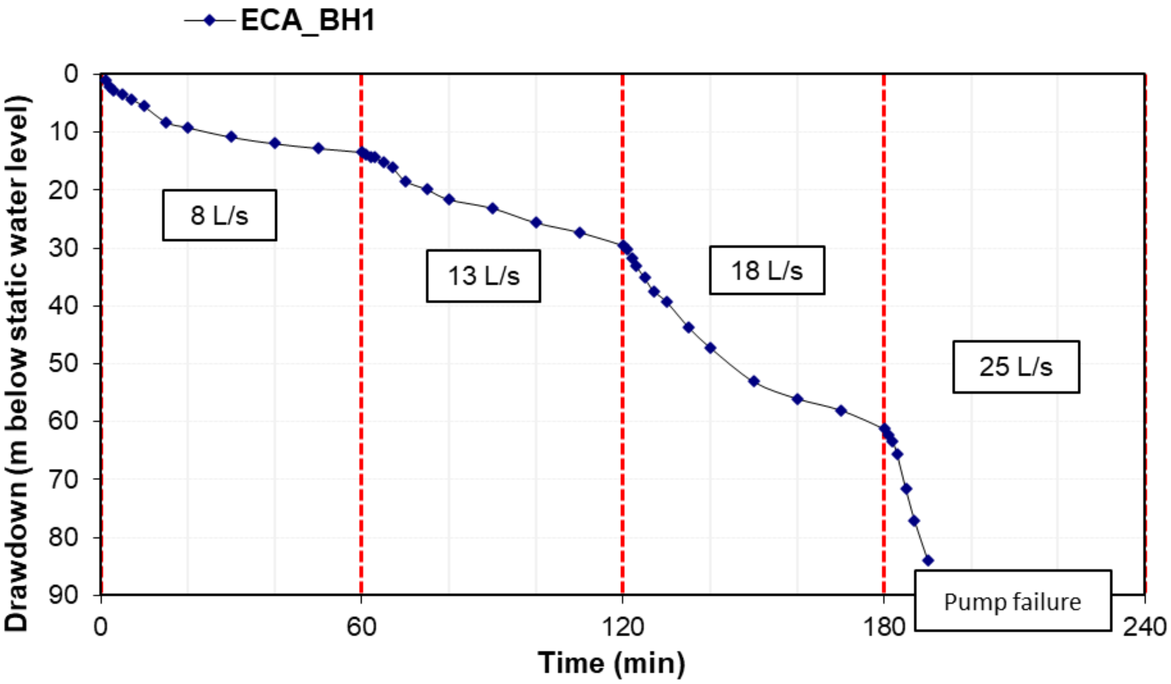


Figure 2: Step Test drawdown data for ECA_BH1.

The water level was left to recover overnight. Before starting the CDT, the water level recovered to 8.57 mbgl. Based on the results of the Step Test, the planned 24-hour CDT was conducted at a rate of 15 L/s (54 000 L/hour). After 17.7 hours, the water level had drawn down 109.12 meters below the rest water level (pump inlet). The borehole was left to recover to 12.98 mbgl, before starting a second CDT for the remaining 7 hours at 12.5 L/s. After the 7 hours, the water level had drawn down to 52.7 meters below the rest water level to 66.39 mbgl.

The semi-log plot of the drawdown from the CDT is presented in **Figure 3**. The available drawdown (AD) is indicated with the horizontal red line at 54 m.

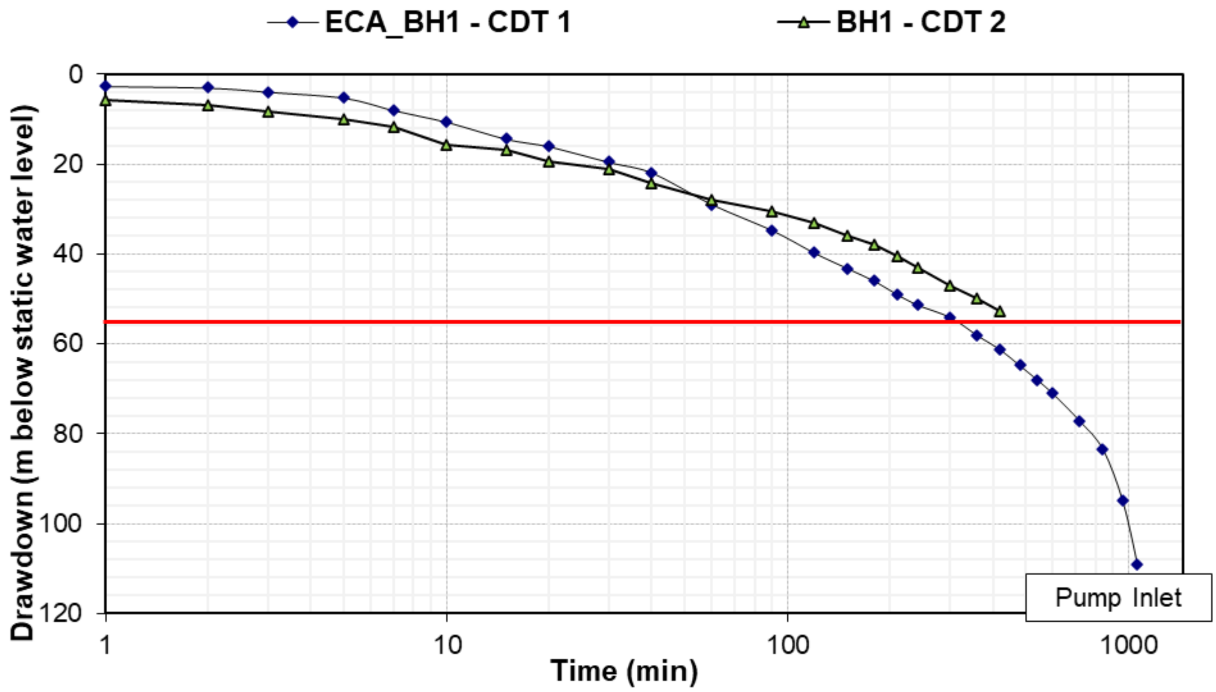


Figure 3: Semi-Log Plot of drawdown during the CDT of ECA_BH1 (CDT 1: 15 L/s, CDT 2: 12.5 L/s).

The recovery of the water level was monitored after the first CDT and is presented in **Figure 4**. The recovery was moderate, reaching 93.6% after pump time and 95.8% in 24 hours. Monitoring will be essential to determine the long-term recovery of the borehole.

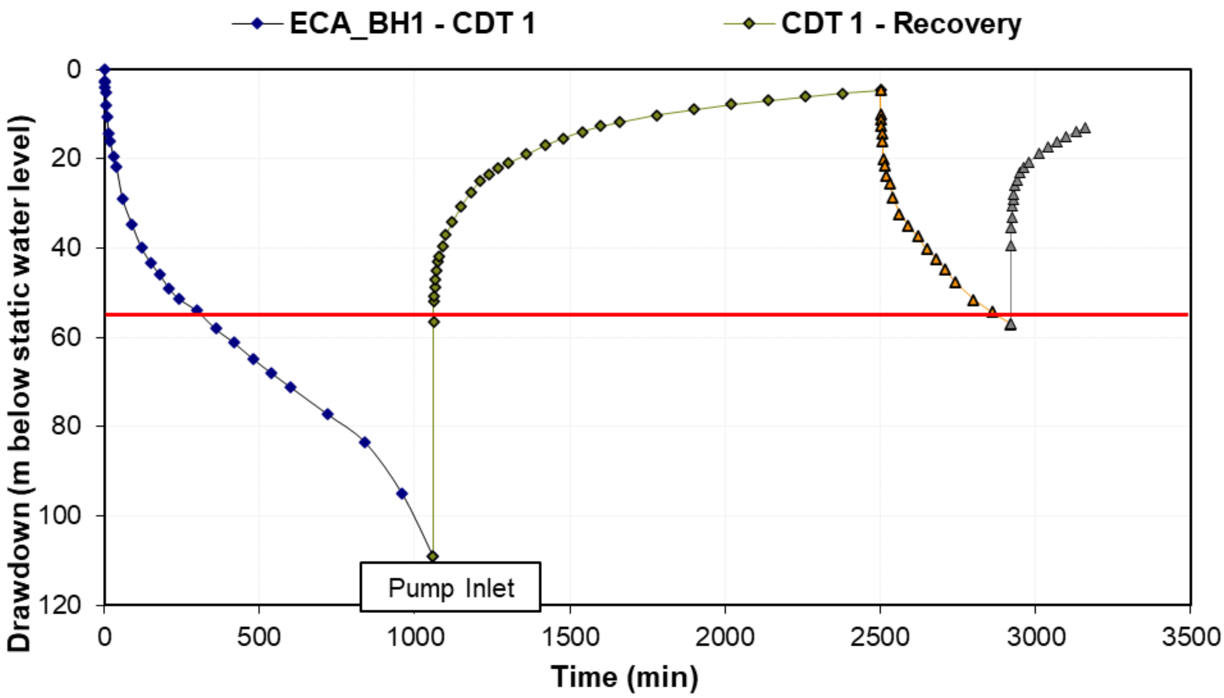


Figure 4: Time-series drawdown and recovery for ECA_BH1 (CDT 1: 15 L/s, CDT 2: 12.5 L/s).

Several methods were used to assess the yield test data as presented in **Table 2**. It is recommended that the borehole can be abstracted from at a rate of up to 1.5 L/s (5 400 L/hour) for up to 24 hours per day. The assessments were based on an available drawdown (AD) of 54 meters below the RWL of the CDT, which equates to 63 mbgl.

Table 2: Yield Determination - ECA_BH1.

ECA_BH1			
Method	**Sustainable Yield (L/s)**	**Late *T (m^2/d)**	***AD used (m)**
Basic FC	1.88	5.8	54.0
FC inflection point	1.89		58.0
Cooper-Jacob	2.19	6.1	54.0
FC Non-Linear	0.71	3	54.0
Barker	0.79		54.0
Average Q_sust (L/s)	**1.49**		
Recommended Abstraction			
Abstraction Rate (L/s)	**Abstraction Duration (hours)**		**Recovery Duration (hours)**
1.5	24		0

**AD- Available Drawdown
* T – Transmissivity

No boreholes were monitored during the testing of ECA_BH1. Transmissivity was calculated through the Theis method using the drawdown response in ECA_BH1. The transmissivity of the system was calculated at 6.1 m^2/d. A storativity value of $5x10^{-4}$ was used for the radius of influence calculation based on an average expected value of confined aquifers as report by (Todd, 1980). Based on the aquifer parameters the radius of influence was calculated for the recommended sustainable yield of the borehole. A drawdown of up to 5 meters can be expected 1 kilometre away from ECA_BH1 at the recommended sustainable rate (1.5 L/s for 24 hours per day) after 2 years of abstraction without recharge (**Figure 5**).

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 model will only provide an indication of how abstraction at AB_BH1 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.

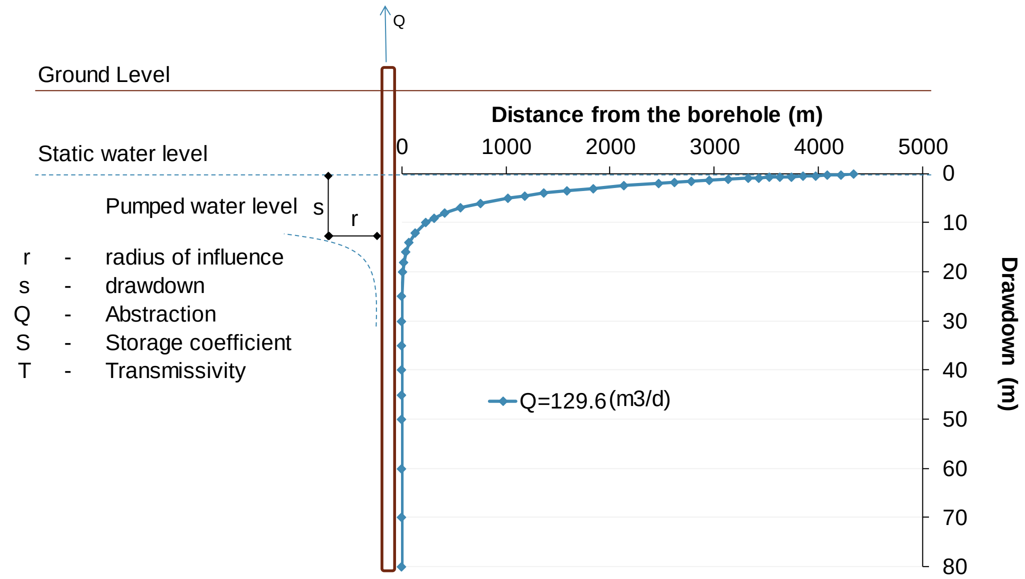


Figure 5: Radius of influence for ECA_BH1 at the recommended sustainable yield (1.5 L/s).

3 Water Quality Analysis

Groundwater samples were collected from the borehole at the end of the yield test and submitted for inorganic chemical analyses to a SANAS accredited laboratory (Vinlab) in the Western Cape. The certificate of analysis for the sample is presented in **Appendix C**. The chemistry results obtained for the borehole have been classified according to the SANS241-1: 2015 standards for domestic water (**Table 3**). **Table 5** presents the water chemistry analysis results, colour coded according to the SANS241-1: 2015 drinking water assessment standards.

Table 3: Classification table for the specific limits.

Acute Health	Aesthetic	Chronic Health	Operational	Acceptable

The limits and associated risks for domestic 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 4** enables an evaluation of the water quality with regards to the various parameters measured (DWAF, 1998). **Table 6** presents the water chemistry analysis results colour coded according to the DWAF drinking water assessment standards.

Table 4: 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, 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.

From the chemical results presented in **Table 5** and **Table 6**, groundwater from ECA_BH1 is of poor quality for potable use. The primary issue is elevated turbidity, measured at 27.3 NTU, which exceeds the SANS 241-1:2015 aesthetic standard. This level of turbidity is likely due to fine sediments entering the borehole, and it causes aesthetic issues such as cloudiness in the water. Although some of the turbidity may clear up during borehole development, the presence of elevated iron (0.549 mg/L) poses additional concerns. High iron levels can lead to aesthetic problems like red staining on walls and infrastructure, and they increase the risk of iron biofouling. If not managed properly, biofouling could clog the borehole and associated abstraction infrastructure.

Table 5: Production borehole results classified according to SANS241-1:2015.

Analyses	ECA_BH1	SANS 241-1:2015
Date and Time Sampled	03/09/2024 15:00	
pH (at 25 ºC)	6.0	5.0 ≤ Operational ≤ 9.7
Conductivity (mS/m) (at 25 ºC)	28.0	Aesthetic ≤170
Total Dissolved Solids (mg/L)	189.84	Aesthetic ≤1200
Turbidity (NTU)	27.30	Operational ≤1 Aesthetic ≤5
Colour (mg/L as Pt)	<15	Aesthetic ≤15
Sodium (mg/L as Na)	37	Aesthetic ≤200
Potassium (mg/L as K)	4	N/A
Magnesium (mg/L as Mg)	4	N/A
Calcium (mg/L as Ca)	7	N/A
Chloride (mg/L as Cl)	64.43	Aesthetic ≤300
Sulphate (mg/L as SO_4)	6.86	Aesthetic ≤250 Acute ≤500
Nitrate & Nitrite Nitrogen (mg/L as N)	0.068	≤1 Acute Health
Nitrate Nitrogen (mg/L as N)	<1.00	Acute Health ≤11
Nitrite Nitrogen (mg/L as N)	<0.05	Acute Health ≤0.9
Ammonia Nitrogen (mg/L as N)	<0.15	Aesthetic ≤1.5
Total Alkalinity (mg/L as $CaCO_3$)	25.1	N/A
Total Hardness (mg/L as $CaCO_3$)	33.9	N/A
Fluoride (mg/L as F)	0.16	Chronic Health ≤1.5
Aluminium (mg/L as Al)	0.217	Operational ≤0.3
Total Chromium (mg/L as Cr)	<0.004	Chronic Health ≤0.05
Manganese (mg/L as Mn)	0.045	Aesthetic ≤0.1 Chronic ≤0.4
Iron (mg/L as Fe)	0.549	Aesthetic ≤0.3 Chronic ≤2
Nickel (mg/L as Ni)	<0.008	Chronic Health ≤0.07
Copper (mg/L as Cu)	0.005	Chronic Health ≤2
Zinc (mg/L as Zn)	0.716	Aesthetic ≤5
Arsenic (mg/L as As)	<0.010	Chronic Health ≤0.01
Selenium (mg/L as Se)	<0.008	Chronic Health ≤0.04
Cadmium (mg/L as Cd)	<0.001	Chronic Health ≤0.003
Antimony (mg/L as Sb)	<0.013	Chronic Health ≤0.02
Mercury (mg/L as Hg)	0.002	Chronic Health ≤0.006
Lead (mg/L as Pb)	<0.008	Chronic Health ≤0.01
Uranium (mg/L as U)	<0.028	Chronic Health ≤0.03
Cyanide (mg/L as CN^-)	<0.01	Acute Health ≤0.2
Total Organic Carbon (mg/L as C)	1.74	N/A
Charge Balance Error %	0.5	≥-5 - ≤5 Acceptable

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Table 6: Classified production borehole results according to DWAF 1998.

Sample Marked:	ECA_BH1	DWAF (1998) Drinking Water Assessment Guide				
		Class 0	**Class I**	**Class II**	**Class III**	**Class IV**
		Ideal	**Good**	**Marginal**	**Poor**	**Dangerous**
Date and Time Sampled	03/09/2024 15:00					
pH	6.0	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)	28.0	<70	70-150	150-370	370-520	>520
Turbidity (NTU)	**27.30**	<0.1	0.1-1	1.0-20	20-50	>50
	mg/L					
Total Dissolved Solids	189.84	<450	450-1000	1000-2400	2400-3400	>3400
Sodium (as Na)	37	<100	100-200	200-400	400-1000	>1000
Potassium (as K)	4	<25	25-50	50-100	100-500	>500
Magnesium (as Mg)	4	<70	70-100	100-200	200-400	>400
Calcium (as Ca)	7	<80	80-150	150-300	>300	
Chloride (as Cl)	64.43	<100	100-200	200-600	600-1200	>1200
Sulphate (as SO_4)	6.86	<200	200-400	400-600	600-1000	>1000
Nitrate & Nitrite (as N)	0.068	<6	6.0-10	10.0-20	20-40	>40
Fluoride (as F)	0.16	<0.7	0.7-1.0	1.0-1.5	1.5-3.5	>3.5
Manganese (as Mn)	0.045	<0.1	0.1-0.4	0.4-4	4.0-10.0	>10
Iron (as Fe)	0.549	<0.5	0.5-1.0	1.0-5.0	5.0-10.0	>10
Copper (as Cu)	0.005	<1	1-1.3	1.3-2	2.0-15	>15
Zinc (as Zn)	0.716	<20	>20			
Arsenic (as As)	<0.010	<0.010	0.01-0.05	0.05-0.2	0.2-2.0	>2.0
Cadmium (as Cd)	<0.001	<0.003	0.003-0.005	0.005-0.020	0.020-0.050	>0.050
Hardness (as $CaCO_3$)	33.900	<200	200-300	300-600	>600	
Charge Balance Error %	0.5	≥-5 - ≤5 Acceptable				

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 Stiff Diagram is a graphical representation of the equivalent concentrations of the cations (positive ions) and anions (negative ions). This diagram shows concentrations of cations and anions relative to each other and direct reference can be made to specific salts in the water. From **Figure 6**, ECA_BH1 is classified as a Sodium & Potassium/Chloride hydrofacies. This is expected of groundwater hosted in the sandstone of the Rietvlei formation.

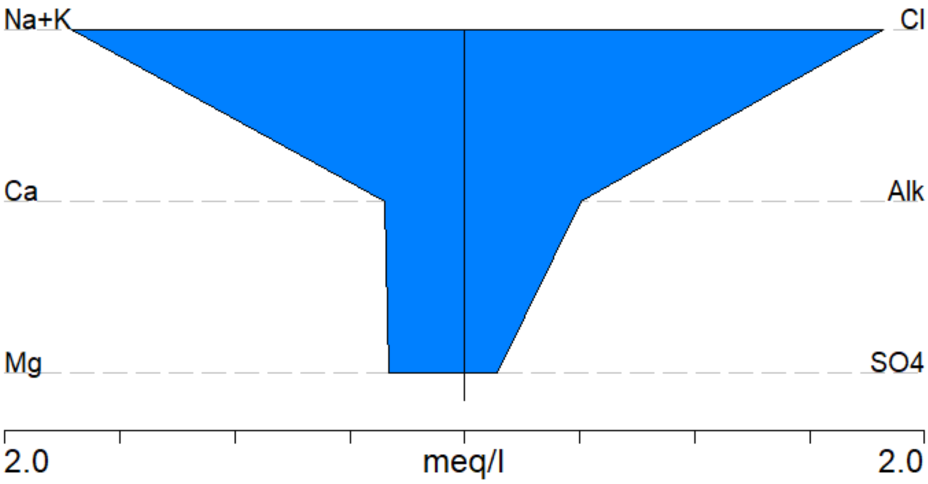

Figure 6: Stiff diagram of the groundwater sample (ECA_BH1).

The Sodium Adsorption Ratio (SAR) of the groundwater is plotted in **Figure 7**. ECA_BH1 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, is dependent on soil texture and crop type.

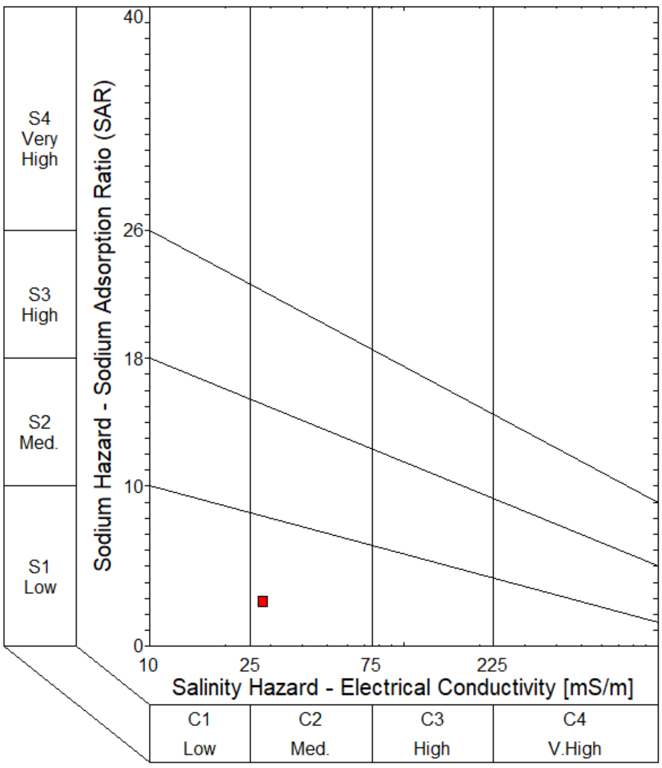

Figure 7: SAR diagram of the groundwater sample (ECA_BH1).

4 Recommendations

Based on the information obtained from the yield test, the abstraction recommendation for the borehole is presented in **Table 7**. 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 rate, should the dynamic water level's drawdown be less or more than expected as per **Table 7**. Both of these points are best managed through long term monitoring data.

Table 7: Borehole Abstraction Recommendations.

Borehole Details				
Borehole Name	**Latitude (DD, WGS84)**	**Longitude (DD, WGS84)**	**Borehole Depth (m)**	**Inner Diameter (mm)**
ECA_BH1	-34.30790°	19.47264°	138.6	177
Abstraction Recommendations				
Borehole Name	**Abstraction rate (L/s)**	**Abstraction Duration (hrs)**	**Recovery Duration (hrs)**	**Possible Volume Abstracted (L/d)**
ECA_BH1	1.5	24	0	129 600
Pump Installation Details				
Borehole Name	**Pump Installation Depth (mbgl)**	**Critical Water Level (mbgl)**	**Dynamic Water Level (mbgl)***	**Rest Water Level (mbgl)**
ECA_BH1	66	63	29	8.23

* Typical water level expected during long-term production

For borehole ECA_BH1 it is recommended that abstraction can occur at a rate of up to 1.5 L/s for 24 hours per day. A pump suitable to deliver the recommended rate should be installed at a depth of 66 mbgl. It is anticipated that abstraction at the recommended rate will cause the water level to drop to a depth of approximately 29 mbgl – this is referred to as the dynamic water level. During abstraction, a maximum level cut off switch should be installed to 63 mbgl to ensure the groundwater level does not drop to the pump inlet.

From the laboratory results, groundwater from ECA_BH1 is of poor quality for potable use. The primary issue is elevated turbidity, measured at 27.3 NTU, which exceeds the SANS 241-1:2015 aesthetic standard. This level of turbidity is likely due to fine sediments entering the borehole, and it causes aesthetic issues such as cloudiness in the water. Although some of the turbidity may clear up during borehole development, the presence of elevated iron (0.549 mg/L) poses additional concerns. High iron levels can lead to aesthetic problems like red staining on walls and infrastructure, and they increase the risk of iron biofouling. If not managed properly, biofouling could clog the borehole and associated abstraction infrastructure.

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 129 600 L/d be required, it is recommended to decrease the pumping rate and not the pumping duration. By pumping continuously instead of on a stop-start schedule, iron oxidation in the borehole is minimized, 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 borehole is 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 authorization type, in the Berg, 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 borehole, it is highly recommended that the borehole be equipped with the following monitoring infrastructure and equipment (diagram included in **Appendix D**):

- 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).

This monitoring data should be analysed by a qualified Hydrogeologist to ensure long-term sustainable use from the borehole. The legal compliance with regard to the use of the groundwater also needs to be addressed with the Department of Water and Sanitation.

5 References

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SANS (10299-4:2003). South African National Standard. Development, maintenance and management of groundwater resources. Part 4: Test-pumping of water boreholes. ISBN 0-626-14912-6.

SANS (241-1:2015). Drinking water – Part 1: Microbiological, physical, aesthetic and chemical determinants.

6 Appendix A: Borehole Log

Log of Borehole No.: ECA_BH1

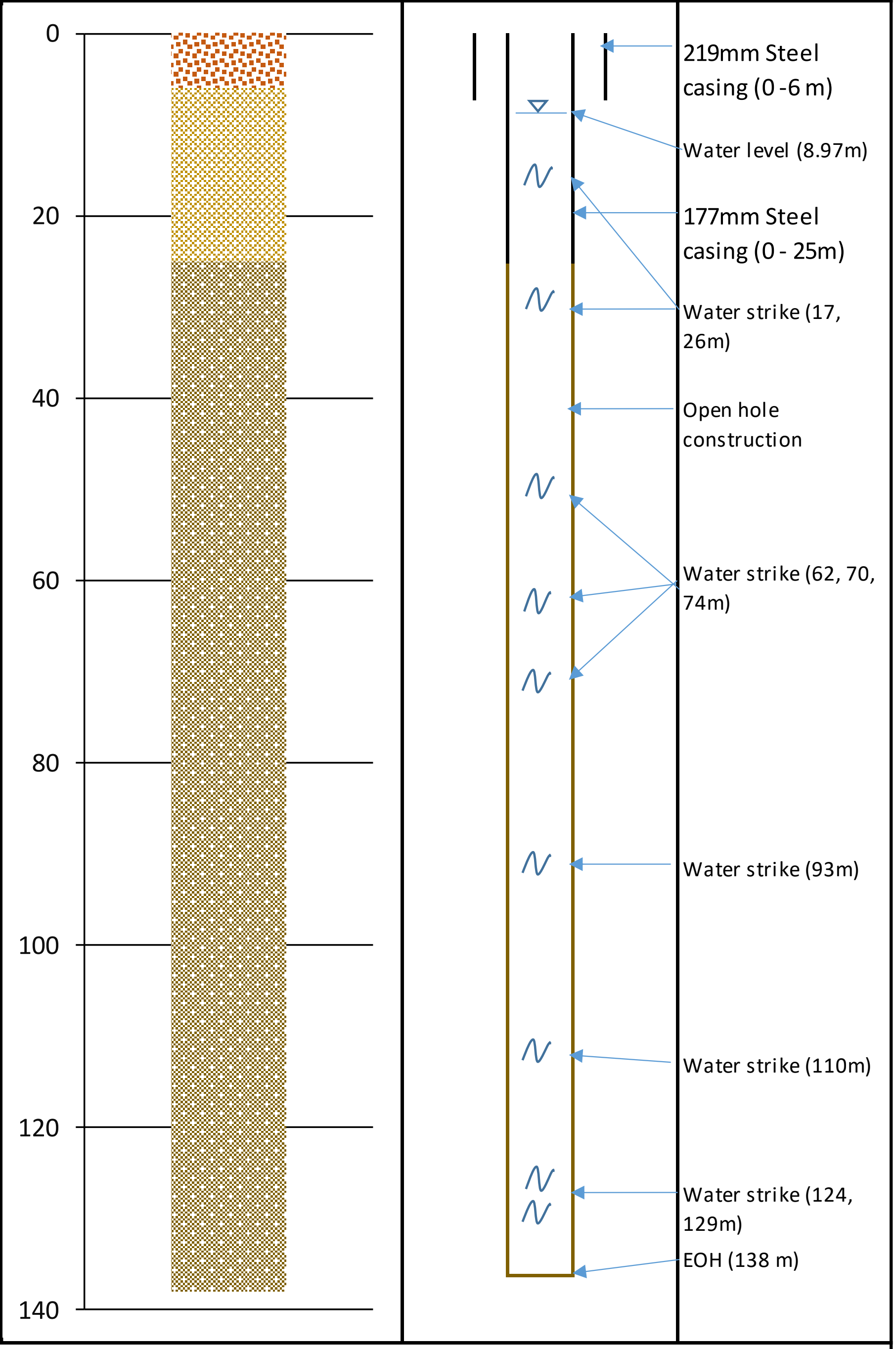
Location:	EFRC Agri Calendon	**Latitude:**	-34.3079
Date:	15-Aug-24	**Longitude:**	19.47264
Client:	EFRC Agri	**Ground Elevation:**	237 mamsl

Lithological Description	Lithology Symbol & Depth (m)	Borehole Construction	Description & water strike

Overburden

Weathered sandstone

Sandstone



Drilled By:	RPM Drilling	**Remarks:**	Blow yield: 60 000 L/h
Drill Method:	Air percussion		
Logged By:	RPM Drilling		

7 Appendix B: Yield Test Data

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

BOREHOLE TEST RECORD

PR0JECT #	P2987
TEAM MEMBERS	MZIMKHULU
	ISAAC
	LUKHANYO

CONSULTANT: GEOSS
DISTRICT: OVERBERG
PROVINCE: WESTERN CAEP
FARM / VILLAGE NAME : ELGIN CHICKEN FARM
DATE TESTED: 31/07/2024

BOREHOLE LOCATION & ACCESS INFORMATION:		
BOREHOLE COORDINATES		**COMMENTS ON ACCESS IF ANY:**
LATITUDE (SOUTH):	34.3079	
LONGITUDE (EAST):	19.47264	
BOREHOLE NO:	**ECA-BH1**	
TRANSMISSIVITY VALUE:		
TYPE INSTALLATION:	**NEW BOREHOLE**	
BOREHOLE DEPTH: (mbg	**138.6**	

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**	EC
Date sample taken	03/08/2024		If sample courier, to where:		**DATA CHECKED BY:**	AVN
Time sample taken	15H00					

DESCRIPTION:	UNIT	QTY		UNIT	QTY
STRAIGHTNESS TEST:	**NO**	0	BOREHOLE DEPTH AFTER TEST:	**M**	138.60
VERTICALLY TEST:	**NO**	0	BOREHOLE WATER LEVEL AFTER TEST: (mbch)	**M**	12.7
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 :	P2987	Coordinates: SOUTH:	34.3079	PROVINCE:	WESTERN CAEP
BOREHOLE NO:	ECA-BH1	EAST:	19.47264	DISTRICT:	OVERBERG
ALT BH NO:	0			SITE NAME:	ELGIN CHICKEN FARM
ALT BH NO:	0				
BOREHOLE DEPTH (m)	138.60	DATUM LEVEL ABOVE CASING (m):	0.32	EXISTING PUMP:	0
WATER LEVEL (mbdl):	8.94	CASING HEIGHT: (magl):	0.39	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	118.50	DIAM PUMP INLET (mm):	170.00	PUMP TYPE:	WA 110-2

STEPPED DISCHARGE TEST & RECOVERY

DISCHARGE RATE 1			276	
DATE:	31/07/2022	TIME:	12H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	1.08		**1**	
2	2.13		**2**	
3	2.83		**3**	
5	3.50		**5**	
7	4.28	6.25	**7**	
10	5.50		**10**	
15	8.25	8.02	**15**	
20	9.20	8.09	**20**	
30	10.85		**30**	
40	11.98	8.12	**40**	
50	12.77		**50**	
60	13.49	8.04	**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP	22.10	°C	**180**	
EC	288	µS/cm	**210**	

DISCHARGE RATE 2		RPM	434	
DATE:	31/07/202	TIME:	13H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	13.96		**1**	
2	14.24	10.96	**2**	
3	14.37		**3**	
5	15.12	12.52	**5**	
7	16.04		**7**	
10	18.43	13.00	**10**	
15	19.90		**15**	
20	21.62	13.04	**20**	
30	23.13	13.10	**30**	
40	25.63		**40**	
50	27.30	13.12	**50**	
60	29.57		**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP	17.80	°C	**180**	
EC	274	µS/cm	**210**	

DISCHARGE RATE 3		RPM	618	
DATE:	31/07/202	TIME:	14H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	30.22		**1**	
2	31.84		**2**	
3	33.08		**3**	
5	35.17	17.45	**5**	
7	37.43		**7**	
10	39.27	18.09	**10**	
15	43.63		**15**	
20	47.17	18.14	**20**	
30	53.07	18.11	**30**	
40	56.03		**40**	
50	58.02	18.06	**50**	
60	61.28		**60**	
70			**70**	
80			**80**	
90			**90**	
100			**100**	
110			**110**	
120			**120**	
pH			**150**	
TEMP	16.20	°C	**180**	
EC	256	µS/cm	**210**	

DISCHARGE RATE 4			RPM	
DATE:	31/07/2024	TIME:	15H40	
TIME (MIN)	DRAW DOWN (M)	YIELD (L/S)	TIME (MIN)	RECOVERY (M)
1	62.30		**1**	38.96
2	63.43		**2**	28.91
3	65.62		**3**	25.89
5	71.61	21.24	**5**	25.00
7	77.02		**7**	21.24
10	83.86	22.28	**10**	19.17
15			**15**	17.67
20			**20**	16.56
30			**30**	14.49
40			**40**	12.95
50			**50**	11.57
60			**60**	10.76
70			**70**	10.03
80			**80**	9.66
90			**90**	9.28
100			**100**	8.68
110			**110**	8.16
120			**120**	7.67
pH			**150**	6.99
TEMP		°C	**180**	6.27
EC		µS/cm	**210**	
			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) 8.97

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P2987	Coordinates: SOUTH:	34.3079	PROVINCE:	WESTERN CAEP
BOREHOLE NO:	ECA-BH1	EAST:	19.47264	DISTRICT:	OVERBERG
ALT BH NO:	0			SITE NAME:	ELGIN CHICKEN FARM
ALT BH NO:	0				
BOREHOLE DEPTH:	138.60	DATUM LEVEL ABOVE CASING (m):	0.32	EXISTING PUMP:	0
WATER LEVEL (mbdl):	9.28	CASING HEIGHT: (magl):	0.39	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	118.50	DIAM PUMP INLET(mm):	170	PUMP TYPE:	WA 110-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED		**TEST COMPLETED**			
DATE: 01/08/2024	TIME: 13H00	DATE:	TIME:	TYPE OF PUMP:	WA 110-2

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance(m);			OBSERVATION HOLE 2 NR: Distance(m);			OBSERVATION HOLE 3 NR: 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	2.64		**1**	56.57	**1**			**1**			**1**	
2	3.00		**2**	51.91	**2**			**2**			**2**	
3	3.92		**3**	50.74	**3**			**3**			**3**	
5	5.26		**5**	48.76	**5**			**5**			**5**	
7	8.02	11.68	**7**	47.02	**7**			**7**			**7**	
10	10.63		**10**	44.98	**10**			**10**			**10**	
15	14.41	13.46	**15**	42.96	**15**			**15**			**15**	
20	16.09		**20**	41.90	**20**			**20**			**20**	
30	19.56	15.06	**30**	39.60	**30**			**30**			**30**	
40	21.20		**40**	37.02	**40**			**40**			**40**	
60	28.96	15.10	**60**	34.23	**60**			**60**			**60**	
90	34.71	15.08	**90**	30.70	**90**			**90**			**90**	
120	39.76		**120**	27.57	**120**			**120**			**120**	
150	43.21	15.02	**150**	25.08	**150**			**150**			**150**	
180	46.02		**180**	23.52	**180**			**180**			**180**	
210	49.00	15.11	**210**	22.06	**210**			**210**			**210**	
240	51.26		**240**	21.09	**240**			**240**			**240**	
300	54.08	15.03	**300**	18.95	**300**			**300**			**300**	
360	58.10	15.07	**360**	17.00	**360**			**360**			**360**	
420	61.24		**420**	15.40	**420**			**420**			**420**	
480	64.82	15.12	**480**	14.02	**480**			**480**			**480**	
540	68.00		**540**	12.88	**540**			**540**			**540**	
600	71.09	15.07	**600**	11.87	**600**			**600**			**600**	
720	77.20		**720**	10.31	**720**			**720**			**720**	
840	83.45	15.10	**840**	9.01	**840**			**840**			**840**	
960	94.98		**960**	7.87	**960**			**960**			**960**	
		12.35	**1080**	6.97	**1080**			**1080**			**1080**	
		12.19	**1200**	6.13	**1200**			**1200**			**1200**	
		11.98	**1320**	5.39	**1320**			**1320**			**1320**	
			1440	4.63	**1440**			**1440**			**1440**	
			1560		**1560**			**1560**			**1560**	
			1680		**1680**			**1680**			**1680**	
			1800		**1800**			**1800**			**1800**	
			1920		**1920**			**1920**			**1920**	
			2040		**2040**			**2040**			**2040**	
			2160		**2160**			**2160**			**2160**	
			2280		**2280**			**2280**			**2280**	
			2400		**2400**			**2400**			**2400**	
			2520		**2520**			**2520**			**2520**	
			2640		**2640**			**2640**			**2640**	
			2760		**2760**			**2760**			**2760**	
			2880		**2880**			**2880**			**2880**	
			3000		**3000**			**3000**			**3000**	
			3120		**3120**			**3120**			**3120**	
			3240		**3240**			**3240**			**3240**	
			3360		**3360**			**3360**			**3360**	
			3480		**3480**			**3480**			**3480**	
			3600		**3600**			**3600**			**3600**	
			3720		**3720**			**3720**			**3720**	
			3840		**3840**			**3840**			**3840**	
			3960		**3960**			**3960**			**3960**	
			4080		**4080**			**4080**			**4080**	
			4200		**4200**			**4200**			**4200**	
			4320		**4320**			**4320**			**4320**	
Total time pumped(min):						**W/L**			**W/L**			**W/L**
Average yield (l/s):												

FORM 5 F

CONSTANT DISCHARGE TEST & RECOVERY

BOREHOLE TEST RECORD SHEET

PROJ NO :	P2987	Coordinates: SOUTH: 34.3079		PROVINCE:	WESTERN CAEP
BOREHOLE NO:	ECA-BH1	EAST: 19.47264		DISTRICT:	OVERBERG
ALT BH NO:	0			SITE NAME:	ELGIN CHICKEN FARM
ALT BH NO:	0				
BOREHOLE DEPTH:	138.60	DATUM LEVEL ABOVE CASING (m):	0.32	EXISTING PUMP:	0
WATER LEVEL (mbdl):	13.69	CASING HEIGHT: (magl):	0.39	CONTRACTOR:	ATS
DEPTH OF PUMP (m):	118.50	DIAM PUMP INLET(mm):	170	PUMP TYPE:	WA 110-2

CONSTANT DISCHARGE TEST & RECOVERY

TEST STARTED				**TEST COMPLETED**				
DATE:	03/08/2024	TIME:	08H20	DATE:		TIME:		TYPE OF PUMP: WA 110-2

DISCHARGE BOREHOLE					OBSERVATION HOLE 1 NR: Distance(m);			OBSERVATION HOLE 2 NR: Distance(m);			OBSERVATION HOLE 3 NR: 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	5.74		**1**	35.02	**1**			**1**			**1**	
2	6.90		**2**	31.16	**2**			**2**			**2**	
3	8.19		**3**	28.68	**3**			**3**			**3**	
5	10.04	10.62	**5**	26.02	**5**			**5**			**5**	
7	11.63		**7**	24.74	**7**			**7**			**7**	
10	15.74	12.54	**10**	23.54	**10**			**10**			**10**	
15	17.00	12.52	**15**	21.51	**15**			**15**			**15**	
20	19.33		**20**	20.47	**20**			**20**			**20**	
30	21.03	12.50	**30**	18.73	**30**			**30**			**30**	
40	24.16		**40**	17.62	**40**			**40**			**40**	
60	27.95	12.54	**60**	16.35	**60**			**60**			**60**	
90	30.49	12.56	**90**	14.51	**90**			**90**			**90**	
120	32.98		**120**	13.00	**120**			**120**			**120**	
150	35.84	12.52	**150**	11.68	**150**			**150**			**150**	
180	38.06		**180**	10.59	**180**			**180**			**180**	
210	40.50	12.57	**210**	9.36	**210**			**210**			**210**	
240	43.12	12.56	**240**	8.61	**240**			**240**			**240**	
300	49.91	12.58	**300**		**300**			**300**			**300**	
360	49.91	12.58	**360**		**360**			**360**			**360**	
420	52.70		**420**		**420**			**420**			**420**	
			480		**480**			**480**			**480**	
			540		**540**			**540**			**540**	
			600		**600**			**600**			**600**	
			720		**720**			**720**			**720**	
			840		**840**			**840**			**840**	
			960		**960**			**960**			**960**	
			1080		**1080**			**1080**			**1080**	
			1200		**1200**			**1200**			**1200**	
			1320		**1320**			**1320**			**1320**	
			1440		**1440**			**1440**			**1440**	
			1560		**1560**			**1560**			**1560**	
			1680		**1680**			**1680**			**1680**	
			1800		**1800**			**1800**			**1800**	
			1920		**1920**			**1920**			**1920**	
			2040		**2040**			**2040**			**2040**	
			2160		**2160**			**2160**			**2160**	
			2280		**2280**			**2280**			**2280**	
			2400		**2400**			**2400**			**2400**	
			2520		**2520**			**2520**			**2520**	
			2640		**2640**			**2640**			**2640**	
			2760		**2760**			**2760**			**2760**	
			2880		**2880**			**2880**			**2880**	
			3000		**3000**			**3000**			**3000**	
			3120		**3120**			**3120**			**3120**	
			3240		**3240**			**3240**			**3240**	
			3360		**3360**			**3360**			**3360**	
			3480		**3480**			**3480**			**3480**	
			3600		**3600**			**3600**			**3600**	
			3720		**3720**			**3720**			**3720**	
			3840		**3840**			**3840**			**3840**	
			3960		**3960**			**3960**			**3960**	
			4080		**4080**			**4080**			**4080**	
			4200		**4200**			**4200**			**4200**	
			4320		**4320**			**4320**			**4320**	
Total time pumped(min):						**W/L**			**W/L**			**W/L**
Average yield (l/s):												

8 Appendix C: Water Quality

Distillery Road
Stellenbosch
Tel 021-8828866/7
info@vinlab.com
www.vinlab.com
2024-08-08

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

Attn: Alison McDuling

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

@VinlabSA

Sample Details					
SampleID	W54284				
Water Type	Drinking Water				
Water Source	Borehole				
Sample Temperature					
Description	ECA_BH1				
Batch Number					
PO Number	3659_L				
Date Received	2024-08-06				
Condition	Good				

Water - Routine

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
pH@25C (Water)		VIN-05-MW01	^^^	>= 5 to <= 9.7	6.01				
Conductivity@25C (Water)	mS/m	VIN-05-MW02	^	<= 170	28				
Turbidity (Water)*	ntu			<= 5	27.3				
Total dissolved solids (Water)*	mg/L			<= 1200	189.84				
Free Chlorine (Water)*	mg/L			<= 5	<0.02				
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	64.43				
Sulphates (SO4) - Water	mg/L	VIN-05-MW08	7.56%	<= 500	6.86				
Fluoride (F) - Water	mg/L	VIN-05-MW08	12.30%	<= 1.5	0.16				
Alkalinity as CaCO3 (Water)*	mg/L				25.10				
Colour (Water)*	mg/L Pt-Co			<= 15	<15				
Total Organic Carbon (Water)*	mg/L			<=10	1.74				
Date Tested					2024-08-06				

Water - Metals

	Unit	Method	Uncertainty	Limit	Results	Results	Results	Results	Results
Calcium (Ca) - Water	mg/L	VIN-05-MW43	14.60%		7				
Magnesium (Mg) - Water	mg/L	VIN-05-MW43	8.49%		4				
Sodium (Na) - Water	mg/L	VIN-05-MW43	11.45%	<= 200	37				
Potassium (K) - Water	mg/L	VIN-05-MW43	9.42%		4				

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

*** Not SANAS Accredited. Results marked "Not SANAS Accredited" in this report are not included in the SANAS Scope of Accreditation for Vinlab.**

^ - 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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Your partner in quality water analysis

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2024-08-08

TEST REPORT

Water

Geoss South Africa (Pty) Ltd

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@VinlabSA

Zinc (Zn) - Water	mg/L	VIN-05-MW43	19.40%	<= 5	0.716				
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	13				
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	5				
Iron (Fe) - Water	µg/L	VIN-05-MW43	12.49%	<= 2000	549				
Lead (Pb) - Water	µg/L	VIN-05-MW43	16.32%	<= 10	<8				
Manganese (Mn) - Water	µg/L	VIN-05-MW43	12.44%	<= 400	45				
Nickel (Ni) - Water	µg/L	VIN-05-MW43	17.38%	<= 70	<8				
Selenium (Se) - Water*	µg/L			<= 40	<10.0				
Aluminium (Al) - Water	µg/L	VIN-05-MW43	13.49%	<= 300	217				
Cyanide (CN) - Water*	µg/L			<= 200	<10.0				
Mercury (Hg) - Water*	µg/L			<= 6	2				
Barium (Ba) Water	µg/L	VIN-05-MW43	14.09%	<= 700	29				
Uranium (U) - Water*	µg/L			<= 30	<28				
Date Tested					2024-08-06				

Comments
W54284 Ion balance = 0.5%

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

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.

*** Not SANAS Accredited. Results marked "Not SANAS Accredited" in this report are not included in the SANAS Scope of Accreditation for Vinlab.**

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, 30ºC. 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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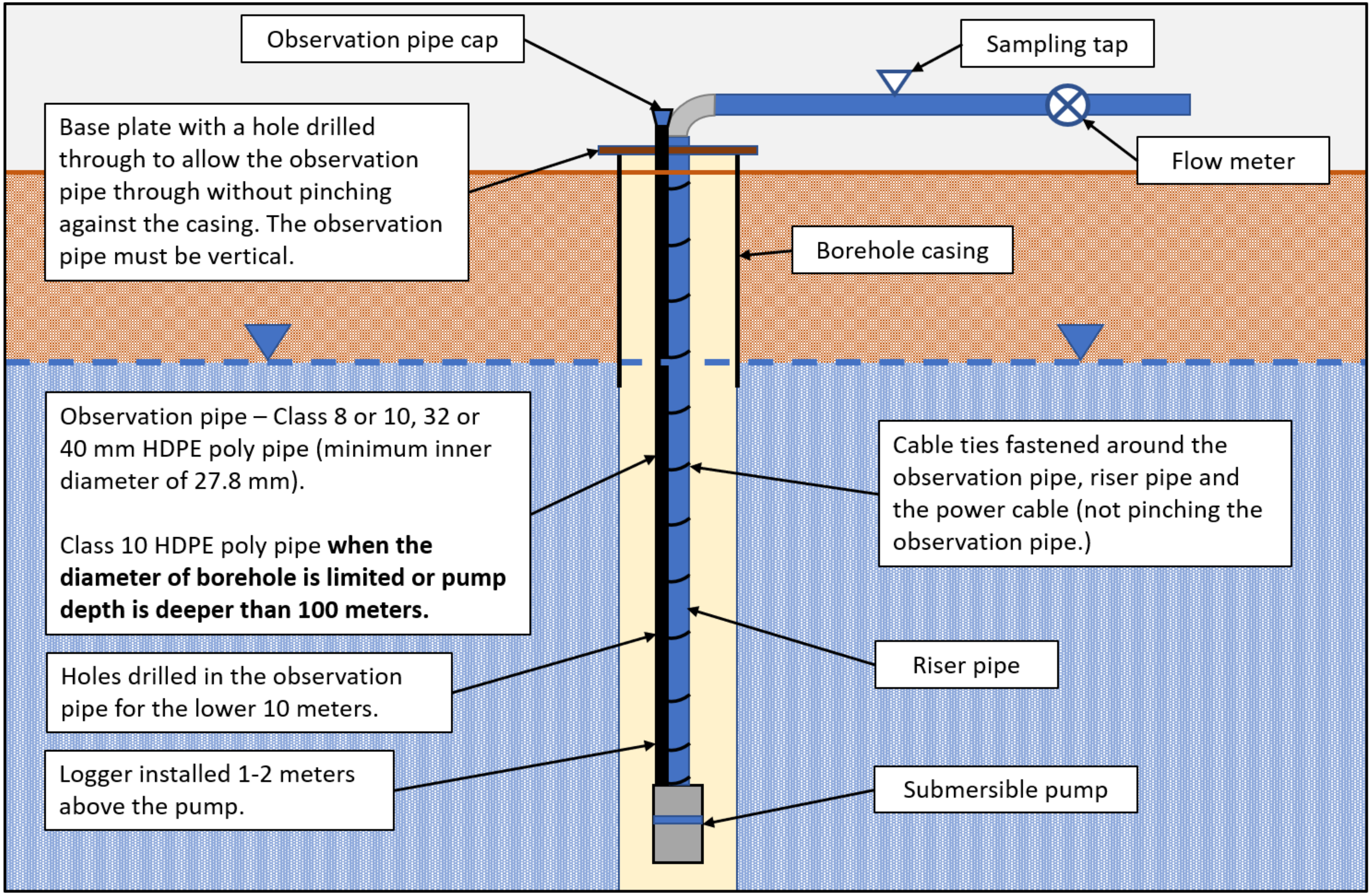
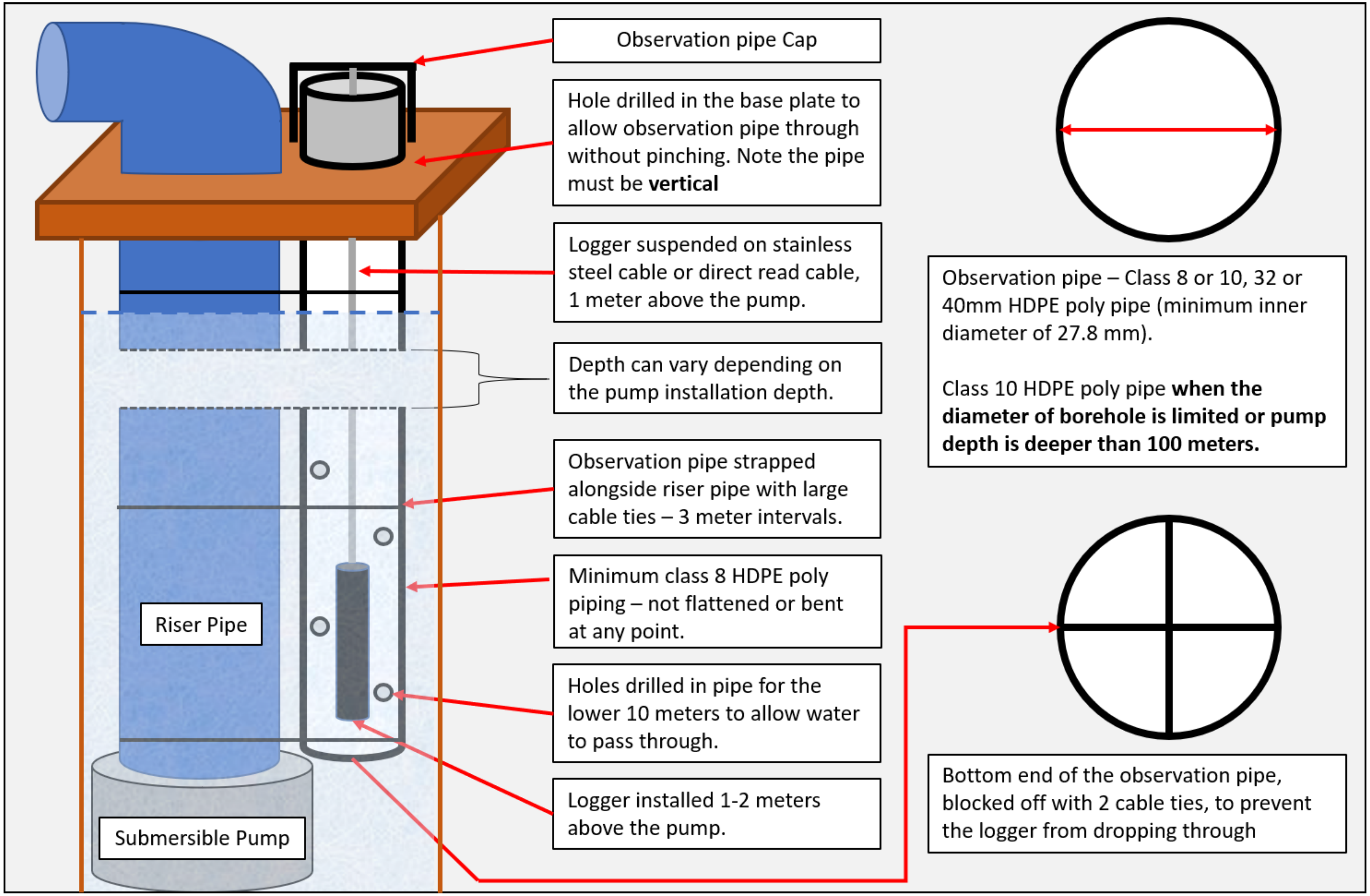
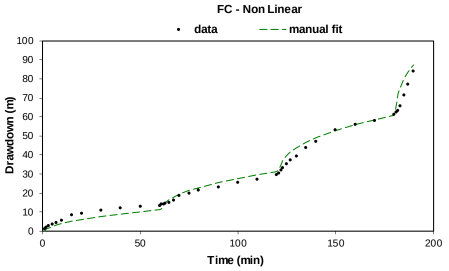
9 Appendix D: Monitoring Infrastructure Diagram


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

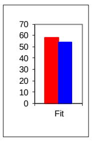
10 Appendix E: Yield Test Data Analysis

ECA_BH1



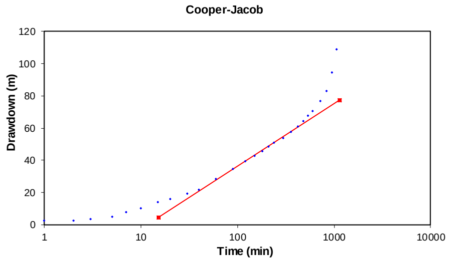
FC - Non Linear Method to estimate Q_Sust

skin effect	Non-Darcian loss		Darcian loss		
A	C	p	B	n	e
1.00E-06	2.41E-06	2.16E+00	1.00E-03	5.00E-01	1.00E+00



Extrapolation	
Ext_pol time (min)	
1051200	
Q (L/s)	Drawdown (m)
1	58.23

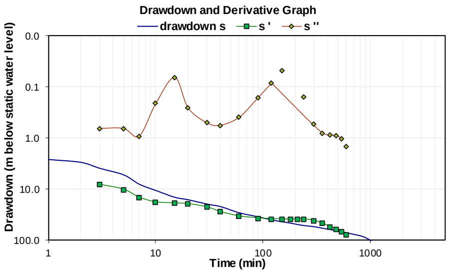
Available drawdown (m) =		54	
No boundaries	1 no-flow	2 no-flow	Closed
1.0	0.5	0.3	0.2
Q_Sust (L/s)=	0.71	std.dev = 0.36	
Boundaries selected	0 - closed		



Cooper-Jacob method

$T(m^2/d)$ =	6.1	r_e (m)=	0.1
S =	1.09E+01	Q (l/s) =	15.00

	No boundaries	1 no-flow	2 no-flow	Closed
Q_sust	4.20	2.10	1.39	1.05
Avg. Q_sust =		2.19	std. dev =	1.41
Boundaries selected	0 - closed			

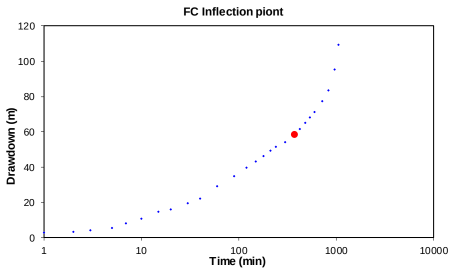


FC method

Extrapolation time in years	2	1051200	Extrapol.time in minutes	
Effective borehole radius (r_e)	43.1428199	43.14281989	Est. r_e	From r(e) sheet
Q (l/s) from pumping test	15	0.000274289	S-late	Change r_e
s_a (available drawdown), sigma_s	**54**	0	Sigma_s from risk	
Annual effective recharge (mm)	0	54	s_available working drawdown(m)	
t(end) and s(end) of pumping test	1060	109.12	End time and drawdown of test	
Average maximum derivative	**40.95**	103.3733784	Estimate of average of max deriv	
Average second derivative	**0.8**	0.095270497	Estimate of average second deriv	
Derivative at radial flow period	17.5525733	17.55257331	Read from derivative graph	
$T\text{-early}[m^2/d]$		13.51186494	Aqui. thick (m)	60
T and S estimates	**$T\text{-late}\ [m^2/d]$**	**5.791648352**	Est. S-late	0.0033
	S-late	0.0033		

BASIC SOLUTION

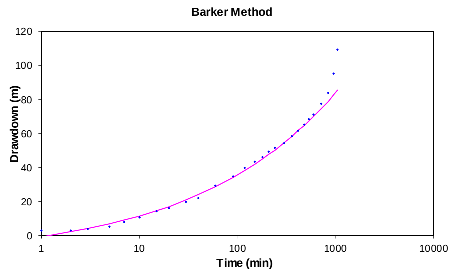
	No boundaries	1 no-flow	2 no-flow	Closed no-flow
sWell (Extrapol.time) =	235.41	358.11	480.82	848.92
Q_sust (l/s) =	3.44	2.26	1.68	0.95
Average Q_sust (l/s) =	**1.88**			
with standard deviation=	1.05			
Boundaries selected	0 - closed			



FC inflection point method

extrapolaltion time in years =	2	1051200
t(min) and s(m) at inflection point =	380	58
enter derivative value at inflection point time =	46.49	46.48555

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	218.01	378.03	538.04	1018.08
Q_sust	3.99	2.30	1.62	0.85
Average Q-sust (l/s)	**1.89**	std. dev =	0.85	
Boundaries selected	0 - closed			

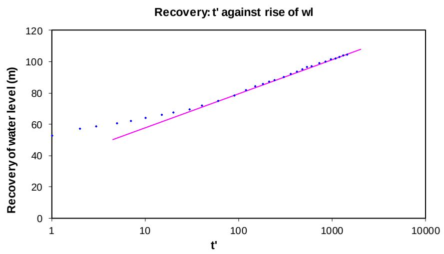


Barker method

	K_f [m/d]	S_f [1/m]	b	n	N
Fit Parameters	150.00	2.00E-03	1.19	1.40	0.3000

	No boundaries	1 no-flow	2 no-flow	Closed
sWell(Extrapol.time)	764.85	1010.25	1132.96	1255.66
Q_sust	1.06	0.80	0.71	0.65

Fractal n = 1.40	**Average Q-sust (l/s)=**	0.79	std. dev =	0.18
	Boundaries selected	0 - closed		



Recovery

T [m2/d]	10.86
CDT Duration	1060
Recovery Duration	1440
Max % Recovery	95.8

(LAST PAGE)

Appendix C: Impact Assessment Methodology

The significance of potential impacts that may result from the proposed project was determined in order to assist decision-makers (typically by a designated competent authority or state agency, but in some instances, the applicant).

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in the table below.

Rating	Definition of Rating	Score
A. *Extent* *– the area (distance) over which the impact will be experienced*		
Local	Confined to project or study area or part thereof (e.g. the development site and immediate surrounds)	1
Regional	The region (e.g. Municipality or Quaternary catchment)	2
(Inter) national	Nationally or beyond	3
B. ***Intensity*** *– the magnitude of the impact in relation to the extent of the impact and sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources*		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. ***Duration*** *– the timeframe over which the impact will be experienced and its reversibility*		
Short-term	Up to 2 years and reversible	1
Medium-term	2 to 15 years and reversible	2
Long-term	More than 15 years and irreversible	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

***Combined Score* (A+B+C)**	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Once the consequence was derived, the probability of the impact occurring was considered, using the probability classifications presented in the table below.

Probability *– the likelihood of the impact occurring*	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall **significance** of impacts was determined by considering consequence and probability using the rating system prescribed in the table below.

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Finally, the impacts were also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below.

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH**: the potential impact **will** affect the decision regarding the proposed activity/development.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

Practicable mitigation and optimisation measures are recommended, and impacts are rated in the prescribed way both without and with the assumed effective implementation of mitigation and optimisation measures. Mitigation and optimisation measures are either:

- **Essential**: measures that must be implemented and are non-negotiable; and
- **Best Practice:** recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the applicant if not implemented.