Black Mountain Mining Prospecting Rights Application:

Geohydrological Specialist Study: GIFKOP AREA

Report Prepared for

ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

Report Number 549553/GIFKOP

Report Prepared by

srk consulting

July 2019

Black Mountain Mining Prospecting Rights Application:

Geohydrological Specialist Study:

GIFKOP AREA

EIMS

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July 2019

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Executive Summary

Environmental Impact Management Services (Proprietary) Limited (EIMS) appointed SRK Consulting (South Africa) (Pty) Ltd (SRK) to undertake a Geohydrological Desktop Specialist study as part of a basic assessment report (BAR) in support of a Mining Prospecting Rights Application.

Summary of principal objectives

The aim of this assessment is to assess the baseline groundwater conditions for the aquifer system/s within the Gifkop Area and to highlight possible risks to the groundwater environment accordingly (from a desktop perspective). The scope of work comprises a desk study in which potentially sensitive geohydrological features are highlighted, to investigate the potential impact on these (if any) and to develop management plans to prevent / mitigate any potential impacts.

Outline of work programme

EIMS appointed SRK on 12 June 2019 to conduct a desktop geohydrological assessment on five areas where exploration drilling is planned. The Gifkop Area, the focus of this report, is one of the five areas.

Focus on results

From the desktop study and information provided to SRK, by EIMS, the following are concluded for the Gifkop Area:

- Although the majority of the area is classed as a minor aquifer system with potentially poor water quality and low expected yields, there are existing groundwater users for which boreholes could be the only water source. It is therefore critical that existing groundwater users be taken into account and that their boreholes are not negatively affected in any way.
- Any negative impact on groundwater and/or groundwater users, whether factual or perceived (complaints from surrounding borehole users) can have a significant financial and reputational impact on the exploration programme and subsequent mining.
- It is not possible to accurately predict the aquifers that will be penetrated when drilling 400 m or more and it is therefore important that support by a geohydrologist is provided before and during the drilling activities.
- Due to the lack of available information, such as hydrocensus information, exact drilling positions, drilling depths and drilling processes, only a basic sensitivity map could be compiled at this stage, incorporating areas covered by quaternary deposits (e.g. sands) and surface water / pans. This information was taken from available geological and topographical maps.

Potential impacts have been identified as:

- Degradation of aquifers;
- Impacts on existing groundwater users; and
- Impacts on surface water features (e.g. streams, rivers, wetlands, saltpans) – which may be recharged by groundwater.

Proposed mitigation measures include:

- Detailed hydrocensus (to include surface water features);

- Once the exact drilling positions are known and the hydrocensus completed, the geohydrological report must be updated and must include an assessment of potential aquifers that could be penetrated by the drilling and whether mixing the water of these aquifers can lead to degradation of any of the aquifers penetrated.

Assumptions, uncertainties and gaps in knowledge

Assumptions: SRK assumes that the main purpose of this desktop study is to provide a broad overview of what has been documented for this specific area in terms of the geohydrology. SRK further assumed that the planned exploration has not yet been publicised or discussed with the local municipalities, local farming unions, or any other private or public sector body. SRK therefore did not make contact with any private or public body in terms of the gathering of site specific data. SRK further assumes that a public participation process will be followed whereby existing groundwater users will be consulted.

Limitations: The potential impacts of any drilling activity on the groundwater regime will vary from site to site, even over short distances due to changes in geology and receptors. As no recent hydrocensus across the entire exploration area has been conducted, SRK did not have access to, for example, positions of existing boreholes, dependency on groundwater, specific water quality, depth to groundwater levels and borehole depths. The sensitivity map and groundwater management plan, as presented in this report, must be seen as working documents that must be improved as more information becomes available.

Gaps: Based on the information presented to SRK, by EIMS, the following information gaps have been identified:

- Exact drilling positions and drilling depths;
- On-site storage and handling of any potentially hazardous materials / substances on the drilling site, e.g. fuels (diesel, petrol, paraffin, etc.), oils and cleaning chemicals;
- Detailed hydrocensus within the area where exploration drilling will take place – the hydrocensus must be completed by a geohydrologist / geohydrological technician who has experience in the collection of geosite data, as prescribed by the Department of Human Settlement, Water and Sanitation (DHSWS).
- Detailed scientific reports (geological and geohydrological) of the exploration area (if any) – sourcing these reports will require open conversations with private and public bodies, in which the purpose of the exploration programme and exploration areas will have to be revealed.

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Disclaimer

The opinions expressed in this Report have been based on the information obtained by SRK Consulting (South Africa) (Pty) Ltd (SRK) from various sources such as the Department of Human Settlement, Water and Sanitation (DHSWS), the National Groundwater Archive (NGA) and others listed under References. SRK has exercised due care in reviewing the obtained information. Whilst SRK has compared the available data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the available data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

List of Abbreviations

DWS - Department of Water and Sanitation (before 30 May 2019)

DHSWS - Department of Human Settlement, Water and Sanitation (after 30 May 2019)

NEMA – National Environmental Management Act

NWA – National Water Act

MPRDA Mineral and Petroleum Resources Development Act

WMA Water Management Area

EWR - Ecological Water Requirements

GRU - Groundwater Resource Units

GIA - Groundwater Impact Assessment

BAR - Basic Assessment Report

EMPR - Environmental Management Program

EIA - Environmental Impact Assessment

GRA2 - Groundwater Resource Assessment Phase 2

AGEP - Average Groundwater Exploitation Potential

SANS - South African National Standard

NGA - National Groundwater Archive

m amsl - metres above mean sea level

m bgl - metres below ground level

L/s - litres per second

mg/L - milligrams per litre

EC - Electrical Conductivity

GPS - Global Positioning System

GIS - Geographic Information Systems

1 Introduction

Environmental Impact Management Services (Proprietary) Limited (EIMS) appointed SRK Consulting (South Africa) (Pty) Ltd (SRK) to undertake a Geohydrological Desktop Specialist study as part of a basic assessment report (BAR) in support of a Mining Prospecting Rights Application, GIFKOP AREA.

1.1 Scope of Work and Terms of Reference

The aim of this assessment was to assess the baseline groundwater conditions for the aquifer system/s within the Gifkop Area and to supply an indication of possible risks to the groundwater environment accordingly. The scope of work comprises a desk study in which potentially sensitive geohydrological features are highlighted, to investigate the potential impact on these (if any) and to develop management plans to prevent / mitigate any potential impacts. No fieldwork or site visit(s) were to be undertaken.

1.2 Legislative and Policy Framework

As per EIMS's request, the geohydrological desktop study is to satisfy the requirements of the NEMA EIA Regulations and the NWA WUL Applications, as well as the relevant MPRDA regulations. The **NWA**, Chapter 3, Part 4 states the following "*The person who owns, controls, occupies or uses the land in question is responsible for taking measures to prevent pollution of water resources*". This includes groundwater. The **MPRDA**, Part IV: Pollution Control and Waste Management Regulation states that the groundwater investigations may include an assessment of "(*iv) the vulnerability and existing potential use of the groundwater resource within the zone that could potentially be affected by the residue facility".* In terms of this report (focussing only on exploration and not mining itself) SRK will replace the term "residue facility" with "exploration activities".

1.3 Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK. SRK has no beneficial interest in the outcome of the assessment which is capable of affecting its independence.

1.4 Summary of Specialist Expertise

Gert Nel is a partner in SRK, qualified **Principal Geohydrologist** and registered Professional Natural Scientist **(Pr. Sci. Nat.)** with over 26 years' of experience in the water and waste fields. Gert started off the first eight years of his career with the South African Department of Water Affairs (DWA) and was involved in geohydrological mapping, water supply and the permitting of solid waste facilities. He then joined the private sector where he continued his involvement in the water and waste fields, but also became involved in geohydrological risk assessments for private industries, including the fuel industry and mines.

Eunice Goossens is a **Principal Hydrogeologist**, registered as a Professional Natural Scientist **(Pr. Sci. Nat.)**. Eunice has 20 years' experience in geohydrological investigations, and started her career at Department of Water Affairs (DWA) and was involved in groundwater supply investigation as well as geohydrological research projects. She joined the private sector and continued her career in Groundwater Management, Groundwater resource development and evaluation, Geophysical investigations, Sanitation Groundwater Protocol Application, Groundwater database management and processing, GIS applications / mapping and Landsat & Aerial photo Interpretation.

Connan Hempel is a **Senior Geologist** and registered Professional Natural Scientist (**Pr. Sci. Nat.**) with over 20 years' experience in academic training, mining and exploration. Connan started the first ten years of his career as a Geology Lecturer at the Nelson Mandela Metropolitan University Department of Geosciences. He later joined Anglo American where he worked as a Senior Production Geologist. Prior to joining SRK Consulting, he also worked for Elitheni Coal as a Senior Exploration & Mining Geologist.

2 Project Work

2.1 Topographical Information

The topography of the Gifkop Area is depicted in **Map 1**, **Appendix 1**.

The area is located approximately 60 kilometres South of the town of Pofadder, Northern Cape, South Africa. It covers 38 farms, over an area of 177 468 Ha (1 774.68) km^2. Topographically, the northern parts of the Gifkop Area are the highest with altitudes in the order of 1020 m amsl. The area then drops towards the south, southeast and southwest to elevations around 860 m amsl. From the elevations it is clear that the area is flat-lying with the majority of the non-perennial rivers / drainages occurring in the southern parts. Minor, non-perennial drainages can also be seen in the middle central parts of the area. The area is also characterised by several salt pans, the largest of these also occurring in the southern parts of the Gifkop Area.

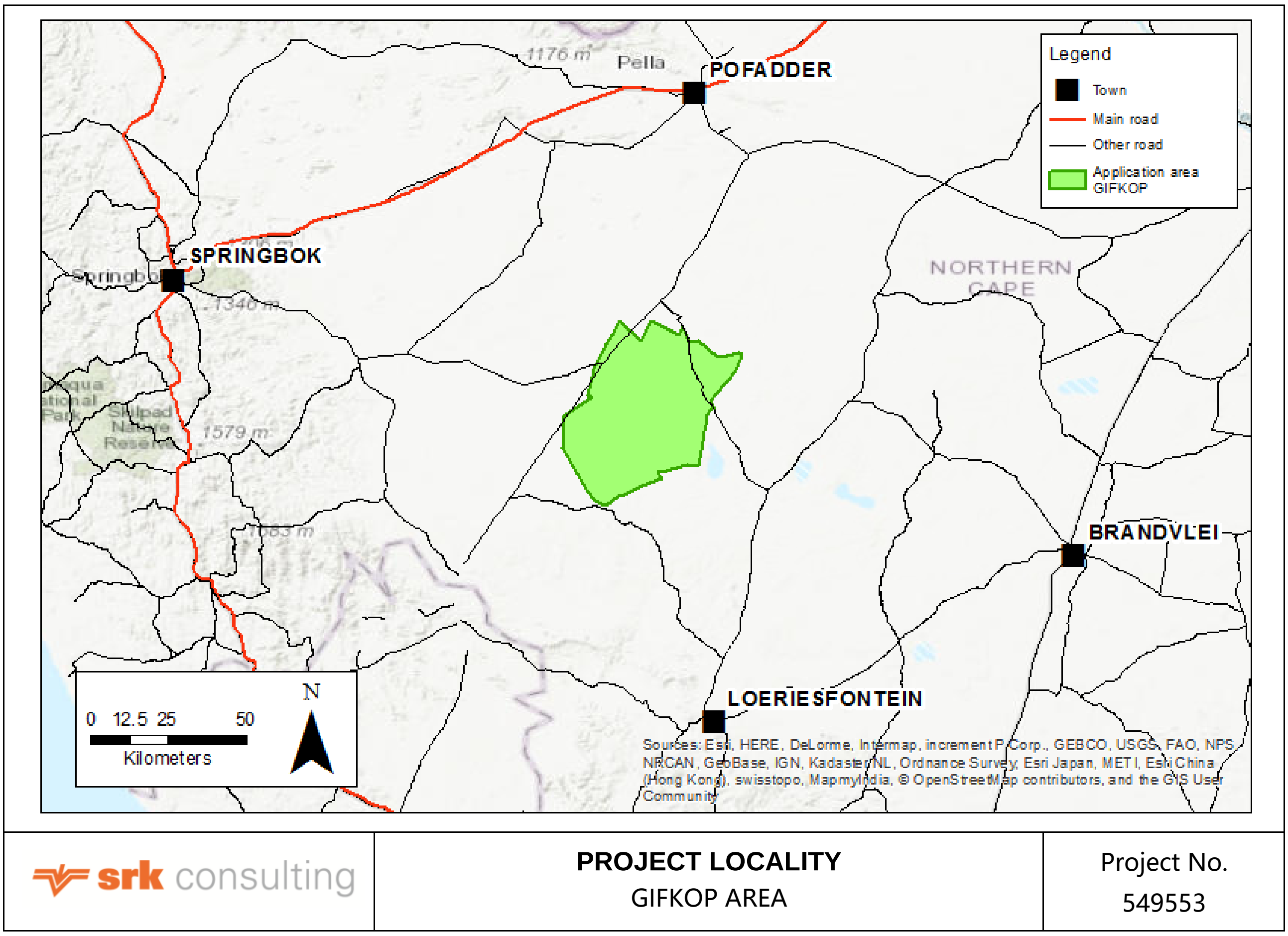

Figure 2-1: Project Locality

2.2 Geology

The terrain consists of flat lying plains with Cenozoic cover sediments overlying Namaqua granites and metasediments. The meta-sedimentary sequences underling the Cenozoic cover are of mid-Proterozoic age and correlated to the Bushmanland Sequence. Alluvial sands, shale, diamictite (tillite), dolerite, gneiss and granite constitute host rock to groundwater (aquifers). Refer to **Map 2** in **Appendix 1**.

2.3 Hydrogeology

The following key information sources were consulted:

- Vegter, J.R., Seymour A., 1995. Groundwater Resources of the Republic of South Africa – Two Map sheets and explanatory brochure. DWAF).
- Parsons, R., Conrad, J., WRC Report No KV 116/98, "Explanatory Notes for the Aquifer Classification Map of South Africa".
- Groundwater Resource Assessment Phase 2 (GRA 2), DWS, 2003
- Department of Water and Sanitation, South Africa, October 2016. Determination of Ecological Water Requirements for Surface water (river, estuaries and wetlands) and Groundwater in the Lower Orange WMA. Groundwater EWR report.
- Department of Water Affairs and Forestry. Hydrogeological Map Series of the Republic of South Africa. Completed in 2002".

A low groundwater potential of 10 – 20 % is reported by Vegter and Seymore (1995). These percentages indicate the probability of drilling a successful borehole (yield > 2 L/s). In their Hydrogeological Map Series, an expected borehole yield of 0.1 – 0.5 L/s was reported.

DWS initiated a project in 2003, referred to as the Groundwater Resource Assessment Phase 2 (GRA 2). The main aim of the project was the quantification of the groundwater resources of South Africa on a national scale. The project included the quantification of recharge, storage and sustainable yield of the aquifer systems throughout South Africa.

The expected average groundwater exploitation potential (AGEP) in the project area is < 2500 m^3/km^2/annum.

Based on the Aquifer Classification Map, the aquifer is classified as a minor aquifer region – therefore being a moderately–yielding aquifer system of variable water quality. These aquifers can be fractured or potentially fractured rocks which do not have a high permeability, or other formations with variable permeability. The aquifer extent may be limited and water quality variable. These aquifers seldom produce large quantities of water.

The Gifkop Area falls partly within the Olifants Doorns and Lower Orange WMA (see Figure 2-2). The EWR report of 2016 covers the Lower Orange WMA, but some information could also be applied to the Gifkop Area. **From the EWR report**, the following information is "deemed relevant[1]" to the Gifkop Area:

- Areas adjacent to, and overlapping with, the Gifkop Area have an estimated 30 – 60 % dependency of groundwater (i.e. domestic use, irrigation, stock watering, bulk supply, mining).

- Gifkop Area falls within **three Quaternary Catchments**, namely D53F, E31A and D82B. In the EWR report, the groundwater characteristics are described as:
    - D53F: Poor groundwater quality from marine sediments

[1] Must first be verified outside the scope of the desktop study before accepting as relevant

- D82B: Poor water quality
- E31A: Not covered by the EWR report

Refer to Figure 2-2 (the insert) for the positioning of the Gifkop Area relevant to the quaternary catchments.

The expected electrical conductivity (EC) for the majority of the area is 300 – 1000 mSm. Exceptions are a portion in the western corner of the area (> 1000 mSm) and a portion in the north-eastern corner (70 – 300 mSm) of the Gifkop Area. **Map 3a** in **Appendix 1** shows the expected EC's for the area.

2.3.1 Groundwater Flow Directions

In the absence of field measurements (water level data) and accurate elevations of boreholes, no accurate groundwater contour map can be compiled. If one assumes that the groundwater table will follow the topography and surface drainage directions, then the inferred groundwater flow is depicted in **Map 3b**, **Appendix 1**.

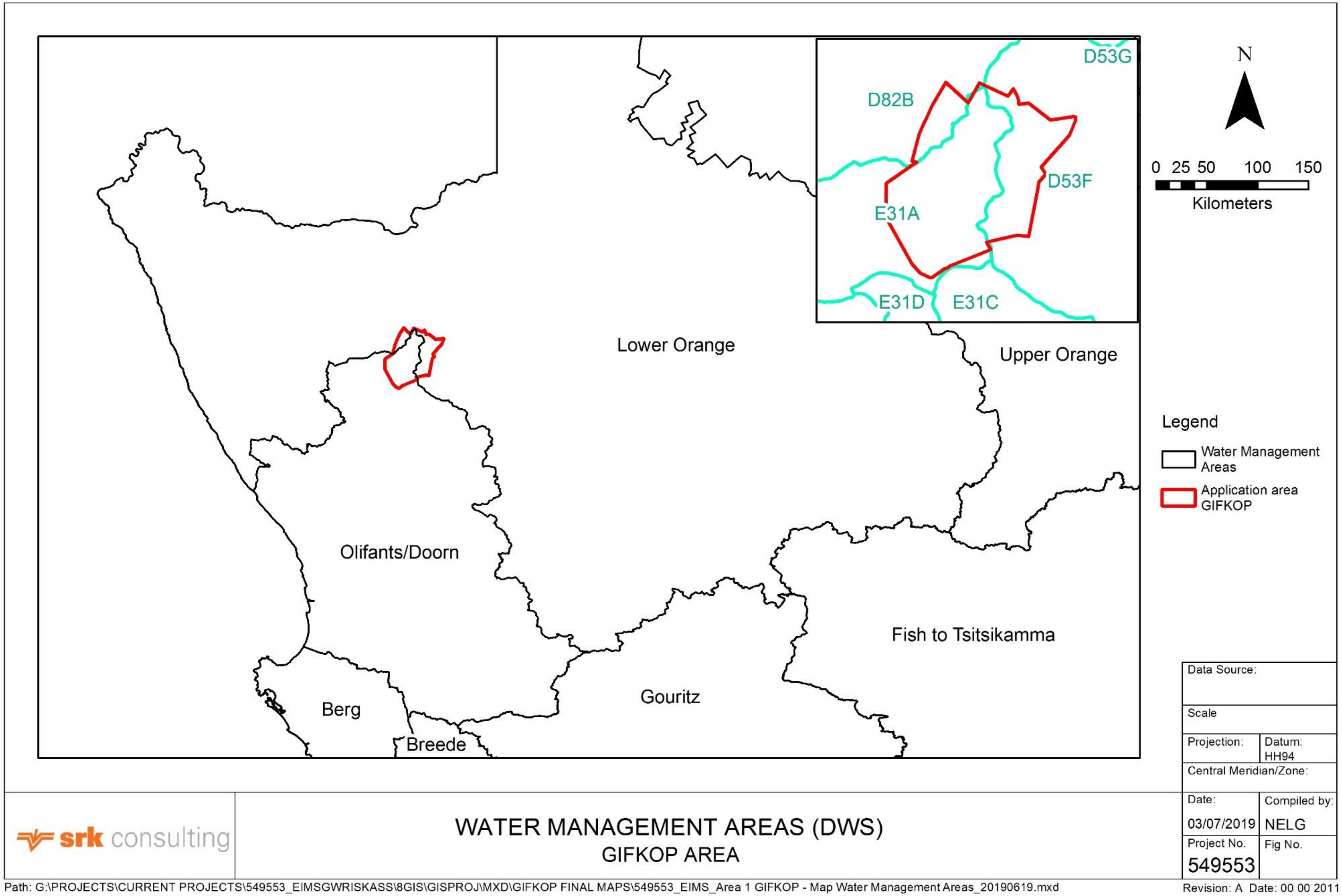

Figure 2-2: Water Management Areas (as per the DWS classification) – Quaternary Catchments inclusion

2.4 Receiving Environment

For the purpose of the geohydrological desktop assessment, and considering that no fieldwork has been conducted, the receiving environment of the Gifkop Area is considered to be:

- Existing groundwater users (via boreholes and springs, where applicable);
- Future groundwater users (via boreholes and springs, where applicable); and
- Groundwater, as a natural resource that falls under the protection of the National Water Act.

In the absence of sufficient data, aspects relating to groundwater recharge have not been taken into account. These include:

- Natural groundwater recharge areas (groundwater catchments); and
- Areas where managed aquifer recharge (artificial recharge) could be considered.

Due to insufficient data, the following receiving environments have also been excluded:

- Wetlands (if there are any in the area) that are groundwater fed - not all wetlands are partially or fully dependent on groundwater for sustainability, but due consideration must be given when boreholes are drilled within 500 m of a wetland, regardless whether the boreholes are for exploration, monitoring or water supply.
- Streams or rivers that are dependent on groundwater inflow – in many cases the base of streams and rivers sits below the groundwater table and are therefore experiencing lateral recharge from groundwater. Groundwater can therefore sustain the baseflow of a river or stream in cases where the water table (or perched water level) is located higher (in terms of elevation, i.e. metres above sea level) than the base of the river or stream.

Information provided to SRK, by EIMS, indicates that the farms listed in **Table 2-1** will be targeted for the exploration programme (Ref: Black Mountain Prospecting Work Programme).

2.4.1 Existing Groundwater Users

To capture all existing groundwater users a hydrocensus[2] will be required. The National Groundwater Archive (NGA) data for this specific area is outdated and the data can therefore not be used to accurately determine how many existing groundwater users there are, and what the water is used for.

Existing borehole information

A data search on the NGA[3] revealed 114 existing boreholes, of which:

- 61 boreholes had water level data – the average groundwater level is 38.91 m bgl[4] , the deepest 151 m bgl and the shallowest 4.8 m bgl;
- 54 boreholes had recorded yields - the average yield being 1.19 L/s and the maximum recorded yield 9.22 L/s;
- 112 boreholes had recorded boreholes depths – the average depth being 70 m bgl and the deepest 220 m bgl (refer to **Map 4a** for a plot of the NGA-derived **borehole depths**); and
- 65 boreholes had recorded water strike depths – the average strike depth being 59 m bgl and the maximum strike depth 162 m bgl.

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[2] Hydrocensus – field survey to capture all existing boreholes, springs and dugholes.
[3] Maintained by the DHSWS
[4] Bgl = below ground level

The data that was obtained from the NGA however dates back to 1940, with the most recent data being from 1991. Although this data provides some information on the use of groundwater at the time, it does not necessarily reflect the current number of boreholes and current use. As GPS (Global Positioning System) technology was not readily available in the 1940's – 1980's the coordinates of the boreholes are not deemed very accurate and would have to be field-verified. This information will have to be obtained by means of a hydrocensus across the entire area.

Table 2-2 provides the borehole information as recorded on the NGA. A plot of the **NGA data** is presented by **Map 4b**, **Appendix 1**.

Table 2-1: List of Properties that form part of the planned Exploration

Table 1: Properties within which the application area falls.

Nr	Registered Land Description	Magisterial District	Extent (Ha)	Title Deed/Diagram Deed	SG Code
1	Farm Doels Vley 161 Portion 1	Calvinia Rd	2002,856118	T11976/2002	C0150000000001 6100001
2	Farm Wiel Kolk 162 Portion 0	Calvinia Rd	1723,804067	T42497/2004CTN	C0150000000001 6200000
3	Farm Gifkop 166 Portion 0 RE	Calvinia Rd	9900,733147	T33330/2008	C0150000000001 6600000
4	Farm Gifkop 166 Portion 1	Calvinia Rd	8571,290413	T49679/1991CTN	C0150000000001 6600001
5	Farm Gifkop 166 Portion 2	Calvinia Rd	8598,744804	T44479/2001CTN	C0150000000001 6600002
6	Farm Gifkop 166 Portion 3 RE	Calvinia Rd	4797,919502	T31072/1969CTN	C0150000000001 6600003
7	Farm Gifkop 166 Portion 4 RE	Calvinia Rd	3215,062565	T4968/1969	C0150000000001 6600004
8	Farm Gifkop 166 Portion 5 RE	Calvinia Rd	2772,254526	T11974/2002CTN	C0150000000001 6600005
9	Farm Gifkop 166 Portion 6	Calvinia Rd	11333,04917	T1633/2018	C0150000000001 6600006
10	Farm Gifkop 166 Portion 7	Calvinia Rd	2168,292651	T10760/2012CTN	C0150000000001 6600007
11	Farm Gifkop 166 Portion 8	Calvinia Rd	4523,208891	T84902/2007CTN	C0150000000001 6600008
12	Farm Gifkop 166 Portion 9	Calvinia Rd	554,960605	T4968/1969	C0150000000001 6600009
13	Farm Gifkop 166 Portion 10	Calvinia Rd	565,77058	T11974/2002CTN	C0150000000001 6600010
14	Farm Gifkop 166 Portion 11	Calvinia Rd	3564,825963	T39084/2000	C0150000000001 6600011
15	Farm Gifkop 166 Portion 12	Calvinia Rd	3771,057983	T33330/2008	C0150000000001 6600012
16	Farm Paul Se Vley 167 Portion 0	Calvinia Rd	8237,317651	T62188/2002	C0150000000001 6700000
17	Farm Tweeling 168 Portion 0	Calvinia Rd	3647,09889	T46509/2011	C0150000000001 6800000
18	Farm Tweeling 168 Portion 1	Calvinia Rd	3679,449156	Unknown	C0150000000001 6800001
19	Farm Annex Koffie Meul 169 Portion 1	Calvinia Rd	299,662049	T12/2005	C0150000000001 6900001
20	Farm Koffie Meul 170 Portion 0 RE	Calvinia Rd	3697,617482	T92055/1994	C0150000000001 7000000
21	Farm Koffie Meul 170 Portion 1	Calvinia Rd	4007,591845	T12/2005	C0150000000001 7000001
22	Farm Kapsvlei 174 Portion 0 RE	Calvinia Rd	12122,93286	T23295/1976CTN	C0150000000001 7400000
23	Farm Kapsvlei 174 Portion 1	Calvinia Rd	12135,63083	T51683/1986CTN	C0150000000001 7400001

Nr	Registered Land Description	Magisterial District	Extent (Ha)	Title Deed/Diagram Deed	SG Code
24	Farm Kapsvlei 174 Portion 2	Calvinia Rd	6038,50704	Unknown	C0150000000001 7400002
25	Farm Kapsvlei 174 Portion 3 RE	Calvinia Rd	2391,011479	T64404/2009	C0150000000001 7400003
26	Farm Kapsvlei 174 Portion 4	Calvinia Rd	1472,643465	T67149/2002	C0150000000001 7400004
27	Farm Kapsvlei Portion 5	Calvinia Rd	1147,322511	T51684/1986	C0150000000001 7400005
28	Farm Kapsvlei 174 Portion 6	Calvinia Rd	2327,361793	T64404/2009	C0150000000001 7400006
29	Farm Kapsvlei 174 Portion 7	Calvinia Rd	3776,592667	T84533/1992	C0150000000001 7400007
30	Farm Kapsvlei 174 Portion 8	Calvinia Rd	2323,931687	T84533/1992	C0150000000001 7400008
31	Farm Blaauw Pan 175 Portion 0	Calvinia Rd	8382,488799	T9011/1981CTN	C0150000000001 7500000
32	Farm Hoepel 180 Portion 0 RE	Calvinia Rd	3283,250155	T11332/2012	C0150000000001 8000000
33	Farm Hoepel 180 Portion 1	Calvinia Rd	5639,188171	T9853/1990CTN	C0150000000001 8000001
34	Farm Hoepel 180 Portion 2	Calvinia Rd	1868,732534	T33330/2008	C0150000000001 8000002
35	Farm Groot Zevenfontein West 181 Portion 0	Calvinia Rd	8448,556192	T10760/2012CTN	C0150000000001 8100000
36	Farm Lospers Plaats 218 Portion 0 RE	Calvinia Rd	4491,872035	T32740/1982CTN	C0150000000002 1800000
37	Farm Lospers Plaats 218 Portion 0 RE	Calvinia Rd	2695,115949	T32740/1982CTN	C0150000000002 1800000
38	Farm Lospers Plaats 218 Portion 1	Calvinia Rd	6660,830913	T3878/2018	C0150000000002 1800001
	TOTAL AREA (HA		177 468		

Table 2-2: NGA Dataset

Site ID No.	Other No.	Latitude	Longitude	Date established	Depth [m bgl]	Groundwater level [m bgl]	Reported Yield [L/s]	Waterstrike depth [m bgl]
3019AC00026		-30.32213	19.13729	02-Dec-99	35			
3019AC00005	155669	-30.29838	19.13118	01-Feb-90	66			
3019AC00006	156179	-30.29755	19.11367	19-Jul-90	42	36.00	1.13	39
3019AC00009	156181	-30.25867	19.13312	23-Jul-90	42			
3019AC00008	156180	-30.25866	19.13312	20-Jul-90	72			
3019AB00014	151321	-30.23367	19.26590	04-May-87	90			
3019AB00013	151322	-30.23366	19.26590	05-May-87	90	49.90	0.09	62.3
3019AA00034		-30.22253	19.05867	02-Dec-99	35			
3019AA00036		-30.22033	19.14951	02-Dec-99	35			
3019AA00030	152838	-30.21970	19.08470	19-Feb-88	34	18.00	1.50	32
3019AA00031	152837	-30.21969	19.08470	19-Feb-88	29	20.00	0.63	26
3019AA00014	136309/5	-30.21702	19.08256	20-Aug-80	58	8.20	0.38	56
3019AA00012	134836/2	-30.21701	19.08256	21-Apr-80	59	13.70	1.17	56.9
3019AA00011	134835/4	-30.21700	19.08256	17-Apr-80	45.7			
3019AA00013	118189/1	-30.21700	19.08257	02-Dec-74	53.5	50.80	0.40	51.8
3019AA00015	106584	-30.21700	19.08258	24-Dec-69	65.53	32.92	3.41	50.9 and 59.74
3019AA00018	134854/0	-30.20505	19.22090	30-Jun-80	59			59
3019AA00024	134855/8	-30.20505	19.22090	01-Jul-80	71			71
3019AA00035		-30.18113	19.10006	02-Dec-99	35			
3019AB00033		-30.17093	19.33895		30			
3019AB00034		-30.17093	19.33895	08-Dec-99	30	16.22		
3019AB00028	35108	-30.16866	19.33812	14-Apr-48	55.17			55.17
3019AB00028		-30.16866	19.33812	14-Apr-48	55.17			55.17
3019AB00030		-30.16866	19.33812	08-Jun-48	43.28	25.91	1.89	39.62
3019AB00032		-30.16453	19.37117	08-Dec-99	50	17.79		
6048	6048	-30.13372	19.38256	16-Jan-52	13.7	9.10	0.51	10.7
6048	45852	-30.13372	19.38256	16-Jan-52	13.7	9.10	0.51	10.7

Site ID No.	Other No.	Latitude	Longitude	Date established	Depth [m bgl]	Groundwater level [m bgl]	Reported Yield [L/s]	Waterstrike depth [m bgl]
3019AB00010		-30.13371	19.38256	08-Jan-52	61.9	18.90	0.05	18.9 and 28.65
3019AB00008	110766	-30.13370	19.38256	28-Jul-71	40.2	18.30	0.01	38.1
3019AB00008	110766	-30.13370	19.38256	28-Jul-71	40.2	18.30	0.01	38.1
3019AB00006	110764	-30.13369	19.38256	26-Jul-71	24.4			
3019AB00004	118184/1	-30.13368	19.38256	18-Nov-74	37.1	35.00	0.63	37.1
3019AB00002	118186/7	-30.13367	19.38256	19-Nov-74	44.8	20.00	0.08	32
3019AB00001	57615	-30.13366	19.38256	04-May-55	40.5	14.30	5.91	21.6
3019AB00003	118185/9	-30.13366	19.38257	19-Nov-74	35	9.00	0.90	35
3019AB00005	118183/3	-30.13366	19.38258	14-Nov-74	41.1	37.00	0.63	39.6
3019AB00007	110765	-30.13366	19.38259	27-Jul-71	30.5			
3019AB00009	110743	-30.13366	19.38260	26-Jul-71	46.8	12.20	0.25	46.8
3019AB00011	35778	-30.13366	19.38261	10-Jul-48	45.72	30.50	2.52	42.7
4715	4715 / 44504	-30.10925	19.24145	17-Oct-51	76.2	45.70	0.05	51.8
3019AA00007	147107/6	-30.10924	19.24145	20-Nov-84	84	71.00	0.86	80
3019AA00005	151313	-30.10923	19.24145	27-Mar-87	75	42.20	0.40	70
3019AA00003	147106/8	-30.10922	19.24145	15-Nov-84	420			
3019AA00004	151314	-30.10922	19.24146	30-Mar-87	60	36.10	0.40	55.3
3019AA00006	147108/4	-30.10922	19.24147	21-Nov-84	22	11.00	0.42	18
4714	4714 / 44190	-30.10922	19.24148	11-Aug-51	87.8			
3019AA00010	73936	-30.10922	19.24149	23-Mar-60	146.6			
3019AA00022	157255	-30.10369	19.12479	18-Jan-91	84			
3019AA00020	157251	-30.10368	19.12479	04-Jan-91	114	35.00	0.48	95
3019AA00017	157254	-30.10367	19.12479	15-Jan-91	84	45.00	0.91	80
3019AA00016	157252	-30.10366	19.12479	08-Jan-91	63	35.00	0.69	61
3019AA00019	157253	-30.10366	19.12480	10-Jan-91	78			
3019AA00021	154257	-30.10366	19.12481	23-Jan-91	30	12.00	2.50	
3019AA00023	157256	-30.10366	19.12482	22-Jan-91	51	20.00	0.91	48
3019AA00026	154507	-30.10168	19.12718	22-Mar-89	72			
3019AA00028	154509	-30.10167	19.12717	28-Mar-89	66			
3019AA00027	154508	-30.10167	19.12718	23-Mar-89	75			
3019AA00029	154510	-30.10166	19.12717	29-Mar-89	72			
3019AB00035		-30.08423	19.41312	16-Nov-99	35			
3019AA00038		-30.07703	19.12034	01-Dec-99	35			
3019AB00027	158963	-30.07533	19.40062	28-Jan-92	42			
3019AB00026	158964	-30.07117	19.40479	28-Jan-92	18			
3019AA00001	147127/0	-30.05033	19.18256	17-Jan-85	160	110.00	0.75	113
3019AA00002	147128/8	-30.05033	19.18257	17-Jan-85	220	151.00	1.00	162
3019AA00032		-30.04843	19.18701	01-Dec-99	35			
3019AA00033	182472	-30.03593	19.07395	01-Dec-99	35			
3019AB00024	156741	-30.03285	19.40617	12-Nov-90	82			
3019AB00022	156745	-30.03284	19.40617	26-Nov-90	78			
3019AB00021	156719	-30.03283	19.40617	06-Nov-90	84	42.00	0.10	
3019AB00023	156720	-30.03283	19.40618	07-Nov-90	72			
3019AB00025	156742	-30.03283	19.40619	13-Nov-90	48	30.00	2.50	33
G01006NC	G01006NC	-30.02832	19.26492	28-Jun-07		40.72		
3019AB00031		-30.01503	19.41562		80			
2919CC00076	151320	-29.98425	19.17115	28-Apr-87	69			69
2919CC00077	151319	-29.98425	19.17115	24-Apr-87	48			48
6044	6044 / 41628	-29.98372	19.18254	14-Oct-50	57.6	48.77	0.25	53.95
2919CC00049	113922	-29.98371	19.18254	26-Sep-72	64.92	29.87	3.45	62.48
2919CC00047		-29.98370	19.18254					9.14 and 12.19
2919CC00046	113921	-29.98369	19.18254	13-Sep-72	64.31			
2919CC00048	26185	-29.98369	19.18255	13-Sep-72	50.29	27.43	0.20	32.61
2919CC00050	111498	-29.98369	19.18256	31-Aug-72	52.43	44.20	9.22	50.6
2919CC00052	041628A	-29.98369	19.18257	24-Aug-50	54.86			53.95
650	650 / 36875	-29.97536	19.25754	18-Dec-48	60.05	52.73	0.23	52.73
2919CD00042		-29.97536	19.25754	16-Nov-48	78.94			78.94
2919CD00043	73201	-29.97536	19.25754	06-Jan-60	115.21	48.77	2.71	106.68
2919CD00044	72273	-29.97536	19.25754	08-Oct-59	126.49			126.49
2919CD00045	36116	-29.97092	19.25560	14-Sep-48	115.21			115.21
2919CC00054	17080	-29.95037	19.14921	23-May-34	139.6	109.73	0.30	121.92
2919CC00053	150013	-29.95036	19.14921	23-Oct-86	100	75.00	1.87	99
4640	4640 / 41993	-29.95036	19.14922	08-Dec-50	65.53	54.86	2.52	60.96
2919CD00030	150406	-29.95036	19.48254	23-Oct-86	16	4.80	1.20	9.9
2919CD00050	110762	-29.92286	19.49588	16-Jul-71	46.33	29.57	0.76	35.05 and 37.19
7026	7026 / 45632	-29.91925	19.38088	29-Jan-52	41.15	22.86	0.23	38.1
2919CD00048	151316	-29.91870	19.38629	21-Apr-87	90	40.10	2.00	87.7

Site ID No.	Other No.	Latitude	Longitude	Date established	Depth [m bgl]	Groundwater level [m bgl]	Reported Yield [L/s]	Waterstrike depth [m bgl]
2919CD00049	151315	-29.91869	19.38629	09-Apr-87	90			
2919CC00080		-29.88816	19.21393	30-Nov-99	60	52.02		
2919CC00068	16873	-29.88370	19.21866	12-May-32	109.72			
2919CC00067	17063	-29.88369	19.21866	15-Aug-32	75.59			
2919CC00063	43687	-29.86707	19.19921	31-May-51	81.69			
2919CC00061	69836	-29.86706	19.19921	02-Mar-59	139.9			
2919CC00059	67752	-29.86705	19.19921	01-Jul-58	144.78			144.78
2919CC00057	19017	-29.86704	19.19921	06-Jul-34	56.69	25.91	1.51	39.62
2919CC00056	16966	-29.86703	19.19921	28-May-32	83.21	53.64	2.42	56.69
2919CC00058	70834	-29.86703	19.19922	19-May-59	81.99	36.58	0.43	50.9
2919CC00060	68713	-29.86703	19.19923	04-Nov-58	149.05			
2919CC00062	43434	-29.86703	19.19924	24-Apr-51	106.68			
2919CD00047		-29.86456	19.37615	16-Nov-99	80	32.43		
2919CC00082		-29.85896	19.15477	30-Nov-99	60	51.25		
2919CD00029	38163	-29.85039	19.28254	15-Aug-49	80.77	60.96	0.13	71.63
647	647	-29.85038	19.28254	03-Jun-49	48.16			
2919CD00025	26576	-29.85037	19.28254	16-Aug-40	106.07	70.10	0.13	79.86
2919CD00024	26216	-29.85036	19.28254	12-Jun-40	101.5	79.25		101.5
2919CD00026		-29.85036	19.28255	26-Sep-33	124.36			
644	644 / 36957	-29.85036	19.28256	28-Feb-49	82.3	79.25	0.01	79.25

2.4.2 Future Groundwater Users

The drivers for future groundwater development usually include the following:

- Existing boreholes that dry up;
- Increase in groundwater demand (e.g. population growth, economic growth, agricultural growth);
- Insecurity of bulk water supplies;
- Surface water shortages (as result of global warming, increased demand); and
- Prolonged droughts.

From a desktop study it is not possible to determine the future demand on groundwater, as the existing use and growth factors have to be taken into account.

2.4.3 Groundwater as Natural Resource

Groundwater falls under the protection of the National Water Act, and may not be polluted.

2.5 Consideration of related/significant aspect management plans in the area

SRK is not aware of any specific aspect management plans in the Gifkop Area, besides the regulations previously discussed.

2.6 Spatial Sensitivity Mapping

According to UNEP-WCMC. (2018),

Sensitivity mapping provides a visual representation of risks, and assets which may be exposed to them. Multiple environmental sensitivity mapping approaches exist, with methods and uses varying based on stakeholders' values, drivers of change, data availability, and the technical capacity of the users. Sensitivity mapping is often carried out using geographic information systems (GIS) technology. The amount and/or type of data used to produce a sensitivity map will affect and limit its potential uses. Nevertheless, environmental sensitivity mapping can have a wide variety of applications. These include but are not limited to:

- *Helping decision-makers understand where protection of valuable environmental assets is needed, which could aid the development of protected area networks;*
- *Informing governmental and private sector spatial planning at the project level, targeting activities to the locations where they will have the lowest impact;*
- *Supporting all stages of impact management, including prevention, mitigation, preparedness, operations, relief, recovery and integration of lessons learned;*
- *Aiding situational awareness and response strategy development for responders and decision makers during an incident.*

In the case of the Gifkop Area and in order to create a spatial sensitive map, the following are deemed of key importance:

- Exploration methods:
  - Drilling positions and drilling methods;
  - The processes that will be followed during the exploration phase; and
  - Implementation and auditing of the groundwater management plan.
- Receiving environment (for the purpose of this report, specifically groundwater):
  - Areas overlain with sand / alluvial deposits (quarternary deposits) – these are highly permeable and contamination may migrate rapidly[5] towards groundwater and surface water; and
  - Proximity of surface water features such as wetlands, streams, rivers and earth dams.

<u>Drilling Positions, Drilling depths and Exploration Processes</u>

Exact drilling positions: According to Black Mountain: "*it is not possible to give details of the drilling program before the surveys and surface work phase 1 is completed. The targeting of all drilling activities will be dependent on the results obtained during the preceding phases of prospecting, namely the geological mapping and geophysical surveying and as such it is currently not possible to include a finalized surface plan showing the intended location, extent and depth of boreholes to be completed.*"

Drilling depths and drilling methods: According to Black Mountain*: The initial planned invasive exploration activities will consist of diamond drill boreholes drilled <u>to appropriate depths</u> to target any*

[5] The migration of a pollution plume is dependent on (1) the viscosity of the pollutant, (2) pathway medium, (3) the volume of pollutant and (4) hydraulic head.

anomalies identified during Phases 2 & 3 of the non-invasive portion of the prospecting work plan. Percussion Rotary Air Blast (RAB) or Reverse Circulation (RC) drilling may be carried out for pre-collaring of diamond drill boreholes or for obtaining samples if significant depth of cover is encountered over particular targets. No bulk sampling work is to be carried out during this prospecting program.

According to Black Mountain, the planned phases detailed in **Table 2-3** below will be used to investigate the prospecting area.

Table 2-3: Planned Activities for the Exploration

Phase	Activity (what are the activities that are planned to achieve optimal prospecting)	Skill(s) required (refers to the competent personnel that will be employed to achieve the required results)	Timeframe (in months) for the activity)
1	**Non-Invasive Prospecting** Desktop Study: Literature Survey / Review	Geologist	Month 1-12
2	**Non-Invasive Prospecting** Regional Airborne Geophysical Survey	Geophysicist / Geologist / field crew	Month 6-12
3	**Non-Invasive Prospecting** Ground Geophysical Survey and Geological Field Mapping	Geologist & field crew	Month 12-24
4	**Invasive Prospecting** Exploration Boreholes (6 RAB holes – 2400m; 4 DD holes – 2000m)	Geologist / drill rig team / field crew / laboratory technicians	Month 24-34
5	**Non-Invasive Prospecting** Compilation, interpretation and modeling of data	Geologist / Geophysicist	Month 34-36
6	**Non-Invasive Prospecting** Detailed Ground Geophysical Survey on individual positively mineralized targets to define possible extent	Geophysicist / Geologist / field crew	Month 36-42
7	**Invasive Prospecting** Boreholes to confirm continuity of mineralization & potential deposit size (20 DD holes – 8000m)	Geologist / drill rig team / field crew / laboratory technicians	Month 42-48
8	**Invasive Prospecting** Resource definition drilling (40 DD holes – 16000m)	Geologist / drill rig team / field crew / laboratory technicians	Month 48-60

9	**Non-Invasive Prospecting** Analytical Desktop Pre-Feasibility Study	Economic Geologist / Mining Geologist	Month 54-60

From the available information gathered during SRK's desktop assessment of the geology, geohydrology, NGA data and information provided by EIMS, the potentially **groundwater sensitive** areas have been restricted to:

- Areas covered by quaternary deposits (e.g. alluvial sands); and
- Existing boreholes.

Other sensitive areas that can be linked to groundwater include:

- Surface water features (e.g. rivers); and
- Salt Pans

The sensitivity map for the Gifkop Area is shown in **Appendix 1**, **Map 5** and shows the areas that have been mapped on the geological map series as quaternary deposits. Mapped rivers and saltpans are also shown. A buffer zone of 150 m from mapped rivers / streams is also drawn. The distance of 150 m has been taken from the DWS document "Groundwater Protocol for the Protection of Aquifers from On-site Sanitation". Although the current exploration activities do not involve the installation of on-site sanitation systems, in SRK's professional opinion, the protocol guidelines can be applied for this project[6].

A hydrocensus of the targeted areas (farms) will provide key information pertaining to specific areas where existing boreholes, springs, rivers, streams and wetlands (groundwater fed) are situated. The spatial sensitivity map can then be updated.

2.7 Identification, description and assessment of potential impacts

From Table 2-3, the "invasive Prospecting" works (Phases 4, 7 and 8) will include Diamond Drilling with possible Percussion Rotary Air Blast (RAB) or Reverse Circulation (RC) for pre-collaring of diamond drill boreholes.

Aquifers are vulnerable to degradation during and following exploration drilling in the following ways:

- Exploration boreholes left open may lead to the inflow of contaminated run-off from the surface;
- Aquifers of good water quality may be connected to aquifers with poor and/or unacceptable water quality via the drilling processes;
- Aquifers with useable quantities of water may be connected to leakage zones / unsaturated zones; and
- Groundwater wastage can occur during drilling, negatively affecting nearby boreholes (groundwater users).

Waterways, such as streams, springs and rivers **are** also vulnerable to negative impact from exploration drilling activities. These negative impacts may manifest via contaminated groundwater, where the groundwater table is present at a higher altitude than the base of the river or stream and

[6] The "safe distance" between any exploration borehole and the relevant (nearest) receptors will have to be determined and adjusted once the exact drilling positions are known

groundwater therefore feeds the stream or river. Drainage of contaminated water from the drilling processes may enter rivers, streams or springs directly. Contaminated drilling spoils that are left on the surface may be washed into rivers, streams or springs during rains.

3 Possible Impacts and Mitigation Measures

The aim of this section is to make a preliminary assessment of any potential groundwater impacts that are likely to arise as a result of the proposed **prospecting activities**. It must be kept in mind that no details of the prospecting / exploration activities were available at the time of writing this report. Where reference is made to possible pollution / contamination, it refers to any contamination that can result from the invasive work, i.e. drilling. This may include, but is not limited to, on-site spills (e.g. fuels and oils), sanitation, litter and mixing of poor water quality with good water quality.

EIMS provided SRK with an evaluation format to be used in the reporting of possible impacts, the severity of the impacts and mitigation measures during the exploration phases. Based on the various evaluation criteria, the following potential impacts have been identified:

- **Potential Impact 1**: **Degradation of aquifers** (see Table 3-1)
- **Potential Impact 2:** **Impact on existing groundwater users** (see Table 3-2)
- **Potential Impact 3**: **Degradation of surface water** (that could be linked to groundwater) (see Table 3-3)

In assessing the potential impacts, and considering mitigation measures, SRK assumed that the drilling positions cannot be moved by a distance > 1 km as the drilling will be target specific and not random.

3.1 Potential Impact 1: Degradation of Aquifers

Terms used:

- **Mitigation:** To reduce the risk of the drilling activities having a negative impact on the aquifer system or various aquifer systems (to be determined) a detailed geohydrological assessment would be required for the exploration area, and could have to be adapted for every drilling position. A qualified geohydrologist must form part of the exploration project team, to provide the necessary input and scientific support in terms of preventing / mitigating degradation of aquifers.
- **Pre-mitigation**: Refers to drilling in the absence of a detailed geohydrological impact assessment and no on-site geohydrological drilling control.
- **Post Mitigation**: Assumes that the proposed mitigation measures have been put in place.
- **Alternative 1**: In this case there is no alternative to drilling and therefore Alternative 1 = No Alternative.

Table 3-1: Potential Impact 1 - Degradation of Aquifers

Impact Name	**Degradation of aquifers**				
Alternative	**Alternative 1**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	4	2
Extent	3	3	Reversibility	3	2
Duration	4	2	Probability	3	3
Environmental Risk (Pre-mitigation)					-10.50
Mitigation Measures					
Detailed geohydrological assessment of expected aquifers and geohydrological support during drilling phases – input to EMP					
Environmental Risk (Post-mitigation)					-6.75
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					3
High: Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
High: Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.83
Final Significance					-12.38

3.2 Potential Impact 2: Impact on Local Groundwater Users

Terms used:

- **Mitigation:** To reduce the risk of the drilling activities having a negative impact on any existing groundwater user (i.e. boreholes) a detailed hydrocensus, followed by a geohydrological assessment would be required for the exploration area. The geohydrological report must include a risk assessment (source-pathway-receptor) of every drill site with nearby boreholes / springs in mind. A qualified geohydrologist must form part of the exploration project team, to provide the necessary input and scientific support in terms of preventing / mitigating impacts on nearby groundwater users.
- **Pre-mitigation**: Refers to drilling in the absence of a hydrocensus, absence of a detailed geohydrological report and no on-site geohydrological drilling control.
- **Post Mitigation**: Assumes that the proposed mitigation measures have been put in place.
- **Alternative 1**: In this case there is no alternative to drilling and therefore Alternative 1 = No Alternative.

Table 3-2: Potential Impact 2: Impact on Local Groundwater Users

Impact Name	**Impact on local GW users**				
Alternative	**Alternative 1**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	4	2
Extent	3	3	Reversibility	3	2
Duration	2	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-9.00
Mitigation Measures					
Detailed hydrocensus, detailed geohydrological assessment and geohydrological support during drilling phases – input to EMP					
Environmental Risk (Post-mitigation)					-4.50
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					3
High: Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
High: Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.83
Final Significance					-8.25

3.3 Potential Impact 3: Degradation of Surface Water (linked to groundwater)

Terms used:

- **Mitigation:** To reduce the risk of the drilling activities having a negative impact on any nearby surface water that may be linked to groundwater (e.g. wetlands that are sustained by groundwater, streams / rivers that are partly recharged by groundwater), the detailed geohydrological report must include a risk assessment (source-pathway-receptor) of every drill site with nearby surface water features in mind. The drilling must also be overseen by a qualified geohydrologist, who will also brief the drilling contractor on the possible risks to the receptors so that the drilling contractor can have a contingency plan in place
- **Pre-mitigation**: Refers to drilling in the absence of a hydrocensus (which must also detect surface water features), absence of a detailed geohydrological impact assessment and no on-site geohydrological drilling control.
- **Post Mitigation**: Assumes that the proposed mitigation measures have been put in place.
- **Alternative 1**: In this case there is no alternative to drilling and therefore Alternative 1 = No Alternative.

Table 3-3: Potential Impact on Surface Water Sources

Impact Name	**Degradation of surface water**				
Alternative	**Alternative 1**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature	-1	-1	Magnitude	4	2
Extent	3	3	Reversibility	3	2
Duration	3	2	Probability	2	2
Environmental Risk (Pre-mitigation)					-6.50
Mitigation Measures					
Detailed hydrocensus, including capturing surface water, geohydrological risk assessment input to EMP					
Environmental Risk (Post-mitigation)					-4.50
Degree of confidence in impact prediction:					Low
Impact Prioritisation					
Public Response					3
High: Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					2
Medium: Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					1
Low: Where the impact is unlikely to result in irreplaceable loss of resources.					
Prioritisation Factor					1.50
Final Significance					-6.75

4 Geohydrological Management Plan

The desktop study has highlighted potential risks and impacts that the invasive phases of the exploration (i.e. drilling) could cause. As the details of the drilling processes, drilling depths and drilling positions are not known at this stage, the potential risks that have been highlighted in this report is generic of nature and applies to exploration drilling in general.

The geohydrological management plan (GMP) cannot be finalised at a desk study phase as the identified risks and potential impacts are site specific and currently the final drilling positions have not been finalised yet. A GMP can be compiled for the Gifkop Area once a hydrocensus has been completed, also taking cognisance of the specific drilling positions and potential receptors.

Site specific information / instructions that will ultimately have to be included in the final GMP and overseen by an experienced and qualified geohydrologist (Pr. Sci. Nat. registered) must include:

- A description of the expected geological formations that will be penetrated and the expected aquifer characteristics associated with each geological formation – depth of the borehole will dictate the potential risks;
- Expected water qualities of each aquifer (associated with the different geological formations) that will be penetrated – depth of the exploration borehole will dictate the potential risks;
- An assessment of the potential degradation of the aquifers should variable water qualities mix;
- Surrounding groundwater users and the protection thereof: positions of boreholes, depths, abstraction rates, water quality and dependency of the owner of his/her borehole.

The following mitigation measures should be implemented as standard during the prospecting phase in order to limit the impact on groundwater resources:

- Ensure vehicles and equipment are in good working order.
- Place oil traps under stationary machinery, only re-fuel machines at fuelling station, construct structures to trap fuel spills at a fuelling station, immediately clean oil and fuel spills and dispose contaminated material (soil, etc.) at licensed sites only.
- Ensure that good housekeeping rules are applied.
- A procedure for the storage, handling and transport of different hazardous materials must be drawn up and strictly enforced.
- Implement and follow water saving procedures and methodologies.
- If boreholes are to be drilled to supply water for the staff or drilling processes;
  - Ensure the location of the borehole/s is selected to prevent a negative effect on the groundwater levels of existing boreholes.
  - Ensure the abstraction from the borehole/s is determined scientifically to prevent over abstraction.
  - Liaise with potentially affected groundwater water users and monitor any potential impact.
  - The distance between a planned exploration drill hole and a privately owned borehole is important to note, as it also affects the distance (pathway) that any potential pollutant must migrate to reach the borehole
- Monitoring of the groundwater quality during and after activities are completed.

- Portable chemical toilets must be used during the exploration phase.
- Mud pits (if to be used) must be lined and properly covered with impermeable material after completion of exploration boreholes
- Cap and seal all exploration boreholes to prevent surface water from entering the borehole.

It is not currently known whether groundwater from boreholes is considered to be utilised during the prospecting phase. It is anticipated that water will be brought onto site and trucked to the identified drill sites.

During exploration drilling the following information must be recorded and reported on:

a) Aquifer type;

b) Depths to first water strike;

c) Depths to deeper water zones;

d) Salinity of water strike zones (EC measurement with field probe);

e) Strike yields;

f) Standing water level (allow several hours after completion); and

g) Hole completion details (e.g. cement / bentonite plug, backfill material, bore cap, bore number and coordinates).

5 Conclusions

From the desktop study and information provided to SRK by EIMS, the following are concluded for the Gifkop Area:

- Although the majority of the area is being classed as a minor aquifer system with potentially poor water quality and low expected yields, there are existing groundwater users for which boreholes could be their only water source. It is therefore critical that existing groundwater users be taken into account and that their boreholes are not negatively affected in any way.
- Any negative impact on groundwater and/or groundwater users, whether factual or perceived (complaints from surrounding borehole users) can have a significant financial and reputational impact on the exploration programme and subsequent mining.
- It is not possible to accurately predict the aquifers that will be penetrated when drilling 400 m or more and it is therefore important that support by a geohydrologist is provided before and during the drilling activities.
- Due to the lack of information, such as hydrocensus information, exact drilling positions and drilling depths, a very basic sensitivity map could be compiled at this stage, incorporating areas covered by quaternary deposits (e.g. sands) and surface water / pans. This information was taken from available geological and topographical maps.

6 Assumptions, uncertainties and gaps in knowledge

6.1 Assumptions

SRK assumes that the main purpose of this desktop study is to provide a broad overview of what has been documented for this specific area in terms of the geohydrology. SRK further assumed that the planned exploration has not yet been publicised or discussed with the local municipalities, local farming unions, or any other private or public sector body. SRK did therefore not make contact with any private or public body in terms of the gathering of site specific data. The information on which the desktop study is based, is therefore mainly the available information from the Department of Human Settlement, Water and Sanitation, on a national scale, and published reports that we could source. SRK further assumes that a public participation process will be followed whereby existing groundwater users will be included.

6.2 Limitations

The potential impacts of any drilling activity on the groundwater regime will vary from site to site, even over short distances due to changes in geology and receptors. As no recent hydrocensus across the entire exploration area has been conducted, SRK did not have access to, for example, positions of existing boreholes, dependency on groundwater, specific water quality, depth to groundwater levels and borehole depths. The sensitivity map and groundwater management plan, as presented in this report, must be seen as working documents that must be improved as more information becomes available.

6.3 Gaps

Based on the information presented to SRK, by EIMS, the following information gaps have been identified:

- Exact drilling positions and drilling depths;
- Storage and handling of any potentially hazardous materials / substances on the drilling site, e.g. fuels (diesel, petrol, paraffin, etc.), oils and cleaning chemicals;
- Detailed hydrocensus within the areas where the exploration drilling will take place – the hydrocensus must be completed by a geohydrologist / geohydrological technician who has experience in the collection of geosite data, as prescribed by the DWS.
- Detailed scientific reports (geological and geohydrological) of the exploration area (if any) – sourcing these reports will require open conversations with private and public bodies, in which the purpose of the exploration programme and exploration areas will have to be revealed.

A **detailed geohydrological assessment** is required prior to any invasive exploration work (e.g. drilling).

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

8 References

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Appendix 1: Maps

Map 1 - Topography

Map 2 – Geology

Map 3a – Electrical Conductivity

Map 3b – Groundwater Flow Directions

Map 4a – Boreholes Depths

Map 4b – NGA Data

Map 5 – Sensitivity Map

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