Black Mountain Mining Prospecting Rights Application:

Geohydrological Specialist Study:

WIT PUTS AREA

Report Prepared for

EIMS | ENVIRONMENTAL IMPACT MANAGEMENT SERVICES

Report Number 549553/WIT PUTS

Report Prepared by

srk consulting

July 2019

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WIT PUTS AREA

EIMS

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SRK Project Number 549553/WIT PUTS

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 Wit Puts 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 Wit Puts 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 Wit Puts 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 areas 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 Study as part of a basic assessment report (BAR) in support of a Mining Prospecting Rights Application, WIT PUTS 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 Wit Puts 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 conducted geohydrological risk assessments for private industries 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 Wit Puts Area is depicted in **Map 1**, **Appendix 1**. The area is located approximately 60 kilometres southeast of the town of Pofadder, Northern Cape, South Africa. It covers 41 farms, over an area of 174 126 Ha (1741.26 km$^{2)}$. Topographically, the north-western parts of the Wit Puts Area are the highest with altitudes in the order of 1040 m amsl. The rest of the area remains relatively flat with altitudes remaining around 1000 and 960 m amsl. Parts of the south-eastern corner are lower with altitudes in the order of 940 – 960 m amsl. Drainage seems to be primarily from northeast to southwest, except for the upper north-western parts where the drainage seems to be northwest to southeast.

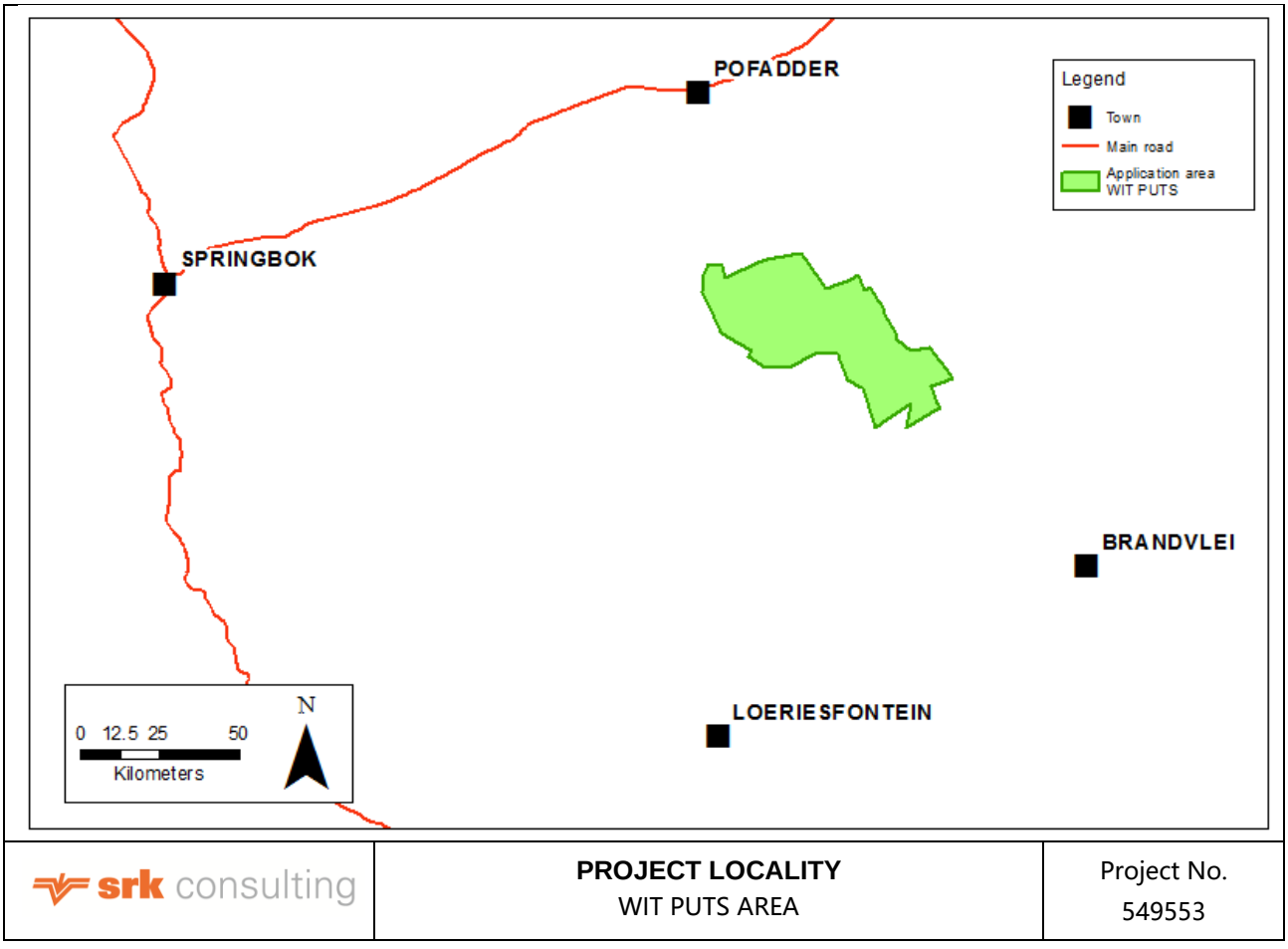

Figure 2-1: Project Locality

2.2 Geology

The terrain consists of flat lying plains with Cenozoic and Karoo-aged sediments overlying Namaquan granite gneiss and meta sediments. The north-western corner of the Wit Puts area comprises diamictite, tillite, subordinate sandstone and mudstone of the Mbizana Formation, as well as migmatised gneiss with lenses of conglomerate and marble of the Kraandraai Formation. The rest (majority) of the area comprises the Prince Albert Formation (brownish-green shale, mudstone and

dolomitic limestone. The central and eastern parts are also characterised by the intrusion of dolerite sheets. Alluvium occurs along the main drainages. 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 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".

According to Vegter and Seymore (1995), the majority of the area can be considered having a low groundwater potential of <10 %. Two small areas, one in the northern corner and one in the south-eastern corner have a groundwater potential of 10 – 20%. These percentages indicate the probability of drilling a successful borehole (yield > 2 L/s). According to the GRA 2, the expected average groundwater exploitation potential (AGEP) in the Wit Puts area is < 2500 m^3/km^2/annum.

Based on the Aquifer Classification Map (Vegter), the middle-to-southern parts are classified as Poor Aquifer Regions – therefore being a low to negligible yielding aquifer system of moderate to poor water quality. The northern and south-western parts are classified a Minor Aquifer Regions, with moderately yielding aquifers of variable water quality.

The Wit Puts Area falls entirely within the Lower Orange WMA (see Figure 2-2). The EWR report of 2016 covers the Lower Orange WMA and from this report the following information is deemed relevant to the Wit Puts Area:

- The Wit Puts Area have an estimated 30 – 60 % dependency of groundwater (i.e. domestic use, irrigation, stock watering, bulk supply, mining).
- Wit Puts Area falls partly within the D53F and D53G Quaternary Catchments and can, according to the EWR report, described as "metamorphic terrain with poor groundwater quality".

Refer to Figure 2-2 (the insert) for the positioning of the Wit Puts Area relevant to the quaternary catchments. The expected electrical conductivity (EC) for the eastern half of the area is 300 – 1000 mSm and for the western half of the area the expected ECs are 70 – 300 mSm. **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**.

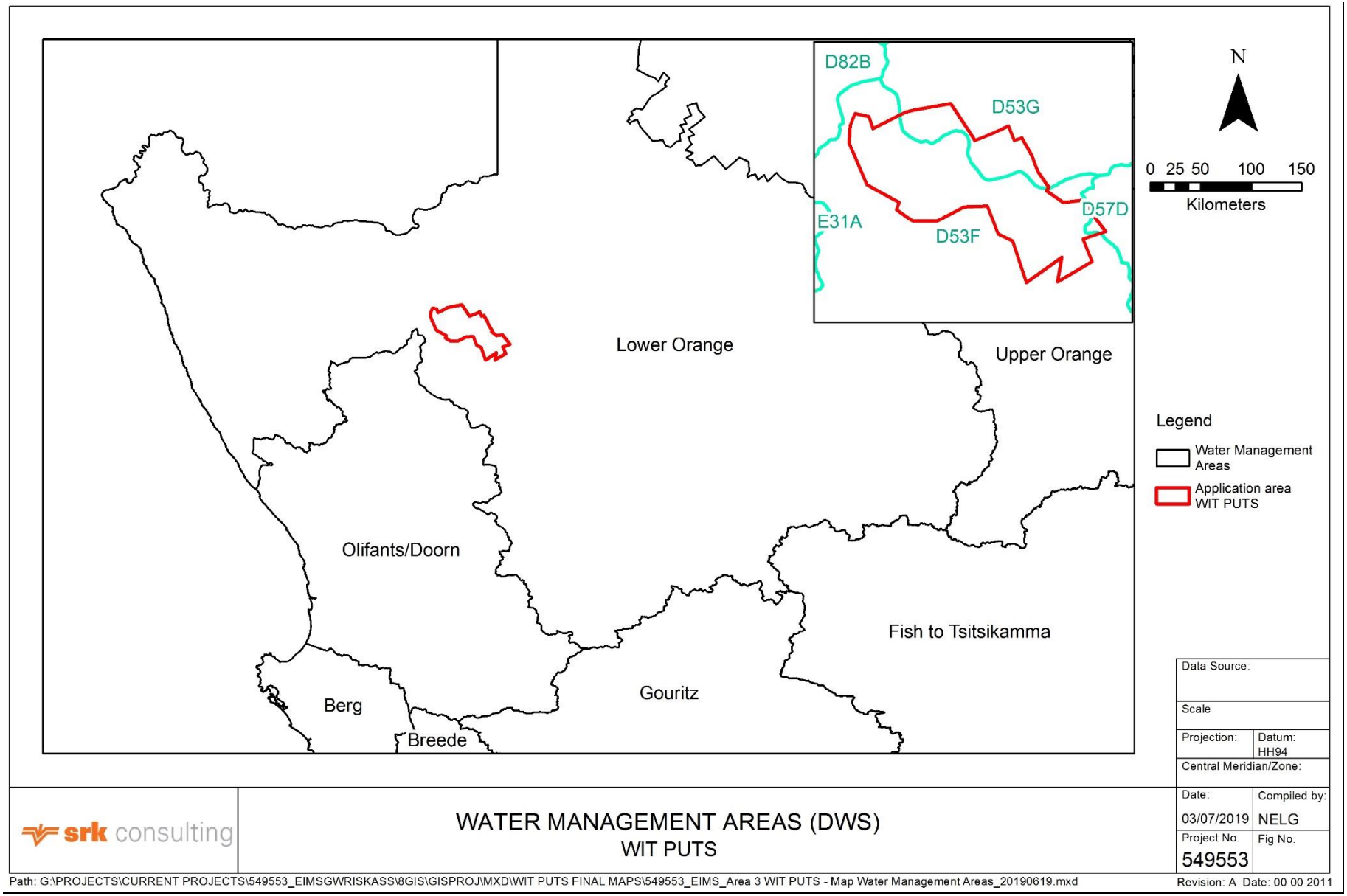

Figure 2-2: Water Management Areas (as per the DWS classification) – Quaternary Catchments inclusion

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 Wit Puts 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).

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

Nr	Registered Land Description	Magisterial District	Extent (Ha)	Title Deed/Diagram Deed	SG Code
1	Farm Nieuw Jaars 6 Portion 0 RE	Calvinia Rd	12928,51143	T423/1996CTN	C01500000000000600000
2	Farm Nieuw Jaars 6 Portion 1 RE	Calvinia Rd	106,35445	T32947/1979CTN	C01500000000000600001
3	Farm Nieuw Jaars 6 Portion 2	Calvinia Rd	282,51192	T95792/2000CTN	C01500000000000600002
4	Farm Koebas Hoek 7 Portion 0 RE	Calvinia Rd	6287,71959	T101542/2007CTN	C01500000000000700000
5	Farm Koebas Hoek 7 Portion 1 RE	Calvinia Rd	3192,963485	T76578/2012CTN	C01500000000000700001
6	Farm Koebas Hoek 7 Portion 2	Calvinia Rd	3232,650177	T15601/1985CTN	C01500000000000700002
7	Farm Wit Puts 9 Portion 0	Calvinia Rd	7830,549328	Unknown	C01500000000000900000
8	Farm Boks Kolk 10 Portion 2	Calvinia Rd	7752,468326	T82745/2001CTN	C01500000000001000002
9	Farm Zout Dwaggas 11 Portion 0 RE	Calvinia Rd	5778,754484	T24140/1977CTN	C01500000000001100000
10	Farm Gurreys 12 Portion 0 RE	Calvinia Rd	6724,354994	T43980/1987CTN	C01500000000001200000
11	Farm Gurreys 12 Portion 1 RE	Calvinia Rd	1862,176627	T27625/2002CTN	C01500000000001200001
12	Farm Gurreys 12 Portion 2	Calvinia Rd	1323,010938	Unknown	C01500000000001200002
13	Farm Gurreys 12 Portion 3 RE	Calvinia Rd	1431,27379	T23270/1976CTN	C01500000000001200003
14	Farm Gurreys 12 Portion 4	Calvinia Rd	1242,586144	T43980/1987CTN	C01500000000001200004
15	Farm Gurreys 12 Portion 5	Calvinia Rd	889,590938	T23270/1976CTN	C01500000000001200005
16	Farm Hou Hou 13 Portion 0	Calvinia Rd	10108,00581	T23270/1976CTN	C01500000000001300000
17	Farm Teriris 142 Portion 0	Calvinia Rd	8527,132152	T36260/2004CTN	C01500000000001420000
18	Farm Onap 143 Portion 0 RE	Calvinia Rd	6713,466657	T16844/1997CTN	C01500000000001430000
19	Farm Onap 143 Portion 1	Calvinia Rd	1,711307	T4570/1925CTN	C01500000000001430001
20	Farm Onap 143 Portion 2 RE	Calvinia Rd	2083,661739	T8553/2013CTN	C01500000000001430002
21	Farm Onap 143 Portion 3	Calvinia Rd	2594,860708	T39074/2005CTN	C01500000000001430003
22	Farm Onap 143 Portion 4	Calvinia Rd	889,303181	T43980/1987CTN	C01500000000001430004
23	Farm Karesses 157 Portion 0	Calvinia Rd	6513,991031	T74859/1990CTN	C01500000000001570000
24	Farm Izaks Puts 158 Portion 0	Calvinia Rd	4482,539852	T23007/1982CTN	C01500000000001580000
25	Farm Soutdwaggas 1199 Portion 0	Calvinia Rd	8124,067635	Unknown	C01500000000011990000
26	Farm Burtons-Vlei 230 Portion 0 RE	Calvinia Rd	4328,445271	T32947/1979CTN	C03600000000023000000

Nr	Registered Land Description	Magisterial District	Extent (Ha)	Title Deed/Diagram Deed	SG Code
27	Farm Burtons-Vlei 230 Portion 1	Calvinia Rd	4164,211965	T95792/2000CTN	C0360000000002300001
28	Farm Klercks Goubeep 236 Portion 0	Calvinia Rd	9224,931233	T46708/1995CTN	C0360000000002360000
29	Farm Baiang Putsen 237 Portion 0	Calvinia Rd	9102,438223	T67184/1992CTN	C0360000000002370000
30	Farm Ysis 289 Portion 1 RE	Calvinia Rd	560,956382	T55001/1984CTN	C0360000000002890001
31	Farm Ysis 289 Portion 3	Calvinia Rd	1842,672858	T55001/1984CTN	C0360000000002890003
32	Farm Ramans Kolk 291 Portion 0 RE	Calvinia Rd	1214,132963	T55001/1984CTN	C0360000000002910000
33	Farm Ramans Kolk 291 Portion 1	Calvinia Rd	5469,985336	T55000/1984CTN	C0360000000002910001
34	Farm Ramans Kolk 291 Portion 2 RE	Calvinia Rd	913,512887	T55001/1984CTN	C0360000000002910002
35	Farm Bossie Kom 292 Portion 0 RE	Calvinia Rd	4667,909982	T21286/1989CTN	C0360000000002920000
36	Farm Bossie Kom 292 Portion 1	Calvinia Rd	4747,531828	T51889/2000CTN	C0360000000002920001
37	Farm Half Kroon 293 Portion 0 RE	Calvinia Rd	4133,77771	T51889/2000CTN	C0360000000002930000
38	Farm Half Kroon 293 Portion 1	Calvinia Rd	4091,527565	T51889/2000CTN	C0360000000002930001
39	Farm Half Kroon 293 Portion 2	Calvinia Rd	495,717382	T21286/1989CTN	C0360000000002930002
40	Farm Wolf Kop 294 Portion 0 RE	Calvinia Rd	4100,068116	T42498/2004CTN	C0360000000002940000
41	Farm Wolf Kop 294 Portion 1	Calvinia Rd	4167,492678	T11247/2006CTN	C0360000000002940001
	TOTAL AREA (HA		**174 126**		

2.4.1 Existing Groundwater Users

To capture all existing groundwater users a hydrocensus[1] 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[2] revealed 68 existing boreholes, of which:

- 36 boreholes had water level data – the average groundwater level was 20.53 m bgl[3];
- 32 boreholes had recorded yields - the average yield being 1.74 L/s and the maximum recorded yield 9.97 L/s;
- 68 boreholes had recorded boreholes depths – the average depth being 62 m bgl and the deepest 131 m bgl (refer to **Map 4a** for a plot of the NGA-derived **borehole depths**); and
- 34 boreholes had recorded water strike depths – the average strike depth being 38 m bgl and the maximum strike depth 86 m bgl.

The data that was obtained from the NGA however dates back to 1913, with the most recent data being from 1999. 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 prior to the 1980's the coordinates of the boreholes are not deemed very accurate and would have to be field-verified. This information will have

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

to be obtained by means of a hydrocensus across the entire area. Error! Not a valid bookmark self-reference. provides the borehole information as recorded on the NGA. A plot of the **NGA data** is presented by **Map 4b**, **Appendix 1**.

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]
3019BB00004	166983	-30.04200	19.91757	08-Mar-96	30			30
3019BB00041	156747	-30.03256	19.88673	03-Dec-90	18	8.00	0.42	8
2919DD00028		-29.98469	19.92765		80			
2919DD00001	136567/3	-29.98369	19.93254	12-May-81	52	5.00	0.73	41.1
2919DD00027		-29.95000	19.98235	03-Nov-99	80	12.70		
2920CC00014	157805	-29.93646	20.05204	29-May-91	72			
2919DD00019	18977	-29.92675	19.90310	26-Jun-34	73.15	19.81	0.76	71.63
2919DD00031	153512	-29.92469	19.95836	14-Jul-88	18			
2919DD00030	153514	-29.92469	19.95837	22-Aug-88	24	3.40	9.97	20
2919DD00030	153514	-29.92469	19.95837	22-Aug-88	24	3.40	9.97	20
2919DD00033	153513	-29.92468	19.95835	14-Jul-88	15	3.00	5.00	10
2919DD00032	153511	-29.92468	19.95836	13-Jul-88	24	3.00	2.00	20
2920CC00015	157804	-29.91841	20.05204	29-May-91	60			
2919DD00004	110771	-29.91704	19.91588	24-Aug-71	24.38	15.24	0.34	18.29
2919DD00002	110769	-29.91703	19.91588	13-Aug-71	76.81			
2919DD00003	110770	-29.91703	19.91589	24-Aug-71	39.62			
2919DD00005	110772	-29.91703	19.91590	25-Aug-71	34.14	4.88	3.57	6.7 and 20.73
2919DC00037		-29.90608	19.59449	04-Nov-99	80	25.00		
2919DD00026		-29.90553	19.98938		80			
2919DC00025		-29.90038	19.56588		6.1			6.1
2919DC00023		-29.90037	19.56588	18-Mar-86	9.14	7.62	0.19	7.62
2919DC00021	149328/0	-29.90036	19.56588	18-Mar-86	34	16.20	0.50	25.1
2919DC00022	149329/8	-29.90036	19.56589	18-Mar-86	28	5.00	1.27	26.1
2919DC00024		-29.90036	19.56590	18-Mar-86	7.62		0.04	
2919DC00026		-29.90036	19.56591	18-Mar-86	9.14			9.14
2919DC00036		-29.89539	19.64527		80			
2920CC00017	157803	-29.88646	20.04509	28-May-91	54			
2919DC00038		-29.88625	19.54740	04-Nov-99	80	11.53		
2920CC00016	157802	-29.88146	20.04148	28-May-91	66			
2919DC00019	149326/4	-29.86706	19.66588	13-Mar-86	58			
2919DC00017	136307/9	-29.86705	19.66588	12-Aug-80	47	12.40	1.00	18.8
2919DC00015	131907/0	-29.86704	19.66588	10-Jan-79	122			
2919DC00013	131904/6	-29.86703	19.66588	11-Dec-78	67			
2919DC00014	131905/4	-29.86703	19.66589	20-Dec-78	89			
2919DC00016	131906/2	-29.86703	19.66590	03-Jan-79	70			
2919DC00018	136308/7	-29.86703	19.66591	12-Aug-80	29	15.20	1.67	19.2
2919DC00020	149327/2	-29.86703	19.66592	17-Mar-86	54	27.10	0.95	45.7
2919DC00040		-29.86592	19.55985	04-Nov-99	80	7.24		
2919DD00024		-29.84983	19.89740	19-Oct-99	80	7.56		
2919DD00023		-29.84680	19.84390	19-Oct-99	80	8.41		
2919DD00015	66583	-29.83371	19.78254	20-Dec-57	103.94			
2919DD00013	65285	-29.83370	19.78254	12-Sep-57	131.06			
2919DC00009	131908/8	-29.83369	19.59921	15-Jan-79	64	21.00	0.68	64
2919DD00012	15040	-29.83369	19.78254	06-Sep-30	113.38		0.10	86.87
2919DD00014	65958	-29.83369	19.78255	09-Nov-57	126.8			
2919DD00016	66937	-29.83369	19.78256	26-Mar-58	127.1			
2919DC00012	150405	-29.81704	19.58254	22-Oct-86	75	20.00	5.00	31.4
2919DC00010	150403	-29.81703	19.58254	20-Oct-86	54	24.10	0.10	39.9
2919DC00011	150404	-29.81703	19.58255	21-Oct-86	48			
2919DD00018	156580	-29.79758	19.93671	31-Oct-90	66	45.00	0.15	60
2919CD00022	39975	-29.77261	19.47421	25-Apr-50	91.44			
2919CD00020	62649	-29.77260	19.47421	13-Dec-56	50.9			
2919CD00018	63187	-29.77259	19.47421	22-Feb-57	81.38	34.74	0.15	74.67
2919CD00019	80456	-29.77259	19.47422	14-Apr-62	76.5	28.65	0.51	65.53, 70.1, 73.15

Site ID No.	Other No.	Latitude	Longitude	Date established	Depth [m bgl]	Groundwater level [m bgl]	Reported Yield [L/s]	Waterstrike depth [m bgl]
2919CD00021		-29.77259	19.47423	08-Feb-50	91.44		0.01	67.05
2919CD00040	166955	-29.75536	19.48421	14-Nov-95	96	80.00	2.25	80
2919DB00013		-29.73506	19.86449		80			
2919CB00078	23592	-29.73369	19.46588	12-Oct-38	109.42	48.16	0.10	67.06 and 93.27
2919DA00008		-29.71816	19.66810		80			
2919DA00006		-29.70346	19.57449	17-Nov-99	80	33.12		
2919DB00002	49512	-29.70036	19.78254	20-Nov-52	21.34	15.85	1.77	18.59
2919CB00068	3901	-29.68370	19.44921	17-Aug-14	80.16	67.36	0.63	74.68
2919CB00066	3531	-29.68369	19.44921	23-Feb-14	78.79	37.19	0.15	38.4
2919CB00067	3750	-29.68369	19.44922	15-Mar-14	25.6			
2919CB00069	24441	-29.68369	19.44923	07-Mar-39	43.89	7.32	0.88	38.71
2919DA00001	3434	-29.66703	19.54921	12-Nov-13	44.2	30.48	4.73	39.01
2919DA00002	24749	-29.66703	19.54922	28-Apr-39	43.28			
2919DA00003	3111	-29.64258	19.64921	09-Aug-13	60.05	24.38	0.05	29.26

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 Wit Puts 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 Wit Puts 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[4] towards groundwater and surface water; and
  - Proximity of surface water features such as wetlands, streams, rivers and earth dams.

Drilling Positions, Drilling depths and Exploration Processes

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 to appropriate depths to target any 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.

[4] 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.

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 Wit Puts 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[5].

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 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.

[5] 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

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 support during drilling phases – input to the 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 the 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	**Degredation 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 and risk assessment report – as 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 Wit Puts 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 Wit Puts Area:

- Although the majority of the area is being classed as a poor 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 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).

Prepared by

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Partner

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Eunice Goossens (Pr. Sci. Nat.)

Principal Hydrogeologist

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 – EC

Map 3b – Groundwater Flow Directions

Map 4a – Boreholes Depths

Map 4b – NGA Data

Map 5 – Sensitivity Map

SRK Report Distribution Record

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Mr. GP Kriel	EIMS	1	Electronic	5 July 2019	E. Goossens
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Approval Signature:

19°30'0"E 19°40'0"E 19°50'0"E 20°0'0"E

29°40'0"S

29°50'0"S

30°0'0"S

D82B D53G D53F D57D

N

0 2 4 8

Kilometers

Legend

- Application area
- Target Farms
- Drainage Region
- Non perennial river
- Non-perennial river bed / Pan / Saltpan / Marsh

Altitude [m amsl]

- < 840
- 841 - 860
- 861 - 880
- 881 - 900
- 901 - 920
- 921 - 940
- 941 - 960
- 961 - 980
- 981 - 1000
- 1001 - 1020
- 1021 - 1040
- 1041 - 1060
- > 1061

Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	
Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP1

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Black Mountain Mining - WIT PUTS

MAP 1: TOPOGRAPHY

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 1 Topography_20190625.mxd

Revision: A Date: 14 06 2019

19°30'0"E 19°40'0"E 19°50'0"E 20°0'0"E

29°40'0"S

29°50'0"S

30°0'0"S

N

0 2 4 8

Kilometers

Code	Unit	Description
		- Alluvium
C-c / T-c:		- Calcrete
J-d:		- Dolerite
Ppr / Pp:	Prince Albert Formation	- Brownish-green shale, mudstone, dolomitic limestone
Pmb:	Mbizana Formation	- Diamictite, tillite, subordinate sandstone and mudstone
Np:		- Pegmatite
Kkd:	Kraandraai Formation	- Migmatised calc-silicate gneiss with lenses of conglomerate and marble
Kbo:	Bossiekom Formation	- Leucogneiss, interlayers quartzite, amphibolite and calc-silicated gneiss
Kld:	Lekkerdrink Gneiss	- Red-brown-weathering, medium-grained leucogneiss

Legend

- Application area
- Target Farms
- Non perennial river
- Non-perennial river bed / Pan / Saltpan / Marsh

Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	
Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP2

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Black Mountain Mining - WIT PUTS

MAP 2: GEOLOGY

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 2 Geology_20190625.mxd

Revision: A Date: 14 06 2019

19°30'0"E 19°40'0"E 19°50'0"E 20°0'0"E

29°40'0"S

29°50'0"S

30°0'0"S

N

0 2 4 8

Kilometers

Legend

- Application area
- Target Farms
- Non perennial river
- Non-perennial river bed / Pan / Saltpan / Marsh

Expected Electrical Conductivity Readings in Groundwater

- 70 - 300 mS/m
- 300 - 1 000 mS/m

Reference: "Department of Water Affairs and Forestry, (2002). Hydrogeological Map Series of the Republic of South Africa. Completed in 2002"

Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	
Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP3a

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Black Mountain Mining - WIT PUTS

MAP 3a: HYDROGEOLOGY - EXPECTED ELECTRICAL CONDUCTIVITY READINGS IN GROUNDWATER

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 3a Hydrogeology EC value_20190625.mxd

Revision: A Date: 14 06 2019

19°30'0"E 19°40'0"E 19°50'0"E 20°0'0"E

29°40'0"S

29°50'0"S

30°0'0"S

N

0 2 4 8

Kilometers

Legend

- Application area
- Non perennial river
- Non-perennial river bed / Pan / Saltpan / Marsh
- Regional groundwater flow direction

Altitude [m amsl]

- < 840
- 841 - 860
- 861 - 880
- 881 - 900
- 901 - 920
- 921 - 940
- 941 - 960
- 961 - 980
- 981 - 1000
- 1001 - 1020
- 1021 - 1040
- 1041 - 1060
- > 1061

Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	
Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP3b

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MAP 3b: REGIONAL GROUNDWATER FLOW DIRECTIONS

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 3b Groundwater Flow Directions_20190625.mxd

Revision: A Date: 14 06 2019

19°30'0"E 19°40'0"E 19°50'0"E 20°0'0"E

29°40'0"S

29°50'0"S

30°0'0"S

N

0 2 4 8

Kilometers

Depth: 109.42 m
Water strike: 80 m

Depth: 126.8 m

Depth: 113.38 m
Water strike: 86.87 m

Depth: 131.06 m

Depth: 122 m

Legend

- Application area
- Non perennial river
- Non-perennial river bed / Pan / Saltpan / Marsh

Borehole Depth [m bgl]

- < 100
- > 100

Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	

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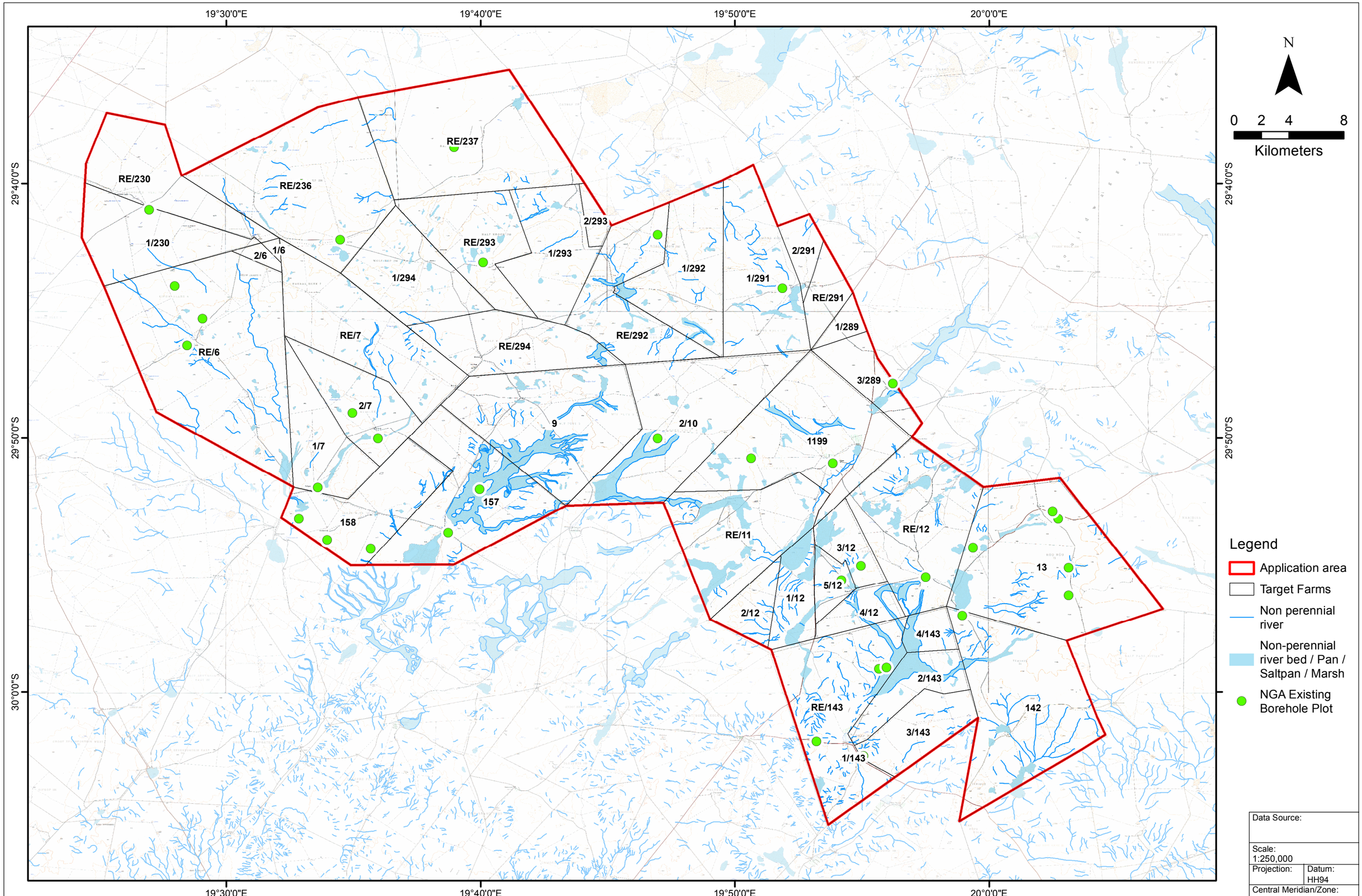
MAP 4a: BOREHOLE DEPTHS AND GROUNDWATER STRIKE DEPTHS

Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP4a

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 4a Hydrogeology Borehole Depths and WS_20190625.mxd

Revision: A Date: 14 06 2019



Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	
Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP4b

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MAP 4b: EXISTING BOREHOLE PLOT

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 4b Existing Borehole Plot_20190625.mxd

Revision: A Date: 14 06 2019

19°30'0"E 19°40'0"E 19°50'0"E 20°0'0"E

29°40'0"S 29°50'0"S 30°0'0"S

N

0 2 4 8
Kilometers

RE/230 RE/236 RE/237 RE/293 RE/294 RE/7 RE/6 RE/292 RE/291 RE/11 RE/12 RE/143

1/230 1/6 2/6 1/294 1/293 2/293 1/292 1/291 2/291 1/289 3/289

2/7 1/7 9 2/10 1199 157 158

3/12 5/12 1/12 2/12 4/12 13

4/143 2/143 3/143 1/143 142

Legend

- Target Farms
- Application area
- Non perennial river
- Non-perennial river bed / Pan / Saltpan / Marsh
- Quaternary Deposits
- 150 m bufferzone from rivers

Data Source:	
Scale: 1:250,000	
Projection:	Datum: HH94
Central Meridian/Zone:	
Date: 14/06/2019	Compiled by: GOOS
Project No: 549553	Fig No: MAP5

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Black Mountain Mining - WIT PUTS

MAP 5: SENSITIVE AREAS

Path: G:\PROJECTS\CURRENT PROJECTS\549553_EIMSGWRISKASS\8GIS\GISPROJ\MXD\WIT PUTS FINAL MAPS\549553_EIMS_Area 3 WIT PUTS - Map 5 Sensitive Areas_20190625.mxd

Revision: A Date: 14 06 2019