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VOLUME 1

Report on a Geohydrological Investigation

General Waste (Witkoppies) Landfill Site,

ESKOM Majuba Power Station

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Compiled for:	Savannah Environmental (Pty)Ltd
Compiled by:	P.G. Hansmeyer & B. Vermeulen
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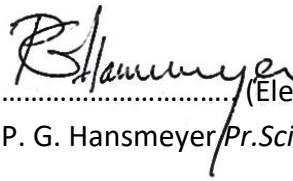

……(Electronic Signature) Date: 27 June 2022

P. G. Hansmeyer *Pr.Sci.Nat.*

EXECUTIVE SUMMARY

A geohydrological investigation was carried out for the Majuba General Waste Landfill Site at Majuba Power Station located within the jurisdiction of the Gert Sibande District Municipality. The site is located on Portions 1 and 6 of the farm Witkoppies 81 HS located on the southern side of Majuba Power Station.

The field work comprised the water sampling of open water resources within a 1km radius of the site at five locations, drilling of three monitor boreholes, yield testing thereof and analyses of borehole water samples by a SANAS accredited water laboratory located in Empangeni.

The initial approach was to decommission the existing landfill site and develop a new site adjacent to the access road along the eastern boundary thereof. An additional 'Alternative Site' to the south of the existing landfill site has also been included and a combined area of 10ha had to be considered.

The site is underlain by sediments – that is shale and sandstone of the Vryheid Formation, intruded by Post-Karoo dolerite as sheets or sills, often capping the low hills in the area. The lithologies of the recently drilled boreholes were dominated by carbonaceous shale and to a lesser extent by sandstone with a dolerite sill in the top 3m, thickening to 14m in a southerly direction. Elsewhere, the bedrock is blanketed by transported soils – that is hillwash and alluvium.

Several hillslope seepage wetlands were identified which ostensibly emanate at the dolerite/sedimentary bedrock contact zones to form spring lines at various elevations below the landfill terrain, draining away to form wetlands covered by thick stands of hydrophilic grasses and -shrubs.

The area surrounding the site is characterised by historically cultivated areas which had been turned over to pastures with thick stands of hip-high Eragrostes grass. Towards the swampy, lower-lying areas, the soggy ground is covered by thick, short stands of hydrophyllic grass and - shrubs with a characteristic rusty colour. The closed landfill site is partially overgrown with short Kikuyu grass, alien shrubs and a single Acacia Karoo sapling.

Rainfall and evaporation data from Meteorological Station No. C1E007, located approximately 50km north-northwest of the Majuba Power Station for the period 1980 to 2017 (38 years) was used.

Regarding air quality problems, no odours from the closed landfill site were detected during the 2018 and 2022 site visits and gas and odour generation are regarded as negligible.

During the day the wind is predominantly from the west, with a secondary component from the east, with fairly strong wind speeds and little calms. During the night the wind field shifts to be mainly from the east and southeast. The wind is generally stronger during the day with more frequent calms during the night.

The yield range for BH1 is unknown. However, the three most recently drilled boreholes recorded yields ranging from dry to <1l/s. The potential application of BH2, BH3 and BH4 is for stock watering only and in terms of aquifer classification, these monitor boreholes comply with a 'Low' type of aquifer. The aquifer will never be utilised except for monitoring purposes of the groundwater regime associated with the landfill site.

Clearly defined rating and rankings scales were used to assess the impacts associated with the proposed activities which include the construction, operational and closure and decommissioning phases of the landfill site. Based on the impact assessment determined from a hydrogeological perspective it can be concluded that all impacts identified have a medium to high negative significance, however with implementation of mitigation measures the impact can be decreased between low and medium.

A groundwater quality monitoring programme is to be implemented once the site is operational to ensure water remains compliant with the DWAF Minimum Requirements for Waste Disposal by Landfill (2nd Edition, 1998). Boreholes to be monitored include BH1, BH2, BH3 & BH4.

The proposed landfill site to the east of the closed landfill site - that is Alternative A - should be developed, mainly due to non-interference with the uppermost springline and sufficient cover soils available for interlayering and capping. Given the potential hydrogeological impacts detailed in this report, the development of the Alternative A site, can only be viable if the mitigation measures are implemented and adhered to. Based on this, the project can be granted environmental authorization.

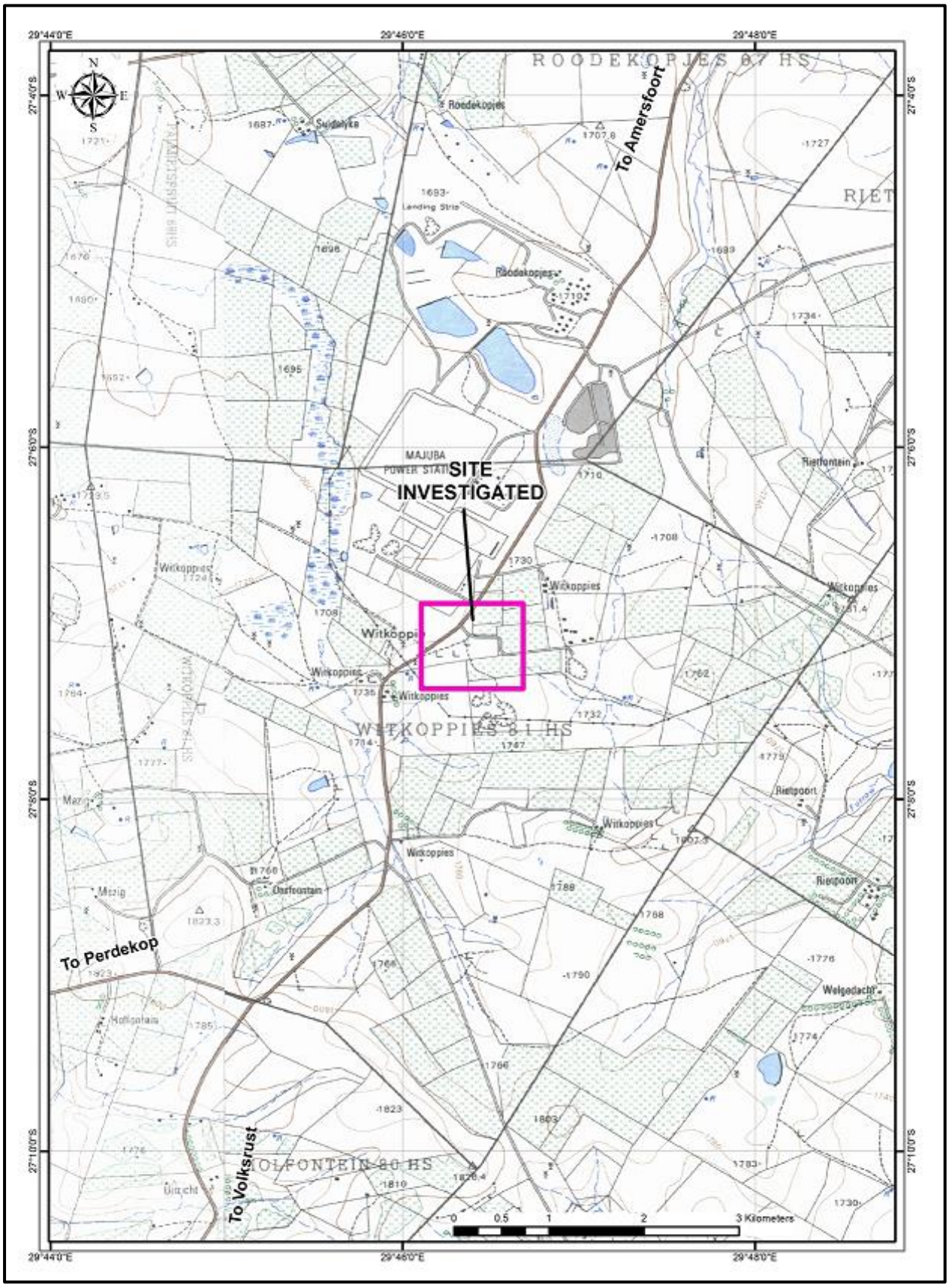

FIGURE 1 – LOCALITY PLAN

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VOLUME 1

Geohydrological Investigation

Majuba General Waste (Witkoppies) Landfill Site, ESKOM Majuba Power Station

1. INTRODUCTION AND TERMS OF REFERENCE

Engeolab (Pty)Ltd was appointed by Savannah Environmental (Pty)Ltd of Woodmead, Johannesburg to conduct a geohydrological investigation for the Majuba General Waste Landfill Site at Majuba Power Station. The site is located on Portions 1 and 6 of the farm Witkoppies 81 HS on the southern side of Majuba Power Station and within the jurisdiction of the Gert Sibande District Municipality – refer to the Locality Plan, Figure 1 in the beginning of the report.

The investigation's aim is to establish the geohydrological aspects of the proposed landfill site which will form part of the EIA phase for the closure of the existing landfill site and the Scoping and Environmental Impact Report for the proposed general landfill site which is located adjacent to the closed landfill site. This will essentially demonstrate that the geohydrology associated with the site is such that a landfill can safely be developed and operated in the environment under consideration.

The scope of work was outlined by Engeolab (Pty)Ltd's quotation, Q210903_REV_LL3821_PH, dated 12 April 2022. The appointment was confirmed by Ms. Mmakoena Mmola, representative of Savannah Environmental (Pty)Ltd on the 8th of March 2022 under their reference SE3357.

The field work comprised the water sampling of open water resources within a 1km radius of the site at five locations, drilling of three monitor boreholes, yield testing thereof and analyses of borehole water samples by a SANAS accredited water laboratory located in Empangeni.

The report is based on field observations, profiling of borehole drill chips, water sample analyses of nine water samples as well as the yield testing of three monitor boreholes.

The report and its appendices are presented as Volume 1 and the drawings are contained in Volume 2.

2. AVAILABLE INFORMATION

The following available information includes:

- Site plan showing layout of the proposed development and boundaries of the site as provided by Savannah Environmental (Pty)Ltd;
- A 1:250 000 scale geological series, Sheet 2728 Frankfort, as compiled by South African Geological Survey, 1988;
- Garmap Africa 2008 series;
- Google Earth imagery of the site;
- Map showing Majuba Power Station monitor boreholes;
- Majuba Power Station Ash Disposal : Groundwater Scoping Study by Lidwala Consulting Engineers, October 2012;
- Climatic information was provided by Savannah Environmentalists (Pty) Ltd;
- Report presented by Engeolab (Pty)Ltd on the findings of a geotechnical investigation carried out on the site in 2018 – Report no. LL3034.

3. SITE ASPECTS

LANDFILL SITE STATUS AND PLANNED DEVELOPMENTS:

The initial approach was to decommission the existing landfill site and develop a new site adjacent to the access road along the eastern boundary thereof – refer to the Site Plan, Figure 2, Volume 2. As of late, an additional 'Alternative Site' to the south of the existing landfill site has been included.

The proposed new waste landfill site is a Category B listed activity which entails the disposal of general waste to land covering an area of some 50,100m^2 with the total capacity of 25,000 tons which equates to 970 tons per year and an expected lifespan of 45 years. The landfill site will be constructed with associated infrastructure with sorting and storage facilities, plant and machinery, security parking and servicing area and an access road. The facility will also be secured with an all-round palisade, access control gate and a guard house.

ACCESS: The site can be accessed by the D979 gravel district road from Amsterdam to Volksrust and is located at co-ordinates 27° 07' 09.4" S and 29° 46' 18.93"E. The site is bounded in the north by the gravel district road which passes close to the security fence along the southern portion of Majuba Power Station.

The combination of the district road, an overhead Eskom powerline and steep topography in the south, confines the site to a sidehill fill covering an area of some 50,100m² along the sloping northerly face of a local hillock, some 1769m above mean sea level.

4. METHODS OF INVESTIGATION

4.1 Walk-Over Survey

A walk-over survey was conducted to establish drainage features, access and to obtain a general overview of the site. An aerial photograph was used during the walk-over survey to assist in the site orientation, to determine the boundaries and its general outlay. This also assisted in identifying areas where surface water could be sampled in relation to the landfill site.

4.2 Drilling of Three Monitor Boreholes

Pollard Drilling of Vryheid (a level 1 BBEEE service provider) drilled three monitor boreholes on the site. The drill sites were selected where access was possible as well as where geophysical anomalies were prominent – refer to the Geotechnical Report, LL3034, 2018 by Engeolab (Pty)Ltd and the Site Plan, Figure 2, Volume 2.

The three 165mm diameter monitor boreholes were drilled using the rotary air flush percussion drilling method. Each borehole was drilled to 20m with the top 6m of the boreholes reamed to 219mm and subsequently sleeved from surface to 6m depth with solid mild steel casing – refer to Plate 1 below and Appendix A – Borehole Profiles. To ensure the long term serviceability of the boreholes, 140mm diameter uPVC casing was installed from surface to the end of the hole (with the lower 3m perforated) and the borehole annulus backfilled with graded filter sand. A lockable lid was welded onto the steel casing and a concrete collar was cast around the casing. To ensure that the borehole position is visible, a 2,5m high yellow and black steel marker was installed as close as possible to the borehole - refer to Plate 2 below. The master key of the lockable borehole lids was handed over to ESKOM's Environmental Manager at Majuba Power Station.

PLATE 1

PLATE 2

The drilling results are summarised in Table 4.2.1. Note that BH1 is an existing monitor borehole and BH3 was dry. Although a static water table of 17,5m was recorded in the latter after 24 hours, the yield was so low that the small submersible pump could not lift the water to surface. Water samples were taken of the historic borehole, BH1 as well as the three recently drilled monitor boreholes.

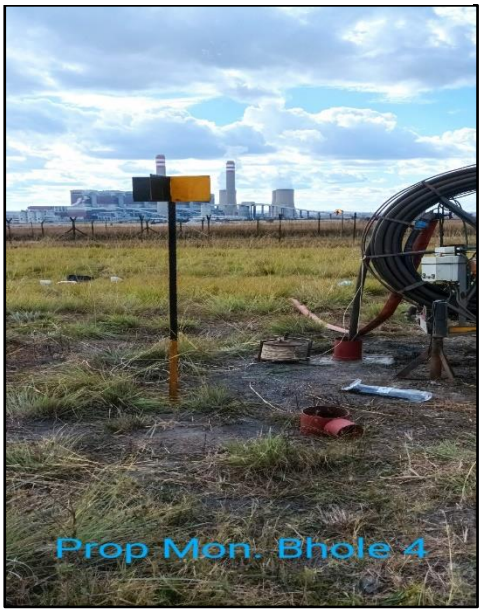
TABLE 4.2.1: DRILLING RESULTS

BH No.	BH Depth (m)	Water Strike Depth (m)	Blow Yield (l/h)	Static Water Level (m)
BH 2	20	7,0	400	3,7
BH 3	20	dry	N/A	17,5
BH 4	20	13,0	720	4,4

4.3 Yield Testing of Three Monitor Boreholes

Using a submersible pump capable of pumping small volumes of water, the yields of the boreholes BH2, BH3 and BH4 were tested – refer to Plate 3.

PLATE 3



The yield tests were carried out in accordance with SANS 10299-4:2003: PART 4 – Test-pumping of Water Boreholes. The data was captured and analysed using Theiss and Cooper methods. Copies of the field test data and analyses are attached as Appendix B and for convenience, a summary of the results is presented by Table 4.3.1.

TABLE 4.3.1: YIELD TESTING DATA & RECOMMENDATIONS

BH No.	Blow Yield (l/h)	Static Water Level (m)	Recommended Pumping yield (l/h)
BH 2	400	3,7	To low yield
BH 3	dry	17,5 (after 24 hrs)	Dry borehole
BH 4	720	4,4	720

4.4 Water Sampling & Laboratory Analyses

- **Historic Sampling (2018)**: Three of the hillslope seepage wetlands, a single monitor borehole and a small leachate dam were sampled and analysed during the geotechnical investigation carried out in 2018 – refer to the report LL3034, Appendix D.

- **Recent Sampling (2022)**: Nine water samples were taken – five from surrounding surface water impoundments (mainly small excavations) and four from the monitor boreholes where BH1 is a historical borehole and boreholes BH2, BH3 and BH4 were recently drilled.

The five surface water samples were submitted for analyses on Friday, 13 May 2022 to Integral Laboratories (Pty)Ltd, a SANAS accredited water laboratory located in Empangeni. The drilling and yield testing commenced the next week and four additional samples were submitted on Thursday, 19 May 2022 – the same day of sampling. A summary of the laboratory test data is presented by Table 4.4.1 and copies of the laboratory tests are attached as Appendix C to the report.

TABLE 4.4.1: SUMMARY OF LABORATORY TEST DATA

Sample Identification			S4 (Marshy) - 10H58	S5 (Dam) - 11h09	S7 (Dam) - 11h25	S8 (Dam) - 10h01	S9 (Spring) - 09h37	Existing Mon BH - 1	Prop Mon BH - 2	Prop Mon BH - 3	Prop Mon BH - 4
Lab / Sample No. & Date Tested			KW-22-97868 (13/05/2022)	KW-22-97869 (13/05/2022)	KW-22-97870 (13/05/2022)	KW-22-97871 (13/05/2022)	KW-22-97872 (13/05/2022)	KW-22-98166 (19/05/2022)	KW-22-98167 (19/05/2022)	KW-22-98168 (19/05/2022)	KW-22-98169 (19/05/2022)
Parameter	*Unit*	*Method*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*
Aluminium as Al3+	µg/L	M38	100	100	100	100	100	100	100	100	100
Ammonia as N	mg/L	M32	0.2	0.2	0.2	0.2	0.2	0.56	0.2	0.21	0.2
Arsenic as As	µg/L	M16	3	3	3	3	3	3	3	198	3
Boron as B	µg/L	M16	100	100	100	100	100	100	100	100	100
Cadmium as Cd	µg/L	M16	1	1	1	1	1	1	1	1	1
Chemical Oxygen Demand (Unfiltered)	mg/L		106	60	39	29	69	28	241	34	70
Chromium as Cr	µg/L	M16	5	5	5	5	5	5	5	5	5
Chromium as Cr6+	µg/L	M44	3	3	3	3	3	3	3	3	3
Copper as Cu	µg/L	M16	20	20	20	20	20	20	20	20	20
Cyanide as CN-	µg/L	M55	10	10	27	8	13	10	10	10	10
Dissolved Organic Carbon	mg/L	M20	21.4	12.3	4.68	4.57	5.09	2.62	3.12	1.16	1.06
Dissolved Oxygen	mg/L	M57	7.62	7.77	8.28	8.29	8.48	5.97	6.59	6.2	6.69
E. coli	MPN/100mL	M9	10	1	72	44	12	0	68	0	8
Electrical Conductivity @ 25°C	mS/m	M4	56.8	51.2	31.2	45	56.7	118	63.6	29	60.8
Fats, Oils & Grease	mg/L		0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Fluoride as F-	mg/L	M32	0.53	0.5	0.5	0.5	0.5	0.5	0.5	1.42	1.28
Free Chlorine	mg/L	On Site	0.52	0.47	0.1	0.1	0.12	0.25	0.05	0.05	0.1
Lead as Pb	µg/L	M16	2	2	2	2	2	2	2	2	2
Manganese as Mn	µg/L	M70	922	84	88	39	91	109	74	10	178
Mercury as Hg	µg/L	M16	1	1	1	1	1	1	1	1	1
Nickel as Ni	µg/L	M16	5	5	5	5	5	5	5	5	5
Orthophosphate as P	mg/L	M32	1	1	1	1	1	1	1	1	1
Oxygen Absorbed	mg/L	M73	24.5	5.9	6.2	6.4	17.7	6.4	24.1	5.7	24.5
pH @ 25°C	pH units	M6	7.19	7.5	7.38	7.93	7.99	7.28	7.8	8.64	7.62
Phenols	µg/L	M34	10	10	10	10	10	10	10	10	10
Potassium as K	mg/L	M18	7.59	17.7	2.41	6.57	4.25	2.57	2.39	10.4	3.13

Sample Identification			S4 (Marshy) - 10H58	S5 (Dam) - 11h09	S7 (Dam) - 11h25	S8 (Dam) - 10h01	S9 (Spring) - 09h37	Existing Mon BH - 1	Prop Mon BH - 2	Prop Mon BH - 3	Prop Mon BH - 4
Lab / Sample No. & Date Tested			KW-22-97868 (13/05/2022)	KW-22-97869 (13/05/2022)	KW-22-97870 (13/05/2022)	KW-22-97871 (13/05/2022)	KW-22-97872 (13/05/2022)	KW-22-98166 (19/05/2022)	KW-22-98167 (19/05/2022)	KW-22-98168 (19/05/2022)	KW-22-98169 (19/05/2022)
Parameter	*Unit*	*Method*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*	*Result*
Selenium as Se	µg/L	M16	20	20	20	20	20	20	20	20	20
Sodium as Na	mg/L	M18	29.2	13.2	16.8	18.5	36.2	65.3	98.3	19	35.7
Somatic Coliphages	Count/10mL	M39	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
Sulphide (as S)	mg/L	M18	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Temperature	°C		20	20	20	20	20	22	22	22	22
Total Sus-pended Solids	mg/L	M8	92	5	7	9	6	20	2128	26	212
Zinc as Zn	mg/L	M16	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05

4.5 Surveying Boreholes and Sampling Points

These features were surveyed using a Garmin Oregon 650 hand-held GPS and plotted on the drawings.

4.5 Historic Geophysical Surveys

Three geophysical traverses were conducted alongside the proposed landfill site during the geotechnical survey carried out in 2018 – refer to Report LL3034 Appendix C. Two prominent electro-magnetic anomalies were recorded on Traverses Majuba PS-1 and PS-3 which were carried out parallel to each other and were used as a guide to locate drilling positions of monitor boreholes BH2, BH3 and BH4.

4.6 Historic Borehole and Spring Census

Five hillslope seepage wetlands were recorded on the site and another hillslope seepage along the toe of the closed landfill site. A 44.2m deep monitor borehole (BH1) with a static water level recorded at 9.7m below ngl located near a small leachate dam on the north-western corner of the closed landfill site was also inspected and vital information recorded – refer to Figure 2, the Site Plan, Volume 2, Report LL3034.

5. GEOLOGY AND SITE SOILS

The site is underlain by sediments – that is shale and sandstone of the Vryheid Formation, intruded by Post-Karoo dolerite as sheets or sills, often capping the low hills in the area – see Figure 3A, Regional Geology, Figure 3B, the Site Geology and Figure 3C, the Cross Section contained in Volume 2 and Table 5.1.

Shallow weathered and intensely fractured dolerite is exposed along the southern fringes of the closed landfill site as well as within the deeply eroded access road along the northern slope of the hillock on which the proposed and historic landfill sites are located. The lithologies of the recently

drilled boreholes were dominated by carbonaceous shale and to a lesser extent by sandstone with a dolerite sill in the top 3m of BH's 3 & 4, thickening southwards to 14m in BH2.

Elsewhere, the bedrock is blanketed by transported soils – that is hillwash and alluvium. The latter covers the area along the toe of the closed landfill site, extending across the district road in a north-westerly direction. Scattered sandstone outcrops further to the east as well as along the steeper southerly slope of the hillock.

TABLE 5.1: STRATIGRAPHIC SEQUENCE OF THE SITE

Lithology	Sub-Group	Group	Sequence
Dolerite	Intrusive	- - -	Post-Karoo
Shale and sandstone	Vryheid	Ecca	Karoo Super Group

The site falls within a region with a Weinert N-Value of 1.3 indicating that chemical decomposition is the dominant mode of weathering.

A north-west trending structural lineament concealed by cover-rocks – thought to be a fault line - was inferred from the geophysical data but was not intersected by the recent drilling. However, dolerite was intersected in all three of the 20m deep monitor boreholes drilled recently.

6. SURFACE HYDROLOGY

The southern boundary of the landfill site more or less runs along the ridge line with an average elevation of 1769m amsl. The site slopes towards the northern boundary along the gravel district road, some 200m downhill. Several hillslope seepage wetlands were identified – refer to Figure 4, Surface Hydrology, Volume 2. These wetlands ostensibly emanate at the dolerite/sedimentary bedrock contact zones to form spring lines at various elevations below the landfill terrain, draining away to form wetlands covered by thick stands of hydrophilic grasses and - shrubs.

The uppermost spring line is about 18m below the crest of the hillock and about 13m below the phreatic surface seemingly present at an elevation of 1765m amsl, followed further downhill at irregular intervals by another two spring lines at 1737m and 1732m amsl.

7. VEGETATION

The area surrounding the site is characterised by historically cultivated areas which had been turned over to pastures with thick stands of hip-high Eragrostes grass – a favourite among cattle breeders.

At the time of the investigation, the proposed site was covered by tall stands of Eragrostes grass which made observations and moving about the site very difficult. Towards the swampy, lower-lying areas, the soggy ground is covered by thick, short stands of hydrophyllic grass and - shrubs with a characteristic rusty colour.

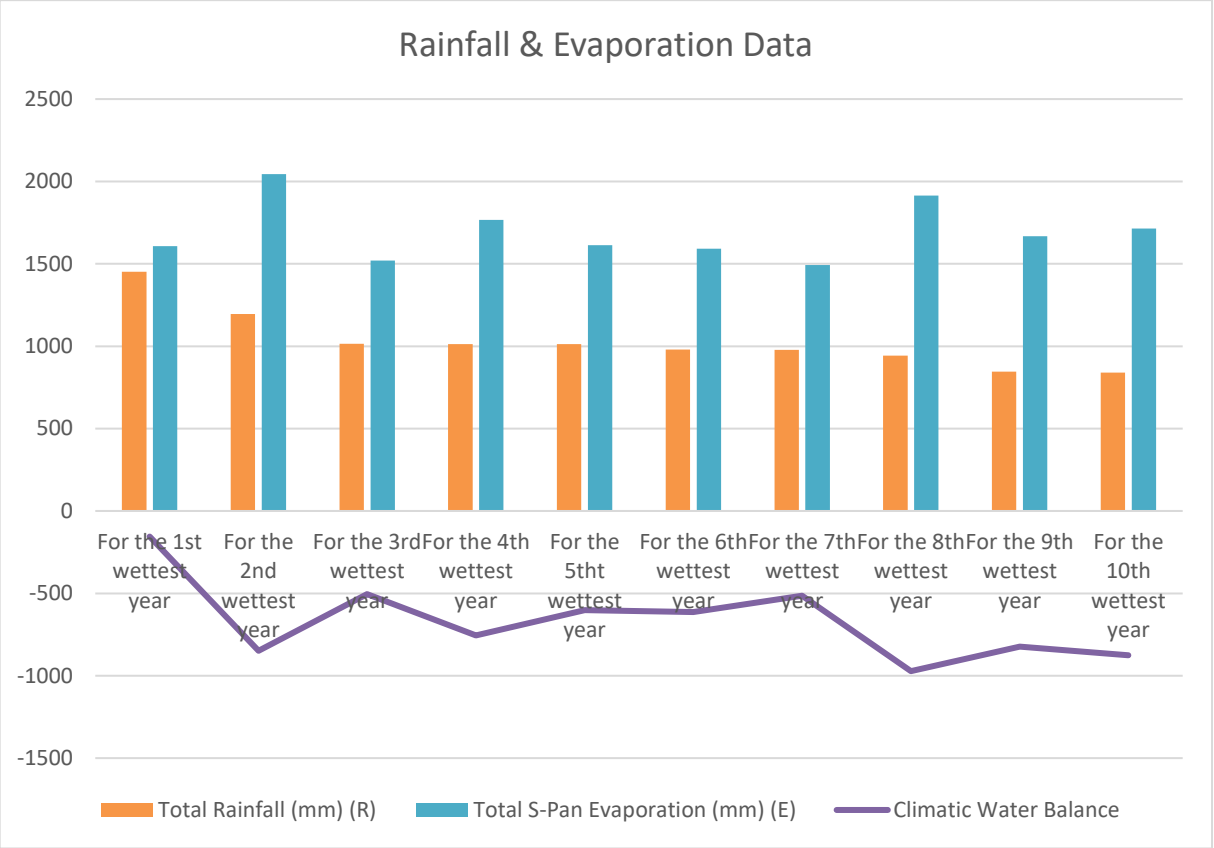
The closed landfill site is partially overgrown with short Kikuyu grass, alien shrubs and a single Acacia Karoo sapling. The current site drainage precautions and grass cover had prevented erosion of the closed waste landfill site but the access road was badly eroded with deep ruts in the weathered bedrock.

8. CLIMATE

8.1 Rainfall

Rainfall and evaporation data from Meteorological Station No. C1E007, located approximately 50km north-northwest of the Majuba Power Station for the period 1980 to 2017 (38 years) is presented below – refer to Table 8.1.1. The data is based on the six-month period in which the most rainfall occurred.

TABLE 8.1.1: RAINFALL & EVAPORATION DATA

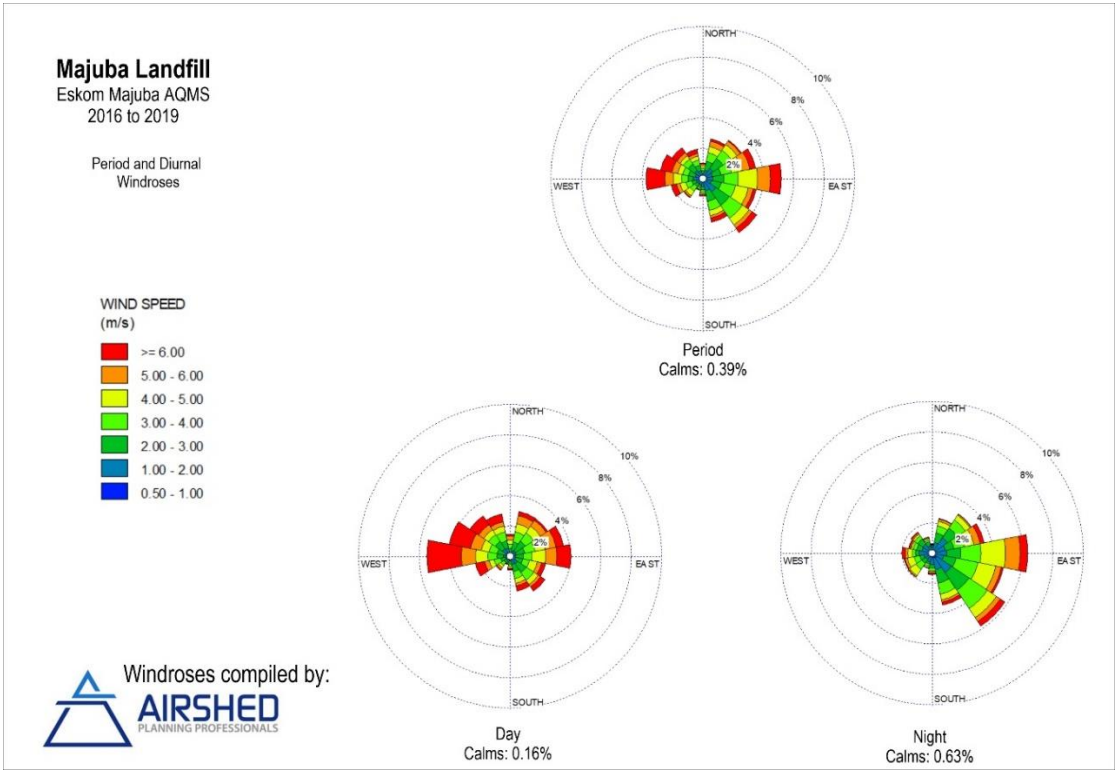


8.2 Surface Wind Field

The wind field for the study area is described with the use of wind roses. Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The period and diurnal for the Eskom Majuba AQMS for the period 2016 to 2019 are shown in Figure 8.2.1. The colours reflect the different categories of wind speeds; the yellow area for example, representing winds of 4 m/s to 5 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The figure given for calm conditions represents the frequency with which the calms occurred, i.e. periods during which the wind speed was below 0.5 m/s.

During the day the wind is predominantly from the west, with a secondary component from the east, with fairly strong wind speeds and little calms. During the night the wind field shifts to be mainly from the east and southeast. The wind is generally stronger during the day with more frequent calms during the night.

FIGURE 8.2.1: PERIOD & DIURNAL WIND ROSES FOR THE ESKOM MAJUBA AQMS, 2016 - 2019



9. INFRASTUCTURE and MAN-MADE FEATURES

The main access road to the closed landfill site which turns off the gravel district road will most probably also be used to access the proposed site. The closed landfill site has been fenced off but at the time of the investigation the 2.5m high security fence was in a state of disrepair and the main gate was broken. The closed landfill site is blanketed by a layer of soil which was imported during the routine maintenance by the contractor. Top soil had been stripped off over quite a large area to the south and to the east of the site, leaving some areas barren with exposed bedrock which had been eroded in places.

Several abandoned borrow pits in close proximity to the site are indicated on the Locality Plan, Figure 1 in the beginning of the report. It is presumed that the borrow materials were imported to the power station at the time of its construction and also used for pavement construction, wearing courses and backfill.

10. GEOHYDROLOGICAL APPRAISAL

10.1 Aquifer, Groundwater Phreatic Surface and Seasonal Fluctuations

The water strike depths, blow yields, phreatic surface and general groundwater flow direction have been established and are presented on the Geological Cross Section, Figure 3C, Volume 2.

The phreatic surface is at an average depth of 4m below surface and seemingly emulates the topography in a NNE direction towards Majuba Power Station with a low groundwater gradient of some < 0.5%. A summary of the water strikes, blow yield and static water levels are presented by Table 10.1.1. As indicated, the static water level of the historic borehole BH1 has receded with 5,1m

over the last four years. Seasonal fluctuations of monitor boreholes BH2, BH3 and BH4 are unknown but will be able to be measured within six months and compared with BH1's recorded variation.

TABLE 10.1.1: SUMMARY OF GROUNDWATER MORPHOLOGY

BH No.	Blow Yield (l/h)	Static Water Level (m) with Dates	Water Strike Depth (m)
BH 1	unknown	9,7 (2018) 14,8 (2022)	unknown
BH 2	400	3,7 (2022)	7,0
BH 3	dry	17,5 (2022) After 24 hrs	Dry borehole
BH 4	720	4,4 (2022)	13

10.2 Aquifer Characteristics

Aquifers are to be classified in terms of their existing and/or potential value as a resource, and hence their sensitivity to pollution. The criteria for classification are potential yield, significance and water quality.

- **Potential Yield**: The yield range for BH1 is unknown. However, the three most recently drilled boreholes recorded yields ranging from dry to <1l/s. The potential application of BH2, BH3 and BH4 is for stock watering only and in terms of aquifer classification, these monitor boreholes comply with a 'Low' type of aquifer.

- **Aquifer Significance**: The potential significance of the site aquifer is assessed as being an insignificant yielding aquifer which will never be utilised except for monitoring purposes in accordance with the following criteria: -

TABLE 10.2.1 POTENTIAL AQUIFER SIGNIFICANCE

Aquifer	Assessment	Site Aquifer
Sole source aquifer	Aquifer used to supply 50% or more of urban domestic water for a given area	N/A
Major aquifer	High – yielding aquifer	N/A
Minor aquifer	Moderately yielding aquifer	N/A
Non-aquifer	Insignificantly yielding aquifer which will never be utilised except for monitoring purposes	Site aquifer
Special aquifer	Designated aquifer	N/A

- **Groundwater Quality:** The background quality of the surface and groundwater, both up- and downslope from the landfill site were determined**.** The groundwater quality is based on historical (2018) and more recent (2022) water analyses data. The Chemical Oxygen Demand (COD) and E. coli concentrations of the historical borehole (BH1), the more recently drilled monitor boreholes (BH2, BH3 & BH4) and five surface water sites were used to indicate that except for BH2 with its high COD value (241mg/l), the site and immediate surroundings are seemingly unpolluted – refer to Table 10.2.2 and Appendix C, Water Laboratory Data.

  In terms of drinking water quality, all the samples submitted inclusive of the historical borehole BH1 comply with Class 1 type water (SANS 241:2015) – the only exception being the high Arsenic

concentration of BH3 which is deemed unsuitable for human consumption. The water quality data is attached as Appendix D to the report.

TABLE 10.2.2: WATER QUALITY ITO COD & E. coli

SAMPLE ID	S4	S5	S7	S8	S9	BH1	BH2	BH3	BH4
OD (mg/l)	106	60	39	29	69	28	241	34	70
E. coli (MPN/ml	10	1	72	44	12	0	68	0	8

Unfortunately, historic data is inadequate and could therefore not be used to compare with the more recent data to assess the impact of the landfill has had on the groundwater quality and will have to be used as future background information.

- **Groundwater Usage:** The borehole and spring census did not record any existing boreholes or wells – that is with the exception of monitor BH1 which was drilled in the past.

- **Sensitive Areas:** The landfill site is not located within an area characterised by aquifers with a potentially strategic value, or where groundwater is or may be used in the future.

- **Sub-Surface Issues:**
  i) Undermined Areas & Future Mining: the area is not undermined and ESKOM confirmed that future mining will not take place – personal communication, Ms. M. Mmola, Savannah Environmental.
  ii) Sinkholes and Surface Subsidence: the site is underlain by sedimentary and intrusive bedrock types and unlike dolomite, are not prone to sinkhole formation.

10.3 Storm Water Management & Site Drainage

A storm water management system should be designed to remove all surface water from the site and direct it to natural drainage lines. It is emphasised that the storm water system has to accommodate the removal of any accumulated surface water and it should also conform to drainage requirements of landfill sites in general.

10.4 Potential for Landfill Gas and Air Quality Problems

During the process of waste decomposition, landfill gases are generated and usually comprise a major component of methane. Where the methane concentrations reach between 5 and 15% of atmospheric gas, landfill gas represents an explosion hazard, as well as a potential risk.

It must be taken into account that the area is rather wind-swept (see Chapter8.2) and although there are calm tendencies during the night, there are no structures on site or in close proximity to which the gas can migrate to where it could accumulate and represent an explosion hazard. Typical methane gas migration paths such as through porous rock – which do not occur on site as the sediments and intrusive dolerite are solid and the absence of subsurface services which may create paths make gas migration highly unlikely.

Regarding air quality problems, no odours from the closed landfill site were detected during the 2018 and 2022 site visits and gas and odour generation are regarded as negligible.

11. IMPACTS AND MITIGATION

This section details the environmental impacts of the proposed development would have on the groundwater. This includes the two designated alternatives, namely A and B located adjacent to the closed landfill site.

11.1 Construction Phase

- Nature of Impact: Groundwater contamination during fuel spillages from construction machinery and vehicle movement.

	Alternative A		Alternative B	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)	Local (2)	Site (1)
Duration	Short (1)	Very Short (1)	Short (1)	Very Short (1)
Magnitude	Minor (2)	Small (0)	Moderate (6)	Low (4)
Probability	Probable (3)	Improbable (2)	Probable (3)	Probable (3)
Significance	Medium (40)	Low (20)	Medium (40)	Medium (40)
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Medium	Low	Low
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes	-	Yes	-

- **Mitigation/Enhancement Measures:**
  - i) containment of fuel storage facility;
  - ii) implement groundwater monitoring programme;
  - iii) accurate fuel records to be kept;
  - iv) clean-up protocols adhered to;
  - v) excavate to 3m depth only to safeguard phreatic surface;
  - vi) overburden soil stockpiled for re-use as interlayer material;
  - vii) install clay liner;
  - viii) rehabilitate areas where soil has been stripped;
  - ix) good drainage and stormwater control.

11.2 Operational Phase

- Nature of Impact: groundwater contamination during fuel spillages from construction machinery and refuse trucks.

	Alternative A		Alternative B	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)	Local (2)	Site (1)
Duration	Medium (3)	Short (3)	Medium (3)	Short (3)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Improbable (2)	Highly Probable (4)	Probable (3)
Significance	Medium (40)	Low (20)	Medium (40)	Low (20)
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Medium	Low	Low
Irreplaceable loss of resources?	yes	No	yes	No
Can impacts be mitigated?	Yes	-	Yes	-

- **Mitigation/Enhancement Measures:**
  - i) implement groundwater monitoring programme;
  - ii) accurate fuel records to be kept;
  - iii) clean-up protocols adhered to;
  - iv) implement inter layering with soil lenses;
  - v) good drainage and stormwater control.

- Nature of Impact: Groundwater contamination due to leakages/spillages.

	Alternative A		Alternative B	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)	Local (2)	Site (1)
Duration	Medium (3)	Short (3)	Medium (3)	Short (3)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Improbable (2)	Highly Probable (4)	Probable (3)
Significance	Medium (40)	Low (20)	Medium (40)	Low (20)
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Medium	Low	Medium
Irreplaceable loss of resources?	Yes	No	Yes	No
Can impacts be mitigated?	Yes	-	Yes	-
Mitigation/Enhancement Measures: i) implement groundwater monitoring programme; ii) ensure adequate lining and drainage systems are installed; iii) ensure surface run-off is contained and treated before disposal; iv) implement inter layering with soil lenses; v) good drainage and storm water control.				

11.3 Closure & Decommissioning Phase

- Nature of Impact: Groundwater contamination due to leakages/spillages

	Alternative A		Alternative B	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Site (1)	Local (2)	Site (1)
Duration	Permanent (5)	Very Short (1)	Permanent (5)	Very Short (1)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Moderate (6)
Probability	Highly Probable (4)	Improbable (2)	Highly Probable (4)	Probable (3)
Significance	Medium (40)	Low (20)	Medium (40)	Medium (40)
Status	Negative	Negative	Negative	Negative
Reversibility	Low	Medium	Low	Medium
Irreplaceable loss of resources?	Yes	No	Yes	No
Can impacts be mitigated?	Yes	-	Yes	-
Mitigation/Enhancement Measures: i) ensure adequate lining and drainage systems as well as leachate pits are installed; ii) ensure that surface run-off is contained and treated before disposal; iii) adequate storm water measures are implemented; iv) groundwater monitoring to ensure early detection of pollution; **v)** capping material to be grassed over.				

11.4 Cumulative Impacts

From a hydrogeological perspective, it can be concluded that all impacts identified have a medium to low significance; however, with implementation of mitigation measures, the impact can be decreased to low.

	Overall Impact of the proposed project considered in isolation	**Cumulative impact of the project in the area**
Extent	Site (1)	Local (2)
Duration	Permanent (4)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Improbable (2)

	Overall Impact of the proposed project considered in isolation	Cumulative impact of the project in the area
Significance	Low (20)	low (20)
Status	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	Yes

11.5 Preferred Alternative

The summary of the preferred alternative to be developed as a general waste disposal site is presented in Table 15.6.1.

TABLE 15.6.1: PREFERRED ALTERNATIVE

Alternative Site	Preference	Reasons
Alternative A	Preferred	The uppermost spring-line is some 9m below the crest of the proposed site and the 3m deep excavation for the landfill is sufficiently shallow to prevent interference with the phreatic line; sufficient interlayer and capping material available on site; mitigation measures will reduce risk of contamination between low and medium.
Alternative B	Discard	This site intersects the spring line and is partially stripped of cover soils required for interlayering and capping; pollution of groundwater sources is highly probable over the long term.

It can be concluded that all impacts identified on the Alternative site A have a medium to low significance; however, with implementation of mitigation measures, the impact can be decreased to low.

- **Mitigation measures to be implemented for inclusion in the EMPr include the following: -**
  - implement groundwater monitoring programme to ensure early detection of pollution;
  - accurate fuel records to be kept;
  - clean-up protocols adhered to;
  - implement inter layering with soil lenses;
  - good drainage and stormwater control.
  - Top soils to be stockpiled for re-use;
  - ensure adequate lining and drainage systems as well as leachate pits/dams are installed;
  - ensure surface run-off is contained and treated before disposal;
  - capping material to be grassed over;

11.6 Sensitive Receptors

There are no potential receptors downstream of the landfill site and at most the water use will be for stock watering.

12. MONITORING PROGRAMME

It is recommended that groundwater quality monitoring be implemented once the site is operational to ensure water remains compliant with the DWAF Minimum Requirements for Waste Disposal by Landfill (2nd Edition, 1998) Boreholes to be monitored includes BH1, BH2, BH3 & BH4.

TABLE12-1: MONITORING BOREHOLE DETAILS

Borehole No.	Southings	Eastings	Monitoring Frequency
BH1	S27° 07' 05.4''	E029° 46' 14.8''	Quarterly
BH2	S27° 07' 21.6''	E029° 46' 16.0''	
BH3	S27° 07' 17.1''	E029° 46' 29.4''	
BH4	S27° 07' 03.4''	E029° 46' 27.5''	

The suggested parameters for detection monitoring are tabulated below and should be compiled on a quarterly basis.

TABLE 12-2: SUGGESTED PARAMETERS FOR DETECTION MONITORING (DWAF, 1998)

Alkalinity (Total Alkalinity)	Calcium (Ca)
Ammonia (NH3) as N	Fluoride as F
Chemical Oxygen Demand (COD)	Magnesium (Mg)
Chloride as Cl	Sodium as Na
Electrical Conductivity	Sulphate as SO4
Nitrate (NO_3) as N	
Nitrite (NO2) as N	
pH – Value	
Potassium (K)	
Total Dissolved Solids	

These results will be used for comparison purposes during all future monitoring events, in an effort to determine any effects on the environment as a result of the landfill construction, the operational activities and eventually the decommissioning and the landfill site closure.

13. PROPOSED REHABILITATION PLAN

The following rehabilitation plan can be utilized should any contamination be detected during monitoring.

- **Source**
  - Identify the source of contamination;
  - Identify the nature and extent of contamination;
  - Eliminate or control source of contamination (if possible).
- **Exposure Pathways**
  - Establish preferential flow paths;
- **Receptor** (current receptors include animals and plants.)
  - Identify risk to potential receptors;
  - Ensure end-users are aware of potential contamination;
  - Conduct quality analysis to ensure water remains within quality guidelines for intended use.

Routine maintenance of stormwater canals and catch pits, leachate dams, monitoring boreholes etc. should be conducted on a regular basis. Any potential contamination detected should be reported. If present, down gradient users should be notified of the potential concern and remedial measures should be implemented.

14. REASONED OPINION & CONDITIONS FOR AUTHORIZATION

- The proposed landfill site to the east of the closed landfill site – that is Alternative A - should be developed and not the alternative site to south thereof. The reasons being: - easy access, known excavation classes and depths as well as cover soil material qualities and distribution. In addition, the Alternative A or 'northerly' site is at least 9m above the spring line whereas the 'southerly' site's development (stripped from most of the overburden soils) will interfere with the spring line – refer to Figure 4, Surface Hydrology, Volume 2.
- Given the potential hydrogeological impacts detailed in this report, the development of the Alternative site A can only be viable if the mitigation measures, included in Section 11 are implemented and adhered to;
- Groundwater monitoring is imperative and necessary, in order to detect groundwater contamination before impacting nearby receptors;
- Based on this, the project can be granted environmental authorization.

15. DISCUSSIONS & DEVELOPMENT RECOMMENDATIONS

15.1 General

The closed - and proposed landfill sites (both alternatives) are underlain by sedimentary bedrock intruded by a dolerite sill which is in various stages of decomposition. The bedrock is sequentially blanketed by residuum and transported soils.

Whether the inferred north-west trending structural lineament referred to in Chapter 5 has created groundwater compartments or possibly acts as a channel-way connecting elevated water sources within the landfill site with the lower-lying wetlands is unknown and can only be determined by drilling additional boreholes on a small grid to assess the structural tendencies, to monitor seeps and boreholes frequently and to model the groundwater regime of the site.

15.2 General Status of Closed Waste Landfill Site

The closed waste landfill site appears to be well-constructed and the routine maintenance has seemingly been done thoroughly. Erosion, settlement, tension cracks and downhill creep were not observed, thereby indicating negligible to low failure hazard potential.

The seepage emanating along the toe of the fill with some of it draining into the small leachate dam is attributed to natural groundwater drainage rather than leachate from the landfill site.

The site is odourless and methane gas concentrations are seemingly < 5%.

15.3 Surface Hydrology, Phreatic Surface, Drainage and Monitoring

Several perennial and non-perennial hillslope seeps ostensibly emanating at the dolerite/sedimentary bedrock contact zones form spring lines at various elevations on and below the landfill site, draining away to form wetlands – refer to Figure 4, Surface Hydrology, Volume 2.

The phreatic surface is present at 4m below surface level and the landfill design should take this into consideration, allowing for a buffer zone of at least 1m, exclusive of the impermeable clay liner.

In addition to these design precautions, minimal surface water infiltration into the fill and good management of surface run-off are pre-requisites. However, this will also require continuous inter-layering and good fill - as well as site drainage management.

15.4 Water Quality

Generally, the water quality of sampling points that are scattered around the site are, with the exception of two data points, currently indicative of an unpolluted water regime. This will however have to be monitored regularly so that a comprehensive data base can be established and fluctuations identified and compared.

15.5 Aquifer Characteristics, Groundwater Usage and Sub-surface Issues

- The landfill site is characterised by an aquifer of low significance and can only be used for monitoring purposes, confirming the fact that the site is not located in an area characterised by aquifers with a potentially strategic value. Furthermore, the surrounding area is seemingly devoid of groundwater boreholes and stock watering is not an issue as there is sufficient surface sources available.
- The area is not undermined and no future mining is planned.
- The site is underlain by sedimentary and intrusive bedrock types and unlike dolomite, are not prone to sinkhole formation.

16. GENERAL

Variances in groundwater, soil and rock quality and quantity from those predicted may be encountered during construction and these should be recorded, however no warranty against these variations is expressed or implied, due to the geological changes that can occur over time due to natural processes, or human activity.

However, it is impossible under the constraints of an investigation of this nature to guarantee that zones of poorer geological materials or deeper excavation or better quality water were not identified that could have had a significant bearing on the outcomes thereof. The investigation has therefore attempted, through interpolation and extrapolation at known test locations, to identify problem issues of a geotechnical and groundwater nature on which this report is based.

Every effort was made during the feasibility study to ensure that generally accepted practices of our profession were used in the sub-surface evaluation of the site, and that the sampling and testing was representative of the water conditions observed on-site.

17. APPENDICES

- Appendix A Monitor Borehole Profiles with Photographs
- Appendix B Pump Test Data with Recommendations
- Appendix C Water Laboratory Test Data
- Appendix D Water Quality Data
- Appendix E CV's & Notable Experience

APPENDIX A

BOREHOLE PROFILES & PHOTOGRAPHS

CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL3821	HOLE No.	Existing Mon Borehole - BH1
X-COORD:	S 27 07'5.41"	Y-COORD:	E 029 46'14.80"
EXISTING MON BOREHOLE - BH1			

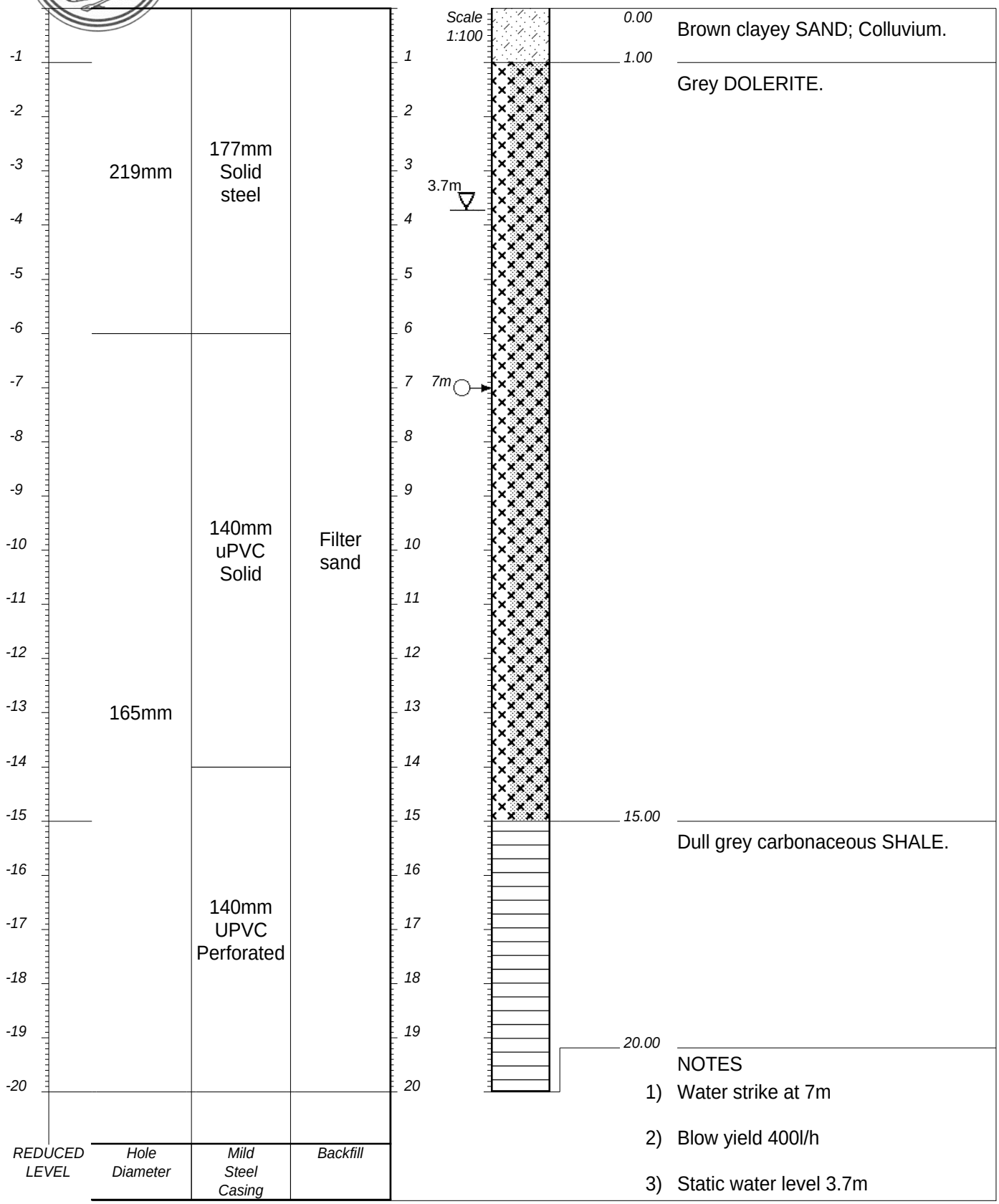
CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL38121	HOLE No.	Prop Mon Borehole - BH2
X-COORD:	S 27 07' 21.6"	Y-COORD:	E 029 46' 16.0"
PROP MON BOREHOLE - BH2			

CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL38121	HOLE No.	Prop Mon Borehole - BH3
X-COORD:	S 27 07' 17.1"	Y-COORD:	E 029 46' 29.4"
PROP MON BOREHOLE - BH3			

Savannah Environmental
ESKOM MAJUBA PS LFS

HOLE No: Mon BH2
Sheet 1 of 1

JOB NUMBER: LL3821



NOTES

1) Water strike at 7m
2) Blow yield 400l/h
3) Static water level 3.7m

CONTRACTOR : Pollard Drilling
MACHINE :
DRILLED BY : J H Smit
PROFILED BY : PG Hansmeyer

INCLINATION : Vertical
DIAM :
DATE :
DATE : 16/05/2022

ELEVATION :
X-COORD : 27˚ 07'21.6"S
Y-COORD : 29˚ 46'16.0"E

HOLE No: Mon BH2

TYPE SET BY : R du Randt
SETUP FILE : STANDARD.SET

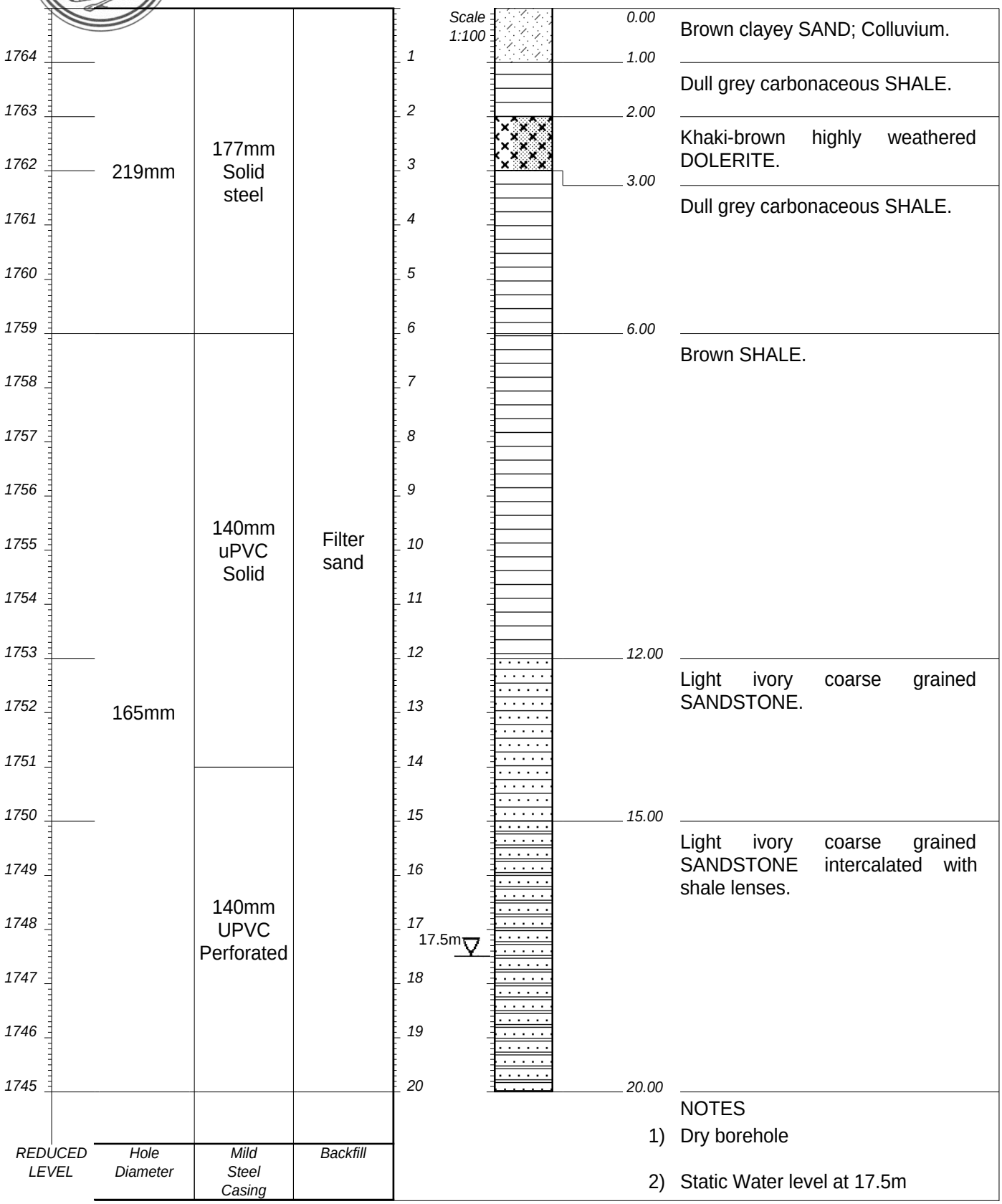
DATE : 28/06/2022 04:08
TEXT : ..aPSProfiles(Rev01PH).txt

CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL38121	HOLE No.	Mon BH2
X-COORD:	S 27 07'21.6"	Y-COORD:	E 029 46'16.0"
BOREHOLE _ Mon BH2			

Savannah Environmental
ESKOM MAJUBA PS LFS

HOLE No: Mon BH3
Sheet 1 of 1

JOB NUMBER: LL3821



NOTES

1) Dry borehole

2) Static Water level at 17.5m

CONTRACTOR : Pollard Drilling
MACHINE :
DRILLED BY : J H Smit
PROFILED BY : PG Hansmeyer

INCLINATION : Vertical
DIAM :
DATE :
DATE : 16/05/2022

ELEVATION : 1765m
X-COORD : 27´° 07' 13.0"S
Y-COORD : 29´° 46' 29.9"E

HOLE No: Mon BH3

TYPE SET BY : R du Randt
SETUP FILE : STANDARD.SET

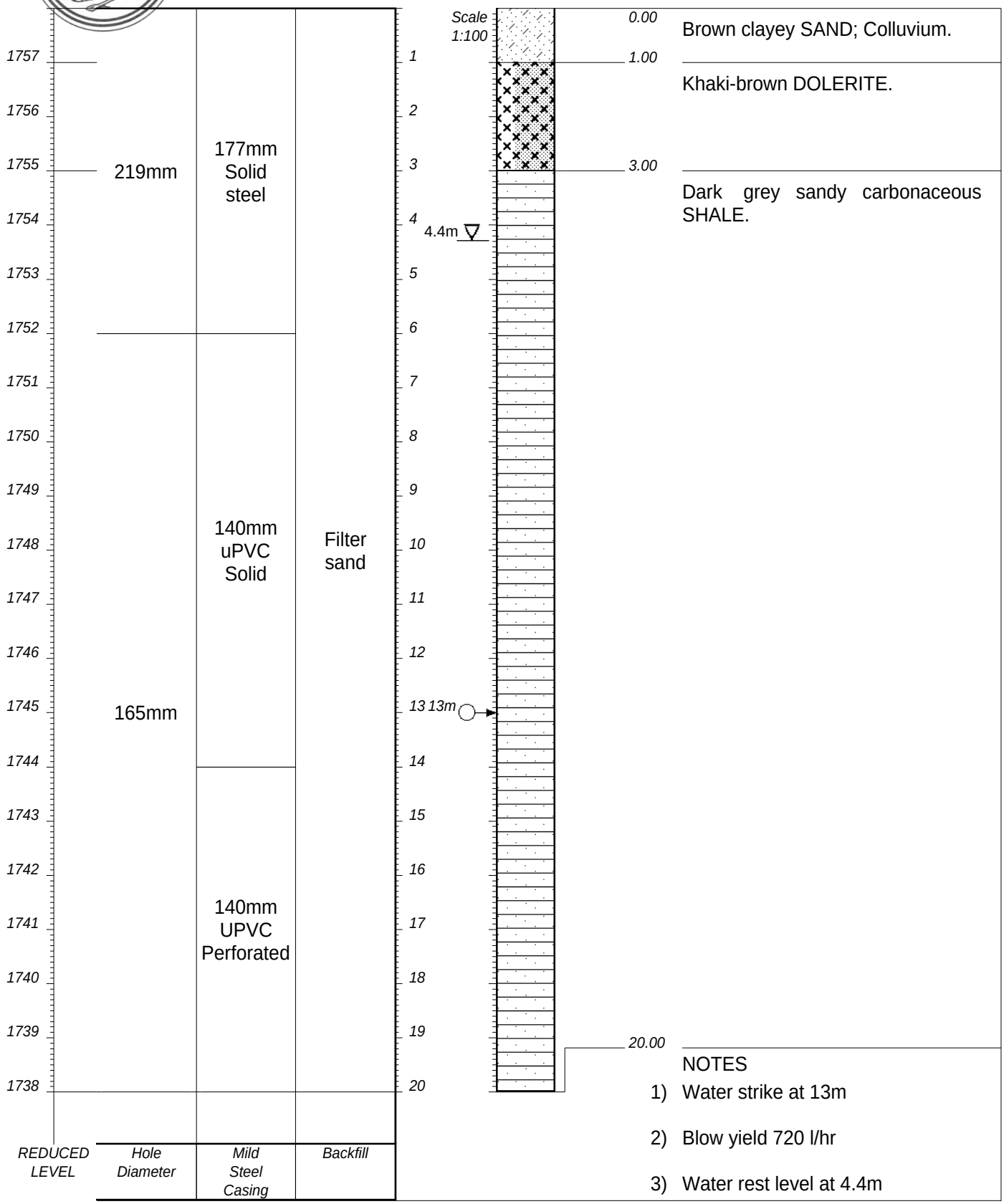
DATE : 28/06/2022 04:08
TEXT : ..aPSProfiles(Rev01PH).txt

CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL38121	HOLE No.	Mon BH3
X-COORD:	S 27 07' 13.0"	Y-COORD:	E 029 46' 29.9"
BOREHOLE _ Mon BH3			

Savannah Environmental
ESKOM MAJUBA PS LFS

HOLE No: Mon BH4
Sheet 1 of 1

JOB NUMBER: LL3821



NOTES

1) Water strike at 13m
2) Blow yield 720 l/hr
3) Water rest level at 4.4m

CONTRACTOR : Pollard Drilling
MACHINE :
DRILLED BY : J H Smit
PROFILED BY : PG Hansmeyer

TYPE SET BY : R du Randt
SETUP FILE : STANDARD.SET

INCLINATION : Vertical
DIAM :
DATE :
DATE : 17/05/2022

DATE : 28/06/2022 04:08
TEXT : ..aPSProfiles(Rev01PH).txt

ELEVATION : 1758m
X-COORD : 27´° 07' 03.4"S
Y-COORD : 29´° 46' 27.5"E

HOLE No: Mon BH4

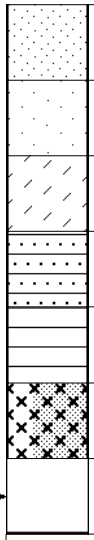
CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL3821	HOLE No.	Mon BH4
X-COORD:	S 27 07' 03.4"	Y-COORD:	E 029 46' 27.5"
BOREHOLE _ Mon BH4			

CLIENT:	Savannah Environmental	PROJECT NAME:	ESKOM MAJUBA PS LFS
PROJECT REF:	LL38121	HOLE No.	Mon BH4A
X-COORD:	S 27 07' 03.4"	Y-COORD:	E 029 46' 27.5"
CAPPED BOREHOLE _ Mon BH4			

Savannah Environmental
ESKOM MAJUBA PS LFS

LEGEND
Sheet 1 of 1

JOB NUMBER: LL3821



	SAND	{SA04}
	SANDY	{SA05}
	CLAYEY	{SA09}
	SANDSTONE	{SA11}
	SHALE	{SA12}
	DOLERITE	{SA18}{SA42}
6.5	WATER SEEPAGE/water strike	{CH50}
	STATIC WATER / REST LEVEL	{SA35}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : R du Randt
SETUP FILE : STANDARD.SET

DATE : 28/06/2022 04:08
TEXT : ..aPSProfiles(Rev01PH).txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX B

PUMP TEST DATA

BOREHOLE TEST RECORD SHEET

REQUEST NO. :		MAP REFERENCE:		0	REGION : 0
BOREHOLE NO.:	BH 02	COORDINATES	(DD-MM-SS)	Lo: 0	DISTRICT :
ALT. BH. NO.:		LATITUDE :	S27 07 21.6	0	SITE NAME: MAJUBA
ALT. BH. NO.:	-	LONGITUDE:	E29 46 16.0	0	FARM NAME:

BOREHOLE DEPTH (m):	20,00	DATUM LEVEL ABOVE CASING (m):			EXISTING PUMP:
WATER LEVEL (mbgl):	3,70	CASING HEIGHT (magl):	0,00		
DEPTH OF PUMP (m):	18,00	BH DIAM. (PUMP INLET) (mm):	165		CONTRACTOR: Pollard Drilling

CONSTANT RATE DISCHARGE TEST AND RECOVERY

TEST STARTED		TEST COMPLETED		DURATION (min): 190
DATE: 18/05/2022	TIME:	DATE: 18/05/2022	TIME:	TYPE OF PUMP : 0

* NOTE * Distance between discharge and observation holes in m.

DISCHARGE BOREHOLE					OBSERVATION HOLE 1		OBSERVATION HOLE 2		OBSERVATION HOLE 3	
					Nr : -		Nr : -		Nr : -	
					Distance m: -		Distance: -		Distance: -	
TIME	DRAWDOWN	YIELD	TIME	RECOVERY	TIME	DRAWDOWN	TIME	DRAWDOWN	TIME	DRAWDOWN
(min)	(m)	(l/s)	(min)	s' (m)	(min)	(m)	(min)	(m)	(min)	(m)
1	5,06	0,08	1	11,75	1		1		1	
2	5,52	0,08	2	11,40	2		2		2	
3	5,73	0,08	3	11,25	3		3		3	
4	6,05	0,08	4	11,10	4		4		4	
5	6,75	0,08	5	10,90	5		5		5	
7	7,17	0,08	7	10,74	7		7		7	
9	7,68	0,08	9	10,54	9		9		9	
15	9,34	0,08	15	10,23	15		12		12	
20	10,09	0,08	20	9,86	20		15		15	
25	11,26	0,08	25	9,58	25		20		20	
30	12,56	0,08	30	9,28	30		25		25	
40	14,30	0,08	40	8,96	40		30		30	
50			50	8,58	50		40		40	
60			60	8,19	60		50		50	
70			70	7,97	70		60		60	
150			150	7,78	70		70		70	
180			180		80		80		80	
210			210		90		90		90	
240			240		120		120		120	
300			300		150		150		150	
360			360		180		180		180	
420			420		210		210		210	
480			480		240		240		240	
540			540		270		270		270	
600			600		300		300		300	
720			720		360		360		360	
840			840		420		420		420	
960			960		480		480		480	
1080			1080		540		540		540	
1200			1200		600		600		600	
1320			1320		660		660		660	
1440			1440		780		780		780	
1320			1140		900		900		900	
1440			1200		1020		1020		1020	
			1260		1140		1140		1140	
			1320		1260		1260		1260	
			1380		1380		1380		1380	
			1440		1440		1440		1440	

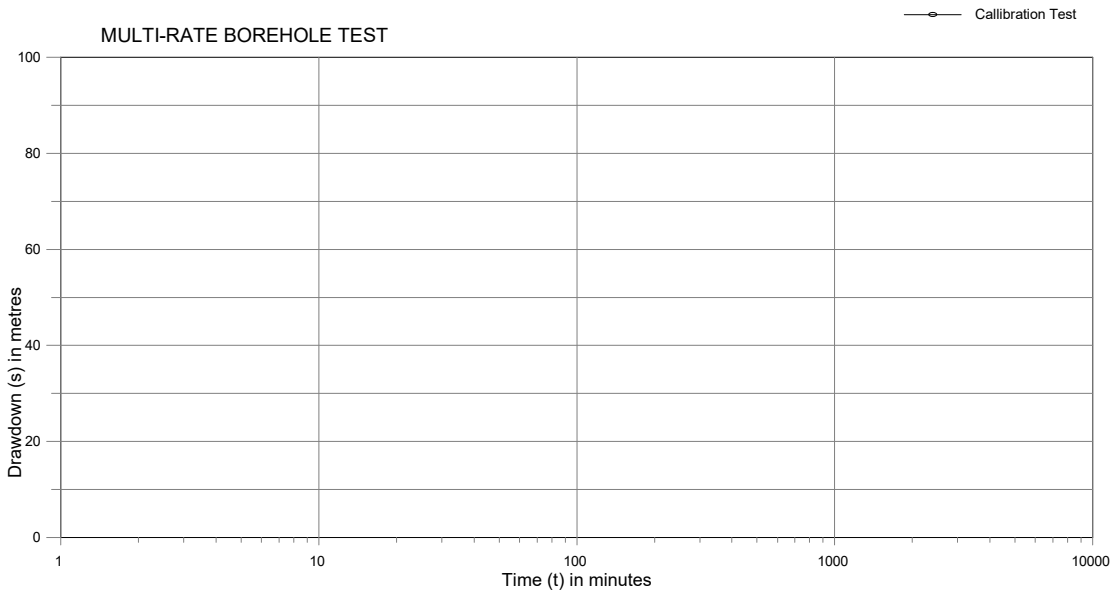
TOTAL TIME PUMPED (min)

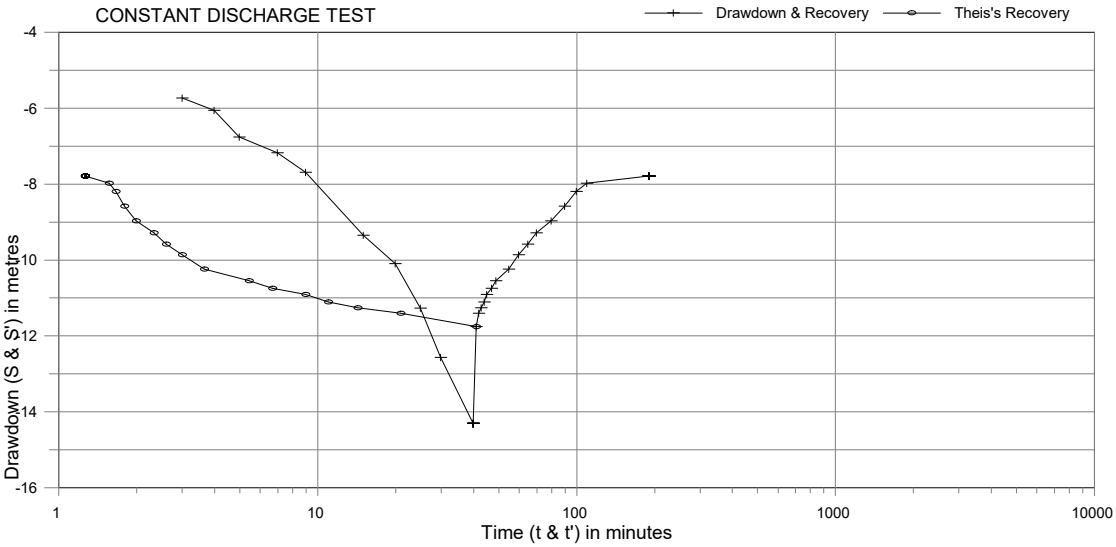
AVERAGE YIELD (l/s): 0,08

t' = total time since pumping started.

t" = time since pumping stopped.

COMMENTS: 1).





REGION :		BOREHOLE NO :	BH 02	MAP REFERENCE :	
DISTRICT :		DEPTH :	20	LATITUDE :	S27 07 21.6
SITE NAME :	Mahikeng Provincial Hospital	WATER LEVEL :	3,7	LONGITUDE:	E29 46 16.0
VILLAGE :		DEPTH OF PUMP:	18	Lo SYSTEM :	

MULTI-RATE BOREHOLE TEST — DATE TESTED : 18/05/2022

TEST Nr	YIELD (l/s)	DURATION (min)	DRAWDOWN (m)	RECOVERY (min)	RECOVERY (m)	Q/st (l/s/m)
1						
2						
3						
4						
5						
CALIBRATION	0,00/0,00					

CONSTANT-RATE DISCHARGE TEST — DATE TESTED : 18/05/2022

AVE. YIELD (l/s)	DURATION (min)	DRAWDOWN (m)	RECOVERY (min)	RECOVERY (m)	kD (m^2/day)	S
0,08	40	14,30	150	7,78	0,0	1,00E-03
OBS. HOLE 1						
OBS. HOLE 2						
OBS. HOLE 3						

Recommendations

			Theis Method		EQUIPMENT
BOREHOLE:		BH 02		0,0	TYPE
DISCHARGE RATE			20 hr/day	ERR l/s	MOTORISED
			20 hr/day	ERR m3/d	
LAT	S27 07 21.6	Max Q	8 hr/day	ERR l/s	MOTORISED
			8 hr/day	ERR m3/d	
LONG	E29 46 16.0		24 hr/day	ERR l/s	MOTORISED
			24 hr/day	ERR m3/d	
			Critical water level	18,0 mbgl	
	20 Hr Cycle		Dynamic water level	ERR mbgl	
	8 Hr Cycle		Dynamic water level	ERR mbgl	
	24 Hr Cycle		Dynamic water level	ERR mbgl	
			Depth of pump	18,0 m	

T	0,00	m2/day
h	11,30	m
u	ERR	
w(u)	ERR	
Theis	ERR	m3/day
Rest WL	3,7	m
Critical h	14	m

Depth to strike / boundary =

Recommendations

1.) The maximum abstraction rate for the borehole yield is not indicated since the borehole does not have enough water or it was not test pumped long enough.

2.) The borehole should either be resited or must be test pumped for longer.

Recovery Check			
CD Yield (l/s)	0,1		
CD Duration (hr)	40,0		
Rec Duration (hr)	150,0		
Total (CD + Rec)			190,0
Drawdown (CD)	14,3		
Rec	7,8		
% Rec			45,6
Airlift Yield		(l/s)	
Inflow on a 24 hr/day	0,0	(l/s)	

MAX YIELD FOR GIVEN PERIOD: Q/st Metho

Q/st	ERR	24 hR
Drawdown	11,30	
Q max	ERR	

Q/st	ERR	20 hR
Drawdown	11,30	
Q max	ERR	

Q/st	ERR	8 Hr
Drawdown	11,30	
Q max	ERR	

NOTE: A monitoring facility must be installed in all equipped boreholes.

BOREHOLE TEST RECORD SHEET

REQUEST NO. :		MAP REFERENCE:		0	REGION : 0
BOREHOLE NO.:	BH 04	COORDINATES	(DD-MM-SS)	Lo: 0	DISTRICT :
ALT. BH. NO.:		LATITUDE :	S27 07 03.1	0	SITE NAME: Majuba
ALT. BH. NO.:	-	LONGITUDE:	E29 46 27.6	0	FARM NAME:

BOREHOLE DEPTH (m):	20,00	DATUM LEVEL ABOVE CASING (m):			EXISTING PUMP:
WATER LEVEL (mbgl):	4,43	CASING HEIGHT (magl):	0,00		
DEPTH OF PUMP (m):	18,00	BH DIAM. (PUMP INLET) (mm):	165		CONTRACTOR: Pollard Drilling

CONSTANT RATE DISCHARGE TEST AND RECOVERY

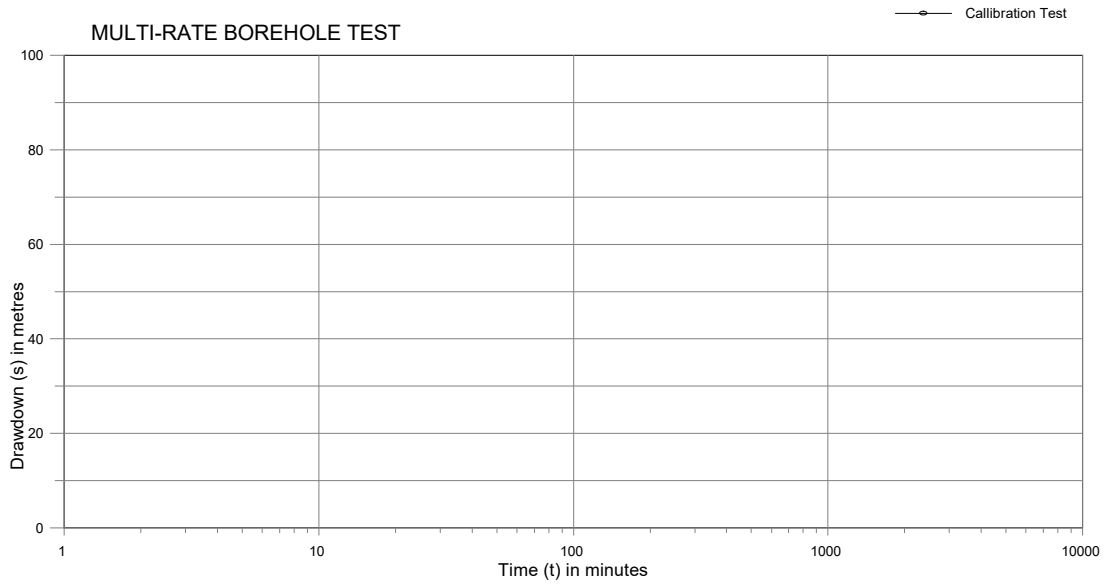
TEST STARTED		TEST COMPLETED		DURATION (min):
DATE: 17/05/2022	TIME:	DATE: 17/05/2022	TIME:	TYPE OF PUMP : 0

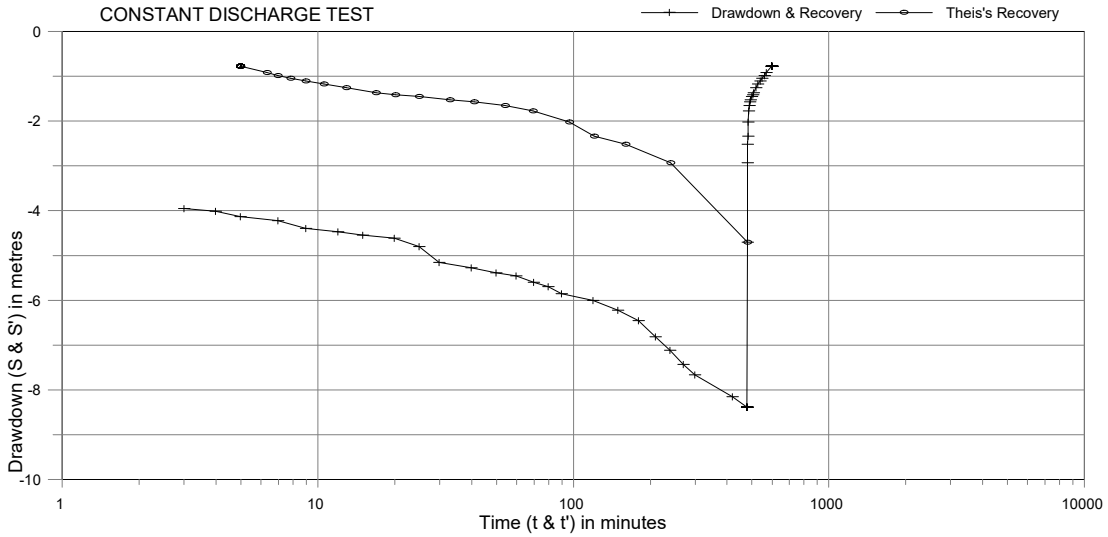
* NOTE * Distance between discharge and observation holes in m.

DISCHARGE BOREHOLE					OBSERVATION HOLE 1		OBSERVATION HOLE 2		OBSERVATION HOLE 3	
					Nr : -		Nr : -		Nr : -	
					Distance m: -		Distance: -		Distance: -	
TIME	DRAWDOWN	YIELD	TIME	RECOVERY	TIME	DRAWDOWN	TIME	DRAWDOWN	TIME	DRAWDOWN
(min)	(m)	(l/s)	(min)	s' (m)	(min)	(m)	(min)	(m)	(min)	(m)
1	3,85	0,18	1	4,70	1		1		1	
2	3,90	0,18	2	2,93	2		2		2	
3	3,95	0,18	3	2,51	3		3		3	
4	4,01	0,18	4	2,33	4		4		4	
5	4,13	0,18	5	2,02	5		5		5	
7	4,22	0,18	7	1,77	7		7		7	
9	4,39	0,18	9	1,65	9		9		9	
12	4,47	0,18	12	1,57	12		12		12	
15	4,54	0,18	15	1,52	15		15		15	
20	4,61	0,18	20	1,45	20		20		20	
25	4,80	0,18	25	1,41	25		25		25	
30	5,15	0,18	30	1,36	30		30		30	
40	5,27	0,18	40	1,25	40		40		40	
50	5,38	0,20	50	1,17	50		50		50	
60	5,45	0,20	60	1,10	60		60		60	
70	5,59	0,20	70	1,04	70		70		70	
80	5,69	0,20	80	0,98	80		80		80	
90	5,85	0,20	90	0,91	90		90		90	
120	6,00	0,20	120	0,77	120		120		120	
150	6,22	0,20	150		150		150		150	
180	6,45	0,20	180		180		180		180	
210	6,81	0,20	210		210		210		210	
240	7,11	0,20	240		240		240		240	
270	7,43	0,20	270		270		270		270	
300	7,66	0,20	300		300		300		300	
420	8,15	0,20	420		360		360		360	
480	8,38	0,20	480		420		420		420	
960			960		480		480		480	
1080			1080		540		540		540	
1200			1200		600		600		600	
1320			1320		660		660		660	
1440			1440		780		780		780	
1320			1140		900		900		900	
1440			1200		1020		1020		1020	
			1260		1140		1140		1140	
			1320		1260		1260		1260	
			1380		1380		1380		1380	
			1440		1440		1440		1440	

TOTAL TIME PUMPED (min		t' = total time since pumping started.
AVERAGE YIELD (l/s):	0,20	t" = time since pumping stopped.

COMMENTS: 1).





REGION :		BOREHOLE NO :	BH 04	MAP REFERENCE :	
DISTRICT :		DEPTH :	20	LATITUDE :	S27 07 03.1
SITE NAME :	Mahikeng Provincial Hospital	WATER LEVEL :	4,43	LONGITUDE:	E29 46 27.6
VILLAGE :		DEPTH OF PUMP:	18	Lo SYSTEM :	

MULTI-RATE BOREHOLE TEST — DATE TESTED : 25/02/2022

TEST Nr	YIELD (l/s)	DURATION (min)	DRAWDOWN (m)	RECOVERY (min)	RECOVERY (m)	Q/st (l/s/m)
1						
2						
3						
4						
5						
CALIBRATION	0,00/0,00					

CONSTANT-RATE DISCHARGE TEST — DATE TESTED : 26/02/2022

AVE. YIELD (l/s)	DURATION (min)	DRAWDOWN (m)	RECOVERY (min)	RECOVERY (m)	kD (m^2/day)	S
0,20	480	8,38	120	0,77	2,5	1,00E-03
OBS. HOLE 1						
OBS. HOLE 2						
OBS. HOLE 3						

Recommendations

			Theis Method			EQUIPMENT
BOREHOLE:		BH 04		0,0		TYPE
DISCHARGE RATE			20 hr/day	0,084	l/s	MOTORISED
			20 hr/day	6,0	m3/d	
LAT	S27 07 03.1	Max Q	8 hr/day	0,20	l/s	MOTORISED
			8 hr/day	5,7	m3/d	
LONG	E29 46 27.6		24 hr/day	0,07	l/s	MOTORISED
			24 hr/day	6,0	m3/d	
			Critical water level	12,8	mbgl	
	20 Hr Cycle		Dynamic water level	7,6	mbgl	
	8 Hr Cycle		Dynamic water level	11,4	mbgl	
	24 Hr Cycle		Dynamic water level	4,4	mbgl	
			Depth of pump	18,0	m	

T	2,50	m2/day
h	5,38	m
u	1,9E-09	
w(u)	19,5230	
Theis	8,66	m3/day
Rest WL	4,43	m
Critical h	8	m

Depth to strike / boundary =

Recommendations

1.) A monitoring facility must be installed for this borehole and the waterlevel of the borehole must be measured regularly.
2.) The maximum abstraction rate for the borehole is the yield indicated for the 8 hour pumping cycle resting for the remainder of the time (16 hours).
3.) It is recommended that the 8 hour pumping cycle be used and the borehole be allowed to recover 16 hours.
4.) If the demand is more than 5,7m3/d the borehole can be pumped using the 8hour pump cycle twice a day, resting 4 hours between cycles.
5.) Do not over pump initially!!
6.) Water quality monitoring should take place to ensure good water quality.

Recovery Check			
CD Yield (l/s)	0,2		
CD Duration (hr)	480,0		
Rec Duration (hr)	120,0		
Total (CD + Rec)			600,0
Drawdown (CD)	8,4		
Rec	0,8		
% Rec			90,8
Airlift Yield		(l/s)	
Inflow on a 24 hr/day	0,1	(l/s)	

MAX YIELD FOR GIVEN PERIOD: Q/st Metho

Q/st	0,03	24 hR
Drawdown	5,38	
Q max	0,14	

Q/st	0,03	20 hR
Drawdown	5,38	
Q max	0,14	

Q/st	0,03	8 Hr
Drawdown	5,38	
Q max	0,16	

NOTE: A monitoring facility must be installed in all equipped boreholes.

APPENDIX C

WATER LABORATORY ANALYSES

Integral Laboratories (Pty) Ltd Unit 11A + B, 11 Platina Road, Kuleka
Empangeni, Kwazulu-Natal, 3880
Tel: 035 787 0062

T0477

Certificate Of Analysis

Company: Engeolab CC
Address: 18 Cleopatra Ave
18 Cleopatra Ave
, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Sample Identification: S4 (Marshy) - 10H58

Sample Number: KW-22-97868 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		10	2022-05-13
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-24
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		7.62	2022-05-16
Electrical Conductivity @ 25°C	M4	mS/m		56.8	2022-05-13
Oxygen Absorbed*	M73	mg/L		24.5	2022-05-16
pH @ 25°C	M6	pH units		7.19	2022-05-13
Temperature*	On Site	°C		20.0	2022-05-13
Total Suspended Solids	M8	mg/L		92.0	2022-05-16
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-13
Fluoride as F-	M32	mg/L		0.53	2022-05-13
Orthophosphate as P	M32	mg/L		<1.00	2022-05-13
Potassium as K	M18	mg/L		7.59	2022-05-20
Sodium as Na	M18	mg/L		29.2	2022-05-20
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-20
Zinc as Zn	M16	mg/L		<0.05	2022-05-25
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-13
Arsenic as As*	M16	µg/L		<3.00	2022-06-08
Boron as B	M16	µg/L		<100	2022-05-25
Cadmium as Cd	M16	µg/L		<1.00	2022-05-25
Chromium as Cr	M16	µg/L		<5.00	2022-05-25
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-24
Copper as Cu	M16	µg/L		<20.0	2022-05-25
Cyanide as CN-*	M55	µg/L		<10.0	2022-05-13
Lead as Pb*	M16	µg/L		<2.00	2022-05-25

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T0477

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Address: 18 Cleopatra Ave
18 Cleopatra Ave
, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		922	2022-05-13
Mercury as Hg*	M16	µg/L		<1.00	2022-05-25
Nickel as Ni	M16	µg/L		<5.00	2022-05-25
Selenium as Se*	M16	µg/L		<20.0	2022-05-25
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		106	2022-05-13
Dissolved Organic Carbon	M20	mg/L		21.4	2022-05-24
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-05-26
Phenols*	M34	µg/L		<10.0	2022-06-09
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.52	2022-05-13

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Certificate Of Analysis

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Sample Identification:	S5 (Dam) - 11h09				
Sample Number: KW-22-97869	**Sample Condition:** Room Temperature		**Remark:**		
Microbiological Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
E. coli	M9	MPN/100mL		1	2022-05-13
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-24
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		7.77	2022-05-16
Electrical Conductivity @ 25°C	M4	mS/m		51.2	2022-05-13
Oxygen Absorbed*	M73	mg/L		5.90	2022-05-16
pH @ 25°C	M6	pH units		7.50	2022-05-13
Temperature*	On Site	°C		20.0	2022-05-13
Total Suspended Solids	M8	mg/L		<5.00	2022-05-16
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-13
Fluoride as F-	M32	mg/L		<0.50	2022-05-13
Orthophosphate as P	M32	mg/L		<1.00	2022-05-13
Potassium as K	M18	mg/L		17.7	2022-05-20
Sodium as Na	M18	mg/L		13.2	2022-05-20
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-20
Zinc as Zn	M16	mg/L		<0.05	2022-05-25
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-13
Arsenic as As*	M16	µg/L		<3.00	2022-06-08
Boron as B	M16	µg/L		<100	2022-05-25
Cadmium as Cd	M16	µg/L		<1.00	2022-05-25
Chromium as Cr	M16	µg/L		<5.00	2022-05-25
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-24
Copper as Cu	M16	µg/L		<20.0	2022-05-25
Cyanide as CN-*	M55	µg/L		<10.0	2022-05-13
Lead as Pb*	M16	µg/L		<2.00	2022-05-25

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Certificate Of Analysis

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, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		84.0	2022-05-13
Mercury as Hg*	M16	µg/L		<1.00	2022-05-25
Nickel as Ni	M16	µg/L		<5.00	2022-05-25
Selenium as Se*	M16	µg/L		<20.0	2022-05-25
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		60.0	2022-05-13
Dissolved Organic Carbon	M20	mg/L		12.3	2022-05-24
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-05-26
Phenols*	M34	µg/L		<10.0	2022-06-09
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.47	2022-05-13

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T0477

Certificate Of Analysis

Company: Engeolab CC
Address: 18 Cleopatra Ave
18 Cleopatra Ave
, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Sample Identification: S7 (Dam) - 11h25

Sample Number: KW-22-97870 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		72	2022-05-13
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-24
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		8.28	2022-05-16
Electrical Conductivity @ 25°C	M4	mS/m		31.2	2022-05-13
Oxygen Absorbed*	M73	mg/L		6.20	2022-05-16
pH @ 25°C	M6	pH units		7.38	2022-05-13
Temperature*	On Site	°C		20.0	2022-05-13
Total Suspended Solids	M8	mg/L		7.00	2022-05-16
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-13
Fluoride as F-	M32	mg/L		<0.50	2022-05-13
Orthophosphate as P	M32	mg/L		<1.00	2022-05-13
Potassium as K	M18	mg/L		2.41	2022-05-20
Sodium as Na	M18	mg/L		16.8	2022-05-20
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-20
Zinc as Zn	M16	mg/L		<0.05	2022-05-25
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-13
Arsenic as As*	M16	µg/L		<3.00	2022-06-08
Boron as B	M16	µg/L		<100	2022-05-25
Cadmium as Cd	M16	µg/L		<1.00	2022-05-25
Chromium as Cr	M16	µg/L		<5.00	2022-05-25
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-24
Copper as Cu	M16	µg/L		<20.0	2022-05-25
Cyanide as CN-*	M55	µg/L		27.0	2022-05-13
Lead as Pb*	M16	µg/L		<2.00	2022-05-25

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T0477

Certificate Of Analysis

Company: Engeolab CC
Address: 18 Cleopatra Ave
18 Cleopatra Ave
, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		88.0	2022-05-13
Mercury as Hg*	M16	µg/L		<1.00	2022-05-25
Nickel as Ni	M16	µg/L		<5.00	2022-05-25
Selenium as Se*	M16	µg/L		<20.0	2022-05-25
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		39.0	2022-05-13
Dissolved Organic Carbon	M20	mg/L		4.68	2022-05-24
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-05-26
Phenols*	M34	µg/L		<10.0	2022-06-09
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.10	2022-05-13

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Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Sample Identification: S8 (Dam) - 10h01

Sample Number: KW-22-97871 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		44	2022-05-13
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-24
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		8.29	2022-05-16
Electrical Conductivity @ 25°C	M4	mS/m		45.0	2022-05-13
Oxygen Absorbed*	M73	mg/L		6.40	2022-05-16
pH @ 25°C	M6	pH units		7.93	2022-05-13
Temperature*	On Site	°C		20.0	2022-05-13
Total Suspended Solids	M8	mg/L		9.00	2022-05-16
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-13
Fluoride as F-	M32	mg/L		<0.50	2022-05-13
Orthophosphate as P	M32	mg/L		<1.00	2022-05-13
Potassium as K	M18	mg/L		6.57	2022-05-20
Sodium as Na	M18	mg/L		18.5	2022-05-20
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-20
Zinc as Zn	M16	mg/L		<0.05	2022-05-25
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-13
Arsenic as As*	M16	µg/L		<3.00	2022-06-08
Boron as B	M16	µg/L		<100	2022-05-25
Cadmium as Cd	M16	µg/L		<1.00	2022-05-25
Chromium as Cr	M16	µg/L		<5.00	2022-05-25
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-24
Copper as Cu	M16	µg/L		<20.0	2022-05-25
Cyanide as CN-*	M55	µg/L		8.00	2022-05-13
Lead as Pb*	M16	µg/L		<2.00	2022-05-25

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		39.0	2022-05-13
Mercury as Hg*	M16	µg/L		<1.00	2022-05-25
Nickel as Ni	M16	µg/L		<5.00	2022-05-25
Selenium as Se*	M16	µg/L		<20.0	2022-05-25
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		29.0	2022-05-13
Dissolved Organic Carbon	M20	mg/L		4.57	2022-05-24
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-05-26
Phenols*	M34	µg/L		<10.0	2022-06-09
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.10	2022-05-13

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
Date of Certificate: 09-June-2022
Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Sample Identification: S9 (Spring) - 09h37

Sample Number: KW-22-97872 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		12	2022-05-13
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-24
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		8.48	2022-05-16
Electrical Conductivity @ 25°C	M4	mS/m		56.7	2022-05-13
Oxygen Absorbed*	M73	mg/L		17.7	2022-05-16
pH @ 25°C	M6	pH units		7.99	2022-05-13
Temperature*	On Site	°C		20.0	2022-05-13
Total Suspended Solids	M8	mg/L		6.00	2022-05-16
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-13
Fluoride as F-	M32	mg/L		<0.50	2022-05-13
Orthophosphate as P	M32	mg/L		<1.00	2022-05-13
Potassium as K	M18	mg/L		4.25	2022-05-20
Sodium as Na	M18	mg/L		36.2	2022-05-20
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-20
Zinc as Zn	M16	mg/L		<0.05	2022-05-25
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-13
Arsenic as As*	M16	µg/L		<3.00	2022-06-08
Boron as B	M16	µg/L		<100	2022-05-25
Cadmium as Cd	M16	µg/L		<1.00	2022-05-25
Chromium as Cr	M16	µg/L		<5.00	2022-05-25
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-24
Copper as Cu	M16	µg/L		<20.0	2022-05-25
Cyanide as CN-*	M55	µg/L		13.0	2022-05-13
Lead as Pb*	M16	µg/L		<2.00	2022-05-25

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48663
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Date Completed: 09-June-2022
Date of Sampling: 12-May-2022
Date of Receival at Lab: 13-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		91.0	2022-05-13
Mercury as Hg*	M16	µg/L		<1.00	2022-05-25
Nickel as Ni	M16	µg/L		<5.00	2022-05-25
Selenium as Se*	M16	µg/L		<20.0	2022-05-25
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		69.0	2022-05-13
Dissolved Organic Carbon	M20	mg/L		5.09	2022-05-24
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-05-26
Phenols*	M34	µg/L		<10.0	2022-06-09
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.12	2022-05-13

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		Date Completed:	09-June-2022
		Date of Sampling:	12-May-2022
		Date of Receival at Lab:	13-May-2022
Contact:	Paul Hansmeyer		

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3. Uncertainties of Measurement, Limits of Detection, and Method Descriptions will be provided upon request.
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Mariette Prins
Technical Signatory

Nolan Africa - Technical Signatory

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Sample Identification: Existing Mon Borehole - 1

Sample Number: KW-22-98166 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		0	2022-05-20
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-30
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		5.97	2022-05-20
Electrical Conductivity @ 25°C	M4	mS/m		118	2022-05-20
Oxygen Absorbed*	M73	mg/L		6.40	2022-05-20
pH @ 25°C	M6	pH units		7.28	2022-05-20
Temperature*	On Site	°C		22.0	2022-05-24
Total Suspended Solids	M8	mg/L		20.0	2022-05-20
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		0.56	2022-05-20
Fluoride as F-	M32	mg/L		<0.50	2022-05-20
Orthophosphate as P	M32	mg/L		<1.00	2022-05-20
Potassium as K	M18	mg/L		2.57	2022-05-27
Sodium as Na	M18	mg/L		65.3	2022-05-27
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-27
Zinc as Zn	M16	mg/L		<0.05	2022-05-26
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-24
Arsenic as As*	M16	µg/L		<3.00	2022-05-26
Boron as B	M16	µg/L		<100	2022-05-26
Cadmium as Cd	M16	µg/L		<1.00	2022-05-26
Chromium as Cr	M16	µg/L		<5.00	2022-05-26
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-27
Copper as Cu	M16	µg/L		<20.0	2022-05-26
Cyanide as CN-*	M55	µg/L		<10.0	2022-05-24
Lead as Pb*	M16	µg/L		<2.00	2022-05-26

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		109	2022-05-24
Mercury as Hg*	M16	µg/L		<1.00	2022-05-26
Nickel as Ni	M16	µg/L		<5.00	2022-05-26
Selenium as Se*	M16	µg/L		<20.0	2022-05-26
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		28.0	2022-05-24
Dissolved Organic Carbon	M20	mg/L		2.62	2022-06-01
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-06-02
Phenols*	M34	µg/L		<10.0	2022-06-13
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.25	2022-05-19

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Sample Identification: Prop Mon Borehole - 2

Sample Number: KW-22-98167 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		68	2022-05-20
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-30
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		6.59	2022-05-20
Electrical Conductivity @ 25°C	M4	mS/m		63.6	2022-05-20
Oxygen Absorbed*	M73	mg/L		24.1	2022-05-20
pH @ 25°C	M6	pH units		7.80	2022-05-20
Temperature*	On Site	°C		22.0	2022-05-24
Total Suspended Solids	M8	mg/L		2128	2022-05-20
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-20
Fluoride as F-	M32	mg/L		<0.50	2022-05-20
Orthophosphate as P	M32	mg/L		<1.00	2022-05-20
Potassium as K	M18	mg/L		2.39	2022-05-27
Sodium as Na	M18	mg/L		98.3	2022-05-27
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-27
Zinc as Zn	M16	mg/L		<0.05	2022-05-26
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-24
Arsenic as As*	M16	µg/L		<3.00	2022-05-26
Boron as B	M16	µg/L		<100	2022-05-26
Cadmium as Cd	M16	µg/L		<1.00	2022-05-26
Chromium as Cr	M16	µg/L		<5.00	2022-05-26
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-27
Copper as Cu	M16	µg/L		<20.0	2022-05-26
Cyanide as CN-*	M55	µg/L		<10.0	2022-05-24
Lead as Pb*	M16	µg/L		<2.00	2022-05-26

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		74.0	2022-05-24
Mercury as Hg*	M16	µg/L		<1.00	2022-05-26
Nickel as Ni	M16	µg/L		<5.00	2022-05-26
Selenium as Se*	M16	µg/L		<20.0	2022-05-26
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		241	2022-05-24
Dissolved Organic Carbon	M20	mg/L		3.12	2022-06-01
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-06-02
Phenols*	M34	µg/L		<10.0	2022-06-13
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.05	2022-05-19

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Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Sample Identification: Prop Mon Borehole - 3

Sample Number: KW-22-98168 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		0	2022-05-20
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-30
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		6.20	2022-05-20
Electrical Conductivity @ 25°C	M4	mS/m		29.0	2022-05-20
Oxygen Absorbed*	M73	mg/L		5.70	2022-05-20
pH @ 25°C	M6	pH units		8.64	2022-05-20
Temperature*	On Site	°C		22.0	2022-05-24
Total Suspended Solids	M8	mg/L		26.0	2022-05-20
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		0.21	2022-05-20
Fluoride as F-	M32	mg/L		1.42	2022-05-20
Orthophosphate as P	M32	mg/L		<1.00	2022-05-20
Potassium as K	M18	mg/L		10.4	2022-05-27
Sodium as Na	M18	mg/L		19.0	2022-05-27
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-27
Zinc as Zn	M16	mg/L		<0.05	2022-05-26
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-24
Arsenic as As*	M16	µg/L		198	2022-05-26
Boron as B	M16	µg/L		<100	2022-05-26
Cadmium as Cd	M16	µg/L		<1.00	2022-05-26
Chromium as Cr	M16	µg/L		<5.00	2022-05-26
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-27
Copper as Cu	M16	µg/L		<20.0	2022-05-26
Cyanide as CN-*	M55	µg/L		<10.0	2022-05-24
Lead as Pb*	M16	µg/L		<2.00	2022-05-26

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Tel: 035 787 0062

T0477

Certificate Of Analysis

Company: Engeolab CC
Address: 18 Cleopatra Ave
18 Cleopatra Ave
, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		<10.0	2022-05-24
Mercury as Hg*	M16	µg/L		<1.00	2022-05-26
Nickel as Ni	M16	µg/L		<5.00	2022-05-26
Selenium as Se*	M16	µg/L		<20.0	2022-05-26
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		34.0	2022-05-24
Dissolved Organic Carbon	M20	mg/L		1.16	2022-06-01
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-06-02
Phenols*	M34	µg/L		<10.0	2022-06-13
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.05	2022-05-19

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Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Sample Identification: Prop Mon Borehole - 4

Sample Number: KW-22-98169 **Sample Condition:** Room Temperature **Remark:**

Microbiological Parameters	Method	Unit	Limit	Result	Analysis Date
E. coli	M9	MPN/100mL		8	2022-05-20
Somatic Coliphages*	M39	Count/10mL		Not Detected	2022-05-30
Physical / Aesthetic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Dissolved Oxygen*	M57	mg/L		6.69	2022-05-20
Electrical Conductivity @ 25°C	M4	mS/m		60.8	2022-05-20
Oxygen Absorbed*	M73	mg/L		24.5	2022-05-20
pH @ 25°C	M6	pH units		7.62	2022-05-20
Temperature*	On Site	°C		22.0	2022-05-24
Total Suspended Solids	M8	mg/L		212	2022-05-20
Chemistry (Macro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Ammonia as N	M32	mg/L		<0.20	2022-05-20
Fluoride as F-	M32	mg/L		1.28	2022-05-20
Orthophosphate as P	M32	mg/L		<1.00	2022-05-20
Potassium as K	M18	mg/L		3.13	2022-05-27
Sodium as Na	M18	mg/L		35.7	2022-05-27
Sulphide (as S)*	M18	mg/L		<0.10	2022-05-27
Zinc as Zn	M16	mg/L		<0.05	2022-05-26
Chemistry (Micro) Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Aluminium as Al3+*	M38	µg/L		<100	2022-05-24
Arsenic as As*	M16	µg/L		<3.00	2022-05-26
Boron as B	M16	µg/L		<100	2022-05-26
Cadmium as Cd	M16	µg/L		<1.00	2022-05-26
Chromium as Cr	M16	µg/L		<5.00	2022-05-26
Chromium as Cr6+	M44	µg/L		<3.00	2022-05-27
Copper as Cu	M16	µg/L		<20.0	2022-05-26
Cyanide as CN-*	M55	µg/L		<10.0	2022-05-24
Lead as Pb*	M16	µg/L		<2.00	2022-05-26

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T0477

Certificate Of Analysis

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18 Cleopatra Ave
, 1034,

Contact: Paul Hansmeyer

Service Request Number: KW-2022-48725
Date of Certificate: 14-June-2022
Date Completed: 14-June-2022
Date of Sampling: 19-May-2022
Date of Receival at Lab: 19-May-2022

Chemistry (Micro) Parameters	Method	Unit	Limit	Result	Analysis Date
Manganese as Mn*	M70	µg/L		178	2022-05-24
Mercury as Hg*	M16	µg/L		<1.00	2022-05-26
Nickel as Ni	M16	µg/L		<5.00	2022-05-26
Selenium as Se*	M16	µg/L		<20.0	2022-05-26
Organic Parameters	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Chemical Oxygen Demand (Unfiltered)	M2	mg/L		70.0	2022-05-24
Dissolved Organic Carbon	M20	mg/L		1.06	2022-06-01
Fats, Oils & Grease*	M74	mg/L		<0.50	2022-06-02
Phenols*	M34	µg/L		<10.0	2022-06-13
On-Site	**Method**	**Unit**	**Limit**	**Result**	**Analysis Date**
Free Chlorine*	On Site	mg/L		0.10	2022-05-19

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Certificate Of Analysis

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Address:	18 Cleopatra Ave 18 Cleopatra Ave , 1034,	Date of Certificate:	14-June-2022
		Date Completed:	14-June-2022
		Date of Sampling:	19-May-2022
		Date of Receival at Lab:	19-May-2022
Contact:	Paul Hansmeyer		

1. Sampling is outside the laboratory's scope of accreditation. Where applicable, free and total chlorine results are supplied by the sampling officer.
2. This report shall not be reproduced except in full, without written approval from the laboratory.
3. Uncertainties of Measurement, Limits of Detection, and Method Descriptions will be provided upon request.
4. The organization reports results at the 95% confidence interval with a coverage factor k = 2. The overlying acceptance criteria for method expanded uncertainty is < 5%. Decision Rule - Results reflecting on the Certificate of Analysis are actual results as obtained at the time of testing, and do not include any uncertainty considerations. The Laboratory does not issue any statement of conformity, unless by prior arrangement.
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8. The following has reference:
    - Unless otherwise stated, ICP, HPLC, GC, GC-MS and LC-MS samples have been filtered using a 0.45µm filter prior to analysis.
9. In the absence of client specified limits, the limits reflected are based on SANS 241-2015 or General Effluent Standards, as applicable.
10. The quality and integrity of samples submitted has a direct correlation to the results reported. As such, results reflected on this report relate only to the samples as received.
11. Opinions and interpretations expressed herein are outside the scope of SANAS accreditation.

Mariette Prins
Technical Signatory

Nolan Africa - Technical Signatory

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APPENDIX D

WATER QUALITY DATA

QUALITY ANALYSIS

Borehole No.: S4 (Marshy)

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.02	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.52						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		10			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	56.8	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.53	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		21.4						
pH *	pH units	7.19	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	7.59	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	29.2	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: S5 (Dam)

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.02	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.47						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		10			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	51.2	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.5	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		12.3						
pH *	pH units	7.5	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	17.7	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	13.2	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: S7 (Dam)

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.02	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.1						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		27			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	31.2	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.5	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		4.68						
pH *	pH units	7.38	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	2.41	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	16.8	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: S8 (Dam)

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.02	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.1						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		8			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	45	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.5	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		4.57						
pH *	pH units	7.93	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	6.57	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	18.5	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: S9 (Spring)

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.02	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.12						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		13			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	56.7	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.5	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		5.09						
pH *	pH units	7.99	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	4.25	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	36.2	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: Existing Mon BH1

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.56	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.25						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		10			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	118	Class 1: Water of a good quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.5	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		2.62						
pH *	pH units	7.28	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	2.57	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	65.3	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: Prop Mon BH2

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.2	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.05						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		10			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	63.6	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	0.5	Class 0: Water of an ideal quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		3.12						
pH *	pH units	7.8	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	2.39	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	98.3	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: Prop Mon BH3

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.21	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	198	Class 3: Water of an unacceptable quality		Unacceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.05						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		10			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	29	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	1.42	Class 1: Water of a good quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		1.16						
pH *	pH units	8.64	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	10.4	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	19	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

QUALITY ANALYSIS

Borehole No.: Prop Mon BH4

Project No.: LL3821

Project Name: Eskom Amajuba LFS

District: Steelpoort

CO-ORDINATES

Lat:

Long:

INPUT INFORMATION			DWAF		SANS 241:2011	WATER TREATMENT		
SUBSTANCE	UNIT OF MEASURE	TEST VALUE	COMMENTS		COMMENTS	Home	Conventional treatment	Advanced
Aldrin & Dieldrin								
Alkalinity								
Aluminium		100			Class 1, Acceptable			
Ammonia (N) **	mg/l NH3	0.02	Class 0: Water of an ideal quality		Class 1, Acceptable			
Ammonia (NH3)	mg/l NH3							
Appearance								
Arsenic (As) *	mg/l As	3	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	Flocculation with an iron salt, settlement and filtration	Oxidation, flocculation with an iron salt, settlement and filtration
Cadmium (Cd) *	mg/l Cd	1	Class 3: Water of an unacceptable quality		Class 1, Acceptable	No treatment available	No treatment available	Ion exchange
Calcium (Ca)	mg/l Ca							
Calcium (CaCo3)	mg/l CaCO3							
Chloride (Cl)*	mg/l Cl							
Chlorine (Free)		0.01						
Chlorine (Total)								
Chloroform								
Colour								
Copper(Cu)		20			Class 1, Acceptable			
Cyanide		10			Class 1, Acceptable			
Electrical conductivity EC *	mS/m	60.8	Class 0: Water of an ideal quality		Class 1, Acceptable	---	No treatment available	Desalination by ion exchange or reverse osmosis
Faecal coliform *	counts/100 ml							
Fluoride (F) *	mg/l F	1.28	Class 1: Water of a good quality	#VALUE!	Class 1, Acceptable	No treatment available	No treatment available	Ion exchange, Reverse osmosis or Adsorption or activated alumina
Iron (Fe) *	mg/l Fe			#VALUE!				
Lead		2			Class 1, Acceptable			
Magnesium (Mg)	mg/l Mg							
Magnesium (MgCo3) *	mg/l MgCO3							
Manganese (Mn) *	mg/l Mn			#VALUE!				
Mercury		1			Class 1, Acceptable			
Nitrate (as N) *	mg/l N							
Nitrate (as NO3) *	mg/l N							
Nitrite (Soluble)								
Odour & Taste								
Organic carbon(sol)		1.06						
pH *	pH units	7.62	Class 0: Water of an ideal quality		Class 1, Acceptable	Neutralization with marble chips	pH adjustment by controlled addition of alkali such as lime sodium carbonate, carbon dioxide	Controlled addition of a suitable acid/alkali
Phenols		10			Class 1, Acceptable			
Potassium (K) *	mg/l K	3.13	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Reverse osmosis, electrolysis, Ion exchange
Precipitation Potential								
Selenium		20			Class II, Maximum Allowable for 1 year			
Sodium (Na) *	mg/l Na	35.7	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	No treatment available	Desalination by ion exchange or reverse osmosis
Standard plate count								
Sulphate (SO4) *	mg/l SO4							
Total Alkalinity	mg/l							
Total Coliforms								
Total Dissolved Solids (TDS) *	(mg/l)							
Total Hardness **	mg CaCO3/l							
Trihalomethanes								
Turbidity	NTU							
Zinc (Zn) *	mg/l Zn	0.05	Class 0: Water of an ideal quality		Class 1, Acceptable	No treatment available	Precipitation settlement, filtration	Ion exchange

APPENDIX E

CV's & Notable Experience

ENGEOLAB (PTY) LTD

Reg. No. 2017/536405/07 VAT Reg. No. 4710205925

Branches: Gauteng_Pretoria / KZN_Mtunzini / Mpumalanga_eMalahleni

Contact: Enquiries - info@engeolabcc.co.za
Finances - finance@engeolabcc.co.za / 082 800 2245
Sales - paul@engeolabcc.co.za / 082 881 5370

Website:
www.engeolabcc.co.za

EXPERT CONFIRMATION			
Name and Surname	Paul G. Hansmeyer	Date of Birth	21-08-1953
Profession	Geotechnical & Groundwater Practitioner	Nationality	RSA Citizen
Proposed Position on projects	Geological/Geotechnical/Groundwater Key expert		

Membership of Professional Bodies	
Professional Body & Associations	Membership/Registration No's
South African Council for Natural Scientific Professions	4000/12/91
South African Institute for Engineering and Environmental Geologists	22/532
Borehole Water Association of Southern Africa	631

Name of Employer	ENGEOLAB (PTY) LTD
Present Position with the current employer	CEO / Director

Qualifications and Dates Obtained		
Institution	Course	Year of Completion
University of Stellenbosch	B.Sc.	1978
University of Pretoria	B.Sc. Honours Engineering Geology	1988

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me and my qualifications

P.G.Hansmeyer *Pr. Sci. Nat.*

Paul Hansmeyer

Earth Science Consultant

Qualifications

- **University of Pretoria – Graduated 1987**
  - **B.Sc (Hons) degree in Engineering Geology**
- **University of Stellenbosch – Graduated 1976**
  - **B.Sc degree**

Professional Affiliations

- **Registered with SACNASP – Registration No. 400012/91**
  - **Earth Science (Professional Natural Scientist)**
- **Member SAIEG (South African Institute of Engineering Geologists) Registration No. 22/532**

Experience

Paul is a registered scientist _ Earth Science (Professional Natural Scientist and has 44 years of experience and specializes in the field of Geotechnical Engineering, Soil Mechanics, Engineering Geology and Groundwater Development.

Attached herewith a short brochure of ENGEOLAB for more information

ENGEOLAB PTY LTD **2002-Present**
Key Expert_Geological; Geotechnical & Groundwater Practitioner

Duties include, but not limited to: -

- Responsible for geotechnical and geohydrological consulting _ civil and groundwater projects.
- Business Development.
- Project Management of Projects.
- Mentoring, training and skill upgrade.
- Developing standard operating practices (SOPs).
- Research.

Recent significant projects include:

2019-2022

- Umgeni Water
- Gabosch Dam
- Road P234 Nongoma
- Tailings facility (TSF) stability evaluation in Rustenburg, South Africa.
- Consulting on bearing capacity and settlement for a gas plant foundation project in Richards Bay, Kwazulu Natal.
- Consulting on a slope stability assessment for a cemetery site in Kwazulu Natal.
- (2019) Tailings facility (TSF) stability evaluation in Rustenburg, South Africa
  - Analysis of CPTu results and dilatometer (DMT) results of three TSF sites;
  - Comprehensive slope stability analysis using different HDPE liners and unlined scenarios;
  - Different material layering scenarios;
  - Drafting of a review summary of the stability findings.

GROUNDWATER

Continuous appointment since 1994 as geohydrologist consultant to Zululand Regional Council, Umkhanyakudu DM, uThungulu District Municipality. Since 1999 appointed as geohydrological consultants to iNdlovu Regional Council. Tender adjudication; appointment of contractors; community liaison; geophysical borehole siting; drilling and pumptest supervision; design of boreholes in primary and secondary aquifers; pumptest and chemical data analyses and reporting. Other geohydrological consulting appointments: - uThungulu Regional Council for southern and northern Zululand, Mhlathuze Water, Umgeni Water & Zululand DM.

Note attached project list for Geohydrological Investigations for more notable experience

ENGEOLAB (PTY) LTD

Reg. No. 2017/536405/07 VAT Reg. No. 4710205925

Branches: Gauteng_Pretoria / KZN_Mtunzini / Mpumalanga_eMalahleni

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Sales - paul@engeolabcc.co.za / 082 881 5370

Website:
www.engeolabcc.co.za

CONFIRMATION			
Name and Surname	Beate Vermeulen	Date of Birth	27-05-1994
Profession	Geohydrologist	Nationality	RSA Citizen
Proposed Position on projects	Geohydrologist		

Membership of Professional Bodies	
Professional Body & Associations	Membership/Registration No's
South African Council for Natural Scientific Professions	121349

Name of Employer	ENGEOLAB (PTY) LTD
Present Position with the current employer	External Consultant

Qualifications and Dates Obtained		
Institution	Course	Year of Completion
North West University	B.Sc. Environmental and Biological Sciences (Geol & Botany)	2016
	B.Sc. Hons Environmental Sciences (Hydrology)	2017

Certification:

I, the undersigned, certify that, to the best of my knowledge and belief, this data correctly describes me and my qualifications

B Vermeulen *Pr. Sci. Nat.*

Beate Vermeulen

- **North West University Graduated 2016**
  - ❖ **B.Sc. (Hons) 2017 degree in Environmental Sciences (Hydrology)**
  - ❖ **B.Sc. 2016**

- ➢ **Registered with SACNASP – Registration No. 121349**
  - ○ **Earth Science (Professional Natural Scientist)**

Beate is a registered scientist _ Earth Science (Professional Natural Scientist and has 6+ years of experience and specializes in the field of Groundwater Development.

CONSULTANT **MAR 2021 to DATE**

Duties include, but not limited to: -

- Responsible for geohydrological consulting and groundwater projects.
- Project Management of Projects.
- Research.
- Report Writing
- Hydrocensus Surveys
- GIS

ENGEOLAB PTY LTD **2002-Present**

Duties include, but not limited to: -

- Responsible for geohydrological consulting and groundwater projects.
- Project Management of Projects.
- Research.
- Report Writing
- Hydrocensus Surveys
- GIS

Recent significant projects include:

2019-2022

- Umgeni Water
- Gabosch Dam

Note attached project list for Geohydrological Investigations for more notable experience

Notable Professional Experience _ Geohydrological Projects			
Ref	**Client / Company**	**Project Description**	**Year**
LL3781	Umgeni Water	uThukhela Bulk Water Supply	2021-2022
LL3754	Margate Retirement Village	Margate Retirement Village Geohydrological Services	2021
LL3799	VIRTUAL CONSULTING ENGINEERS VCE (PTY) LTD	MAHIKENG PROVINCIAL HOSPITAL _ Geohydrological Inv	2021
LL3749	Alpha Services & Projects	Rea Vay Selby - Geohydro Inv	2021
LL3124	Zululand District Municipality	Geohydrological services for period of 3 years	2018-2021
LL3377	M&D CONSTRUCTION	Geohydrological Services Meje Clinic	2019-2020
LL3358	SGS Matrolab	Geotech & Geohydro - Luipardsvlei Landfill Site	2019
LL3326	Bulk Water Designs cc	Geohydrological Inv _ uMzinyathi DM	2019
LL3325	Ilifa Africa Engineers	Geohydrological Inv _ Nquthu Municipality - Cassino Settlement	2019
LL3319	Electric & Pump Services	Umgungungdlovu District Municipality _ Geohydrological services	2019
LL3298	Map Africa Consulting Engineers	Geohydrological Services _ Rietvlei Hospital	2019
LL3261	Ilifa Africa Engineers (Pty) Limited	Nquthu Municipality Bulk Water Supply	2019
LL3141	Urban Dynamics	Arbor Settlements_ Geohydro & Geotech	2018
LL3034	BTW & Associates (Pty) Ltd	20438 - Eskom Majuba Landfill Site	2018
LL3227	Aquest Colsen	Geohydrological Services _ Glodina Factory - Hammersdale	2018
LL2903	Aquest Colsen	Geohydrological Services _ Grand West Casino	2017
LL2997	Zululand DM	Mandlakazi Bulk Water	2017
LL2557	Ngani Proj (Phiri & Nyoni)	Musukaligwa Municipality _ Warburton Groundwater Dev	2015-2016
LL2677	Lindokuhle Consulting	Arlington Bulk Geoh	2016
LL2651	uMgungundlovu District Municipality	UDM Drought Relief (Gulube & Dwengu)	2016
LL2643	Dept of Agriculture	Geohydrological Inv _ Sibukeni Gardens	2016
LL2355	Tumber Fourie	Geohydrological Investigation - Maditameng Village	2015
LL2311	Dept. of Agriculture & Environ Affairs	(DC26)Hydrogeological Cons Serv in the KZN Prov Stock Watering Intervention - ZDM	2014-2015
LL2305	Holland-Muter & Associates	Geohydrolical Assessment - Ottoshoop	2014
LL2248	Richards Bay Industrial Development Zone (RBIDZ)	Bid No.: 1F/ENV/002/14 Geohydrological Assessment for RBIDZ Phase 1F	2014
LL2228	Ilifa Africa Engineers	Waterfall Community New BH Investigation	2014
LL2191	uMkhanyakude District Municipality	Assessment Status of Water Infra & Sewerage	Jul-05
LL2189	Holland-Muter & Associates	Geohydrological Investigation - Elandspruit Colliery	2014
LL2186	Dept. of Agriculture & Environ Affairs	DWA Stretford Farm	2014
LL2086	PD Naidoo & Ass Consuling Eng	Ingwavuma-Jozini Water Supply Project	2013
LL2075	Umsimbithi Mining	Groundwater Development at Wonderfontein Mine	2013
LL2068	Nkangala District Municipality	Spring Valley Water Scheme Project	2013
LL2066	One Turn/Coalition JV	Makause School: Groundwater Potential & Development	2013

Notable Professional Experience _ Geohydrological Projects			
Ref	**Client / Company**	**Project Description**	**Year**
LL2046	Bigen Africa	Groundwater Development at Houtrivier	2013
LL2042	Mhlathuze Water	MW00202: Geophysical Consulting Serv - Drilling of Boreholes	2012-2013
LL1974	ECA Consulting	Geohydrological Study into the Feasibility of GW Supply in the Ingwavuma Area - Ingwavuma Magistrate's Court	2012-2013
LL1929	Uthungulu District Municipality	UDM/28/2011: Geohydrological Services	2012-2014
LL1879	Zululand District Municipality	Geohydrological services - ZDM953/2010 & ZDM024/2017- ZDM Rudimentary Water Supply Programme	2010-2020
LL1879	Zululand District Municipality	Provision of Geohydrological Support Services (North)	2011
LL1876	Nkangala District Municipality	New Elevated Reservoir Emalahleni	2011
LL1866	WorleyParsons	TCTA Groundwater Dev & Refurbishment Ehlanzeni, Nkangala & Gert Sibande DM	2011-2012
LL1834	uMgungundlovu District Municipality	Triandra School Geohydrological Investigation	2011
LL1831	Rand Water	Lesotho Schools Water Supply Project	2011
LL1796	Electric & Pump Services	Ozwatini Geohydrological Investigation	2011
LL1785	Nkangala District Municipality	Bulk Water Supply line & Elevated Storage Reservoir	2011
LL1784	Nkangala District Municipality	10 Ml Rietfontein Reservoir	2011
LL1782	Mhlathuze Water	Schools Sanitation & Water: SSP/B/16.2.2	2011-2012
LL1680	Umgeni Water	Glendale Heigths Water Development	2009-2011
LL1654	Msukaligwa Local Municipality	Geohydrological Investigation: Drilling of Boreholes in Msukaligwa Farm Areas Tender LM/186373/09/10	2009-2011
LL1603	Umgeni Water	Umgeni Schools Water Development Project	2008-2011
LL1546	Zululand District Municipality	Zululand Rudimentary	2008-2011
LL1499	Gert Sibande District Municipality	Contract GSDM76/2007 Rudimentary Water Supply	2008-2009

MAJUBA POWER STATION
Geohydrological Investigation of Witkoppies Landfill Site

Volume 2

Environmental Consultant:

savannah environmental
t: +27 (0)11 656 3237
f: +27 (0) 86 684 0547

Project No: LL3821

Date: June 2022

Client:

Eskom

MAJUBA POWER STATION
Geohydrological Investigation of Witkoppies Landfill Site

Fig: 2 Site Map

Legend

- Surface Water Sample Points
- Monitoring Borehole - 1
- Monitoring Borehole - 2
- Monitoring Borehole - 3
- Monitoring Borehole - 4
- Existing Landfill
- Alt A
- Alt B
- Cadastral
- Cross-section A - A'

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GIS Consultants:

GEO-DYNAMIC SYSTEMS
GIS & Remote Sensing Consultants

Project No: LL3821

Date: May 2022

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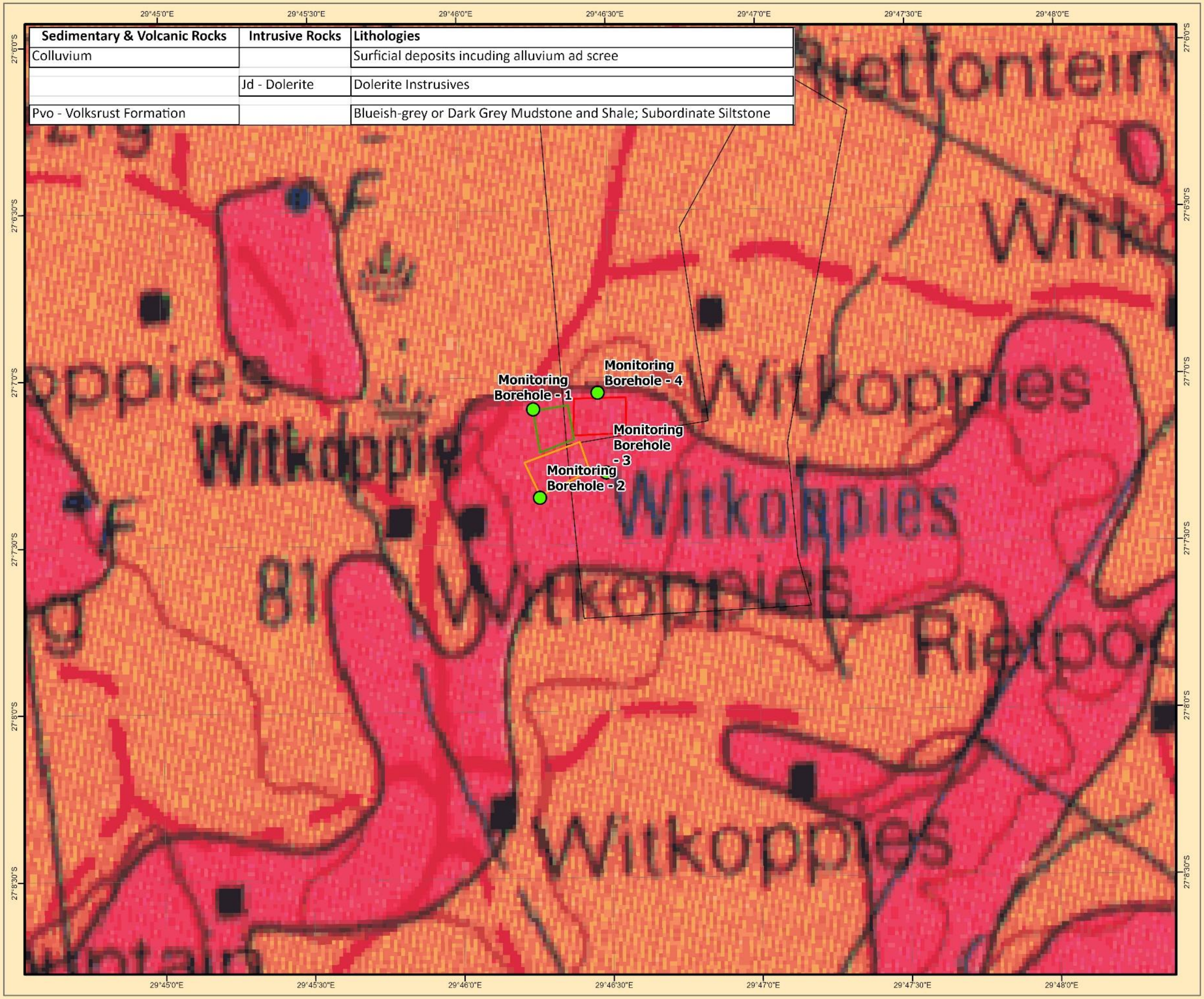

Sedimentary & Volcanic Rocks	Intrusive Rocks	Lithologies
Colluvium		Surficial deposits incuding alluvium ad scree
	Jd - Dolerite	Dolerite Instrusives
Pvo - Volksrust Formation		Blueish-grey or Dark Grey Mudstone and Shale; Subordinate Siltstone

Client:

Eskom

MAJUBA POWER STATION
Geohydrological Investigation
of Witkoppies Landfill Site

Fig: 3A Regional Geology

Legend

- Monitoring Borehole - 1
- Monitoring Borehole - 2
- Monitoring Borehole - 3
- Monitoring Borehole - 4

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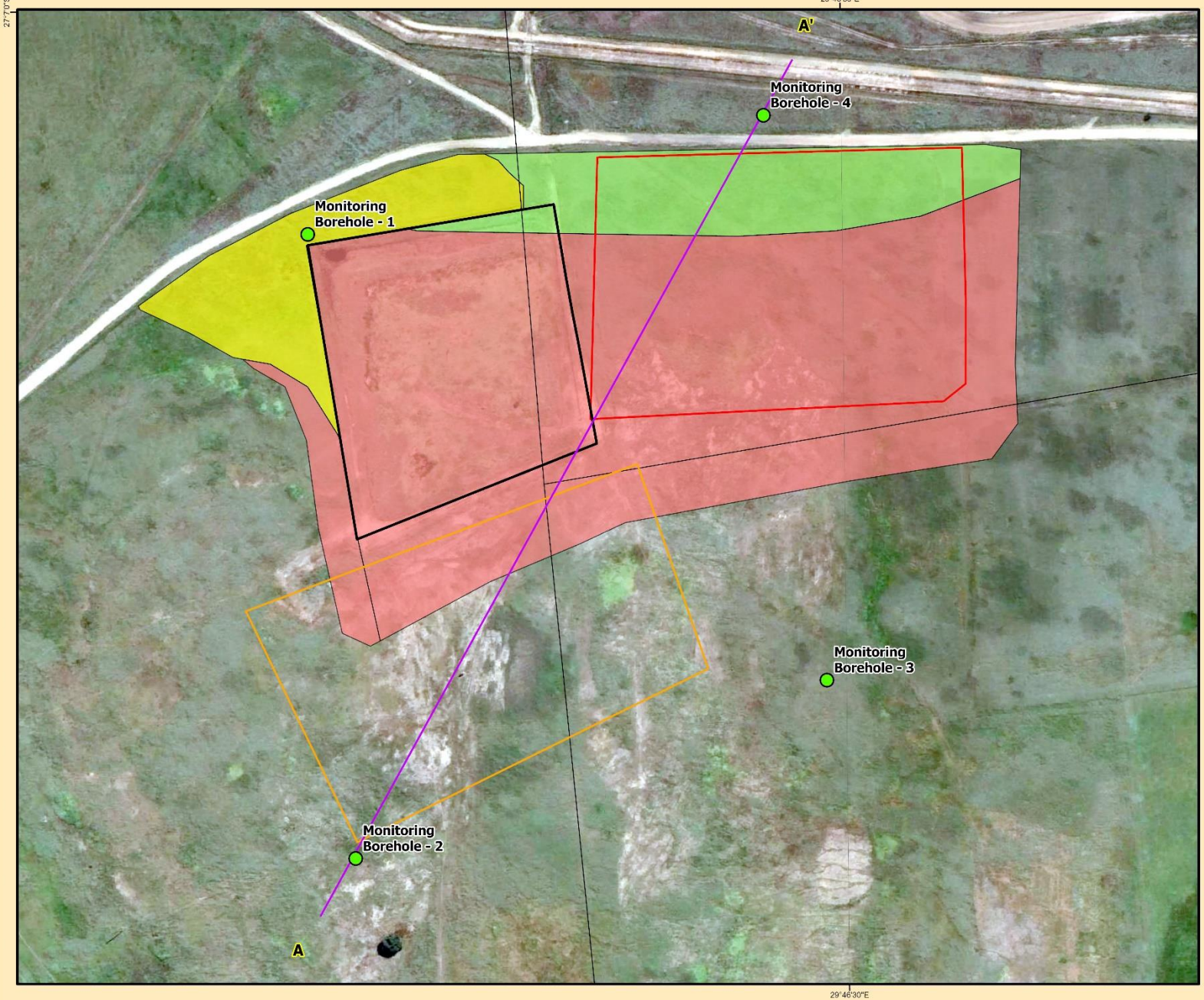

Client:

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Geohydrological Investigation of Witkoppies Landfill Site

Fig: 3B Local Geology

Legend

- Monitoring Borehole - 1
- Monitoring Borehole - 2
- Monitoring Borehole - 3
- Monitoring Borehole - 4
- Existing Landfill
- Alt A
- Alt B
- Cadastral
- Cross-section A - A'
- Clayey Alluvium
- Instrusive Doleriite
- Shale of the Volksrust Formation

Note:
Local geology inferred from Test Pits (2016) and Monitoring Boreholes (2022)

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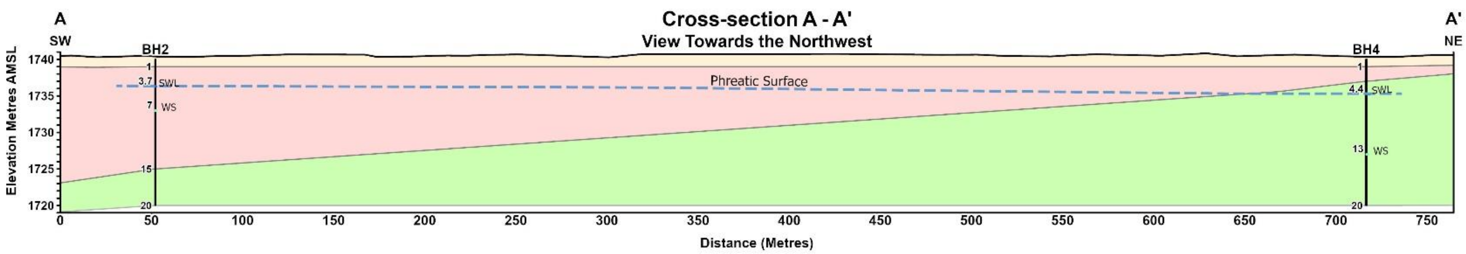

Vertical Exaggeration 4X

Client:

MAJUBA POWER STATION
Geohydrological Investigation
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Fig: 3C Cross-section A - A'

Legend

- Phreatic Surface
- Satic Water Level (SWL)
- Water Strike Depth (WS)

Geology

- Colluvium
- Dolerite
- Carbonaceous Shale

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Fig: 4 Surface Hydrology

Legend

- Existing Landfill
- Alt A
- Alt B
- Cadastral
- Dams
- Inferred Spring Lines with Estimated Elevations
- Drainage Direction
- Railway
- Springs
- Wetlands
- Eskom Overhead Powerline

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