



**Report on a Hydrogeological Assessment for the Proposed Wembezi PLS,
Portion 51 (of 7) of the Farm Kliplaat Drift No. 1009, Estcourt, KwaZulu-
Natal**

Project No.: 21-030R03 Rev 1

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TABLE OF CONTENTS

1.	INTRODUCTION AND TERMS OF REFERENCE	1
2.	INFORMATION	1
3.	SITE DESCRIPTION.....	1
4.	CLIMATE OF THE AREA.....	2
5.	GEOLOGY AND HYDROGEOLOGY OF THE SITE.....	3
5.1	Geology of the Site.....	3
6.	HYDROCENSUS	3
6.1	Open Water Bodies.....	3
6.2	Hydrocensus	3
7.	HYDROGEOLOGY AND AQUIFER CLASSIFICATION	4
8.	RISK ASSESSMENT: POTENTIAL CONTAMINATION BY WEMBEZI PLS DEVELOPMENT ON GROUNDWATER	4
8.1	Potential Risks of Contamination of Groundwater.....	4
8.1.1	<i>Onsite Sanitation</i>	4
8.1.2	<i>Hydrocarbon Contamination – Service Station site and Other Light Industrial Developments</i>	4
9.	MITIGATION OF CONTAMINATION RISKS	5
9.1	Onsite Sanitation.....	5
9.2	Hydrocarbon Contamination – Service Station site and Other Light Industrial Developments	5
10.	CONCLUSIONS.....	6

Appendix A : South Africa Water Standards - SANS 241: 2015
Appendix B : Specialist Declaration and Curriculum Vitae

Figures: 1 to 3

	PREPARED:	APPROVED:
DATE:	March 2022	March 2022
NAME:	Sven Richter	Mark Richter
SIGNATURE:		

Report on a Hydrogeological Assessment for the Proposed Wembezi PLS, Portion 51 (of 7) of the Farm Kliplaat Drift No. 1009, Estcourt, KwaZulu-Natal

1. INTRODUCTION AND TERMS OF REFERENCE

Gondwana Geo Solutions (GGS) were requested by Ms Mary Chettle, on behalf of Mr Greg Cryer, the appointed Project Manager to The Kliplaat Family Trust to provide a cost estimate to conduct a hydrogeological assessment for the proposed commercial development known as Wembezi PLS, located on Portion 51 (of 7) of the Farm Kliplaat Drift No. 1009, Estcourt, in KwaZulu-Natal. Mr Cryer instructed GGS to proceed with the work by accepting the quotation dated 8th August 2021.

This report comprises the hydrogeological assessment of the proposed commercial development of Wembezi PLS. It is based on a desktop study consisting of the review of available information as well as a site verification visit. The report which covers the following elements:

- Topographical setting of the area,
- Geology of the area,
- Aquifer classification,
- Geohydrology of the site,
- Hydrocensus of the area,
- Evaluation of potential impacts of shopping centre site on the groundwater
- Groundwater chemistry monitoring plan

2. INFORMATION

The desktop study involved the review of the following:

- Copy of report referenced 21-030R01, titled “*Report to Peter Jewell Consulting on a Preliminary Geotechnical Investigation carried out for the Proposed Wembezi PLS, Portion 51 (of 7) of the Farm Kliplaat Drift No.1009, Estcourt, KwaZulu-Natal*”, dated April 2021
- Review of the published 1:250 000 scale Geological Series map, 2928 Drakensburg, to determine the regional geology of the area;
- Review of the published 1: 500 000 Aquifer Classification of South Africa, published by the Department of Water Affairs, South Africa, to determine the regional hydrogeology of the area;
- Review of the published 1: 500 000 Aquifer Susceptibility Map of South Africa 2013, published by the Department of Water Affairs, South Africa, in 2012, to assess the susceptibility of the aquifer in the study region
- Review of Google Earth image of the site and surrounding area of the site;
- Access to the National Groundwater Database;
- Access to Southern African Development Community. Groundwater Information Portal: SADC Hydrogeological Mapping Project. Last updated 2010

3. SITE DESCRIPTION

A site walkover mapping assessment was conducted in March 2021. The locality of the proposed Wembezi PLS in relation to Wembezi town is shown in Figure 1 Site Plan.

The site, Portion 51 (of 7) of the Farm Kliplaat Drift No.1009, Estcourt, KwaZulu-Natal, is bounded to the immediate southwestern boundary to the crossroad which includes Ntabamhlope Road (P29) running along the south / southeast and the P179 road to the west / southwest.

At the time of the investigation the site comprised of a dense tree-line along the south to southeastern half of the site running parallel to the P29 road. Land used for the farming of crops were located along the remainder of the site, with cabbage farming located to the northeastern boundary.

Infrastructure comprising a small farm stall is located at the southwestern corner of the site, as well as an Eskom powerline which crosses through the site from the southwest to the northeast.

Topographically, the elevation of the site ranges from about 1299m on the southeast, to 1305m on the north, above mean sea level. There is a general fall in gradient of some 6m over the entire 20 Ha site and it can thus be categorised as flat to very gently sloping. The slope can be classified as planar.

No surface rock outcrop was noted on the site.



Plates 1 & 2: View of the site which is flat to gently sloping towards the northwest



Plate 3: View of the site at the adjacent to the road crossing in the southwest showing a flat gradient



Plate 4: Farming along the northeastern boundary of the site showing a flat gradient

4. CLIMATE OF THE AREA

Wembezi in the Estcourt region normally receives about 946mm of rain per year, with most rainfall occurring mainly during mid-summer. Rainfall is lowest (8mm) in June/July and highest (92mm) in December.

The average daily maximum temperatures for Wembezi range from 23°C in June/July to 28°C in January-March. The region is the coldest during June/July when the mercury drops to 4°C on average during the night.

5. GEOLOGY AND HYDROGEOLOGY OF THE SITE

5.1 Geology of the Site

The general geology of the Wembezi area as shown in Figure 1, inferred from the 1:250 000 geological map series Durban 2930 published by the Council for Geosciences. The area is mainly underlain by the interlayered shales, siltstones and sandstones of the Estcourt Formation of the Beaufort Group. Although not evident from Figure 1, the site could also possibly be locally intruded by intrusive dolerite of Jurassic age, being a fairly common feature in the region.

From a geotechnical investigation carried out by GGS earlier in 2021, the site is generally underlain by a mantle of transported and residual soils which overlie the weathered shale and subordinate, interlayered siltstone and sandstone beds that characterise the rocks of the Estcourt Formation. These rocks are generally flat bedded and seldom show dipping bedding planes more than about 5 degrees to the horizontal.

A surficial layer of transported colluvial or hillwash some 0.5 to 1.2m thick is expected across the site, underlain by residual soils. The residual soils are expected to generally comprise clayey sands to sandy clay (residual shale) through to silty sands (residual siltstone and sandstone), which grade fairly quickly into weathered bedrock.

Experience in this general area indicates that the bedrock is likely to be relatively shallow, in the range 1 to 2 metres, below existing ground level.

6. HYDROCENSUS

A hydrocensus was carried out on the property as well as the adjacent area to identify legitimate groundwater users, the groundwater potential and quality. The hydrocensus, based on information obtained from a variety of sources, including a visit to the site, was confined to an area within 500m of the site boundary and includes an assessment of all surface water bodies, as well as the nearby boreholes used for groundwater abstraction.

6.1 Open Water Bodies

The closest open water body in proximity to the site is an unnamed tributary of the Klein-Boesmansrivier which is located about 760m to the west of the site. There is no evidence of any drainage lines, surface water bodies or wetlands within the boundaries of the site itself.

6.2 Hydrocensus

A search through the Groundwater Information Portal GIS map for the area was carried out. This source identified three groundwater boreholes in the area located approximately within a 500m radius of the 20 Ha site. These boreholes were located about 50m (west), 150m (northeast) and 500m (north) of the site. The approximate positions these boreholes are shown on Figure 1.

Details of the borehole are presented in Table 1 below. No groundwater chemistry or water quality data was provided by this information source.

Table 1
Details of Groundwater Abstraction Boreholes within 500m of the proposed Wembezi PLS Site

National Borehole ID	SADC Borehole ID	Latitude (WGS 84)	Longitude (WGS 84)	Depth (mbgl)	Water Level (mbgl)	Discharge Rate (l/sec)	Pump Type	Elevation (mamsl)
2929BB00069	767633	-29.04188	29.79393	120.0	Unknown	Unknown	Blow	1289.0
2929BB00031	767600	-29.02618	29.81223	66.0	Unknown	Unknown	Blow	1283.0
2929BB00030	767599	-29.03338	29.79093	66.0	Unknown	Unknown	Blow	1257.0

While the above hydrocensus (Table 1) does not provide details of the groundwater levels, it is known from general experience in the area the exploitable groundwater aquifer occurs in the range 60 to 80m below existing ground level.

The general groundwater flow direction is to the southeast i.e general direction towards the low-lying area occupied by the Wagonsdrift Dam near Estcourt.

7. HYDROGEOLOGY AND AQUIFER CLASSIFICATION

Aquifers are classified in terms of their yield and their significance. According to the Regional Aquifer Classification Map of South Africa issued by the Department of Water Affairs, the general area within which the proposed Wembezi PLS site occurs is categorised as a Minor Aquifer System¹ (Figure 2) as well as a region containing surface water bodies. A minor aquifer system can occur with fractured or potentially fractured rocks which do not have a high primary permeability, or other formations of variable permeability. It is thus defined as an intergranular and fractured aquifer with very low to low development potential, with the occurrence of groundwater being more favourable at dolerite dyke intrusions in association with structural or tectonic faulting.

As a result, the aquifer potential is considered limited in extent and water quality likely to be variable. Although these aquifers seldom produce large quantities of water, they may provide important alternative sources of water for livestock, agriculture, and other usage.

Furthermore, the aquifer is classified in terms of the Susceptibility Matrix contained in the Regional Aquifer Susceptibility Map² as being of Low Vulnerability (Figure 3).

The general groundwater flow direction is to the southeast i.e. general direction towards the low-lying area occupied by the Wagonsdrift Dam near Estcourt.

8. RISK ASSESSMENT: POTENTIAL CONTAMINATION BY WEMBEZI PLS DEVELOPMENT ON GROUNDWATER

The site is considered suitable for the development of the Wembezi PLS from a hydrogeological perspective. Shopping centres in general have well designed stormwater management plans with large areas of hardened surfaces, and ingress of stormwater containing contaminants into the ground from the surface will be mitigated to a large degree.

8.1 Potential Risks of Contamination of Groundwater

8.1.1 Onsite Sanitation

There is of course the potential for contamination of the shallow groundwater arising from the use of onsite sanitation methods such as septic tank- soakaway systems.

The level of risk is assessed as being **low**.

8.1.2 Hydrocarbon Contamination – Service Station site and Other Light Industrial Developments

The proposed service station site forming part of the planned development will inevitably be designed along the international guidelines and specifications given by the fuel company responsible for the service station development. Such companies generally place high importance on maintaining “clean” sites in line with international practice and legislation. As fuel spills and underground tank leaks will inevitably occur over time, with resultant hydrocarbon contamination of the soil and shallow groundwater, a groundwater monitoring plan specific to the service station is recommended.

The level of risk is assessed as being **medium to high**.

¹ Aquifer Classification of South Africa. Department of Water Affairs 2012

² Aquifer Susceptibility of South Africa 2013, published by the Department of Water Affairs, South Africa

9. MITIGATION OF CONTAMINATION RISKS

9.1 Onsite Sanitation

Provided the design and construction of onsite sewage disposal systems is carried in accordance with the Local Authority guidelines and the SANS 10400 building regulations the associated risks of contamination will be low. Where these systems are not viable because of space constraints (i.e. limited evapotranspiration area available) or unsuitable soils (i.e. very poor percolation rates), shallow bedrock or shallow groundwater levels, then patented package plant systems will need to be considered for onsite sewage disposal.

9.2 Hydrocarbon Contamination – Service Station site and Other Light Industrial Developments

A ground water monitoring plan is recommended for all development phases of the site to assess the potential for shallow groundwater contamination associated with the shopping centre development, service station and light industrial development over time. In this way the risk can be mitigated by reviewing periodic monitoring data to establish potential contamination of the groundwater.

A ground water plan for sampling the groundwater in the general Wembezi area to assess the general quality in terms of potable or drinking or potable water in terms of SAN241-2015 is provided.

The service station site forming part of the planned development will, however, require a more specific groundwater monitoring plan relating to hydrocarbon contamination.

The groundwater quality should be monitored by sampling the following monitoring points:

- Existing three groundwater boreholes located between 50 and 500m to the west, northwest and northeast of the site, respectively, and
- Specific shallow groundwater monitoring piezometer standpipes which should be installed to cover relatively high-risk areas of anticipated contamination. The locations of these will be decided upon by the groundwater specialist appointed for this work

The groundwater monitoring programme should incorporate the following:

- Baseline monitoring - A once-off event to establish the background or ambient groundwater quality prior to the development of the site
- Long term monitoring - Periodic sampling events over the life of the development to establish the presence of contamination and the rate of increase of any contamination trends beneath the ground

Details of the groundwater monitoring plan are provided in Table 2 below:

Table 2
Recommended Monitoring of Groundwater Boreholes

Sampling	Frequency	List Of Determinants
General Shopping Centre Area		
Baseline Sampling:	All groundwater boreholes in the area and purpose installed groundwater monitoring piezometers or standpipes to be sampled and tested to establish background groundwater quality	Potable Water Quality - SANS 241: 2015 (for determinants see Appendix A)
Long-term monitoring	Six monthly – may be reduced to annual monitoring if stable groundwater chemistry and quality are proven	
Service Station Site		
Baseline Sampling	All groundwater boreholes in the area and purpose installed groundwater monitoring piezometers or standpipes to be sampled and tested to establish background groundwater quality	Hydrocarbons – As required by Fuel Company (owner / manager of facility or supplier of fuel and oil products).
Long-term monitoring	Six monthly (or as required by the Fuel Company's protocols)	Typica determinants could include: Paraffins, naphthalenes, alkylbenzenes; alkanes; alkenes isoalkanes; cycloalkanes; and cycloalkenes

10. CONCLUSIONS

This report contains the results of geohydrological assessment carried out for the proposed 20Ha Wembezi PLS in Wembezi, KwaZulu-Natal.

The site is underlain by the siltstones, shales and sandstones of the Estcourt Formation of the Beaufort Group.

The general area falls into the regional zone categorised as a Minor Aquifer with low yield potential and of Low Vulnerability.

The hydrocensus survey reveals that the closest open water body is the unnamed tributary of the Klein-Boesmansrivier some 760m to the west of the site. To the best of knowledge three groundwater boreholes are located around the proposed area of development: the location of these being about 50m (west), 150m (northeast) and 500m (north) of the site.

While the above hydrocensus does not provide details of the groundwater levels, it is known from general experience in the area the exploitable groundwater aquifer occurs in the range 60 to 80m below existing ground level.

The general groundwater flow direction is to the southeast i.e. general direction towards the low-lying area occupied by the Wagonsdrift Dam near Estcourt.

Contamination of the shallow groundwater by the shopping centre site is generally considered low risk provided the stormwater management plan and the use of onsite sanitation disposal systems are properly designed and managed in accordance with the Local Authority's requirements and SANS10400 building regulations. Recommended groundwater monitoring guidelines are given for the general shopping centre area.

The service station site has a much higher degree of risk of contamination, being hydrocarbons from fuel spillages and leaking underground fuel tanks which can arise from poor housekeeping practice over time. The service station site will thus need to have a stricter monitoring regime. Fortunately, this aspect is likely to be enforced by the fuel company either as owner / manager or supplier of fuel to the facility in accordance with international standards and practice. Suggested shallow groundwater monitoring guidelines are provided.

APPENDIX A

SOUTH AFRICAN NATIONAL STANDARD
Drinking water (SANS 241 :2015)

Parameter	Unit	Risk	Standard limit
pH at 25 ° C	pH Unit	Operational	$\geq 5.0 - \leq 9.7$
Conductivity at 25 ° C	mS/m	Aesthetic	170
Turbidity	NTU	Operational Aesthetic	1 5
Free Chlorine	mg/L	Chronic Health	5
Colour	mg/L	Aesthetic	15
Calcium as Ca	mg/L	Aesthetic/Operational	150
Magnesium as Mg	mg/L	Aesthetic/Health	70
Sodium as Na	mg/L	Aesthetic	200
Potassium as K	mg/L	Operational / Health	50
Zinc as Zn	mg/L	Aesthetic	5
Chloride as Cl	mg/L	Aesthetic	300
Fluoride as F	mg/L	Chronic Health	1.5
Sulphate as SO ₄ ²⁻	mg/L	Acute Health Chemical Aesthetic	500 250
Total Dissolved Solids	mg/L	Aesthetic	1,200
Nitrate and Nitrite Nitrogen as N	mg/L	Acute Health Chemical	12
Ammonia Nitrogen as N	mg/L	Aesthetic	1.5
Iron as Fe	µg/L	Chronic Health Aesthetic	2,000 300
Manganese as Mn	µg/L	Chronic Health Aesthetic	400 100
Aluminium as Al	µg/L	Operational	300
Total Coliforms count	cfu/100mL	Operational	10
E.Coli (<1 taken as 0)	cfu/100mL	Acute Health Micro	0
Heterotrophic Plate Count	cfu/ mL	Operational	1,000
Cytopathogenic Viruses	cfu/10 L	Acute Health Micro	0
Cryptosporidium Species	cfu/10 L	Acute Health Micro	0
Gardia Species	cfu/10 L	Acute Health Micro	0
Chloroform	mg/L	Chronic Health	0.3
Bromodichloromethane	mg/L	Chronic Health	0.06
Dibromochloromethane	mg/L	Chronic Health	0.1
Bromoform	mg/L	Chronic Health	0.1
Combined Trihalomethanes	mg/L	Chronic Health	1
Phenols	µg/L	Aesthetic	10
Nitrate as N	mg/L	Acute Health Chemical	11
Nitrite as N	mg/L	Acute Health Chemical	0.9
Antimony as Sb	µg/L	Chronic Health	20
Arsenic as As	µg/L	Chronic Health	10
Cadmium as Cd	µg/L	Chronic Health	3
Chromium as Cr	µg/L	Chronic Health	50
Cobalt as Co	µg/L	Chronic Health	500
Copper as Cu	µg/L	Chronic Health	2,000
Lead as Pb	µg/L	Chronic Health	10
Mercury as Hg	µg/L	Chronic Health	6
Nickel as Ni	µg/L	Chronic Health	70
Selenium as Se	µg/L	Chronic Health	40
Vanadium as V	µg/L	Chronic Health	200
Cyanide	µg/L	Acute Health Chemical	200
Total Organic Carbon as C	mg/L	Chronic Health	10

APPENDIX B

DECLARATION OF INTEREST BY SPECIALIST



KWAZULU-NATAL PROVINCE
ECONOMIC DEVELOPMENT, TOURISM
AND ENVIRONMENTAL AFFAIRS
REPUBLIC OF SOUTH AFRICA

Provincial Reference Number:	(For official use only)
NEAS Reference Number:	KZN / EIA /
Waste Management Licence Number (if applicable):	
Date Received by Department:	

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

Submitted in terms of section 24(2) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or for a waste management licence in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).

KINDLY NOTE:

1. This form is current as of May 2021. It is the responsibility of the Applicant / Environmental Assessment Practitioner ("EAP") to ascertain whether subsequent versions of the form have been released by the Department.

PROJECT TITLE

Wembezi JunXion Commercial Development

DISTRICT MUNICIPALITY:

uThukela District Municipality

1. SPECIALIST INFORMATION

Specialist name:	Gondwana Geo Solutions (Pty) Ltd		
Contact person:	Mark Richter		
Postal address:	4 Haven Road, Westville, Durban		
Postal code:	3629	Cell:	083 461 6194
Telephone:	VOIP line 087-8050530	Fax:	
E-mail:	mark@ggsgeotec.co.za		
Professional affiliation(s) (if any)	SACNASP, MSAIEG		

Department of Economic Development, Tourism & Environmental Affairs, KwaZulu-Natal	Details of the Specialist and Declaration of Interest	May 2021 V1
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DECLARATION OF INTEREST BY SPECIALIST

Project Consultant / EAP:	Metamorphosis Environmental Consultants		
Contact person:	Ms Vicki King		
Postal address:	P. O. Box 2116, Link Hills		
Postal code:	3625	Cell:	076 420 1441
Telephone:	031 – 756 7554	Fax:	
E-mail:	Vicki@metamorphosisdbn.co.za		
Professional affiliation(s) (if any)	IAIAsa, Reg EAP (EASPAPA), IWM, ELA		

2. DECLARATION BY THE SPECIALIST

I, Mark Vincent Richter

General declaration:

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



Signature of the specialist:

GONDWANA GEO SOLUTIONS (PTY) LTD

Name of company:

4 March 2022

Date:

Department of Economic Development, Tourism & Environmental Affairs, KwaZulu-Natal	Details of the Specialist and Declaration of Interest	May 2021 V1
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CURRICULUM VITAE

Mark Vincent Richter

POSITION

Managing Director

NATIONALITY

South African

CONTACT DETAILS

Email: mark@ggsgeotec.co.za
Tel: 083 461 6194

**SUMMARY OF COMPETENCE AND EXPERIENCE**

Mark Richter is an Engineering Geologist with 40 years' experience in Geotechnical Engineering Consulting and Engineering Geology. His experience ranges from numerous housing, building and infrastructure development projects in South Africa to internationally funded (World Bank, African Development Bank; USAID) road, rail and infrastructure related projects in Swaziland, Lesotho, Malawi, Mozambique, Botswana, Zambia, Zimbabwe, Congo, Kenya, Southern Sudan, Nigeria, Ethiopia, Gambia, Gabon, Madagascar, Uganda and Tanzania. Speciality work includes geotechnical investigations and related design work for housing developments, high-rise buildings, harbours and offshore construction works, airports, roads, railways, tunnels, LNG processing facilities, water supply infrastructure and dams, green or renewable energy projects (wind and sun powered), agricultural (sugarcane) projects, fuel powered generation plants and powerlines.

PROJECT EXPERIENCE:

A selection of noteworthy projects completed are as follows:

Green or Renewable Energy Projects

- Geotechnical investigation for Oya Hybrid Energy Project at Touws River: this project comprised 324Ha of PV power plant area, diesel generator facility, substation and BESS unit, fifteen Wind Turbine Generators (WTG). The geotechnical investigation comprised test pitting using an excavator, Earth Resistivity Testing, and laboratory testing for the PV area; drilling of geotechnical boreholes was carried out at all WTG positions to assess founding conditions. Client Raubex Infra/ G7 Renewable Energy. 2021
- Geotechnical evaluation and reviews: crane pad foundation design, access road and hard standing for mast and blades for Copperton Windfarm Project – Prieska. 2019. Client Raubex / iX Engineers
- Geotechnical investigation for proposed Kleinzee Windfarm comprising site review mapping, drilling, pitting Client: Groundwater Consulting Services. 2020
- Verification of founding conditions for 26No windfarm masts – Loeriesfontein Windfarm, Northern Cape.. Client WorleyParsons. 2016/8

Sugarcane and Sugar-Fuels Projects

- Geotechnical investigation for the Feasibility Study for the proposed Kabalo Sugar Project at Kabalo, in south-central Democratic Republic of Congo (DRC). Preliminary evaluation of foundations for mill & factory building, housing estate. Materials investigations (crushed stone and gravel sources). 2018 Client: Bosch Projects
- Geotechnical investigation for the Feasibility Study for the proposed Humbe Sugar Estate near Cunene in southern Angola. Drilling for pumpstation foundations on the Cunene River. Foundation investigations for mill & factory building, housing estate. Materials investigations (crushed stone and gravel sources) for roads, balancing dams . 2013. Bosch Projects
- Geotechnical investigation for the Feasibility Study for the proposed Dombe sugar estate near Inchope in central Mozambique. Foundation investigations for mill & factory building, housing estate; River Intake towers. Materials investigations (crushed stone and gravel sources). 2007/8 Bosch Projects

Dams and Related Projects

- Augmented Geotechnical Investigation for proposed pumped-storage 23.5m high earth embankment reservoir, Waverenskroon Dam, Tulbagh. Initial site investigation evaluating geological and geotechnical information, laboratory testing, submission of geotechnical report to client SSI in 2012. Subsequent follow up providing design slopes, foundation grouting design and supervision services: 2021/22. Current appointment. Client: iX Engineers
- Geotechnical Investigation for proposed Farm Dam (Category 1) at Korhaan Hill, Empangeni. Site investigation evaluating geological and geotechnical current appointment. Client: McIlrath & Sons Farming
- Preliminary Geotechnical Assessment for the proposed Vreede Dam (15m earth embankment) in Newcastle, KZN. Site appraisal and review of geological and geotechnical information, submission of feasibility report to client. 2020. Client: BJFC
- Geotechnical investigations (Phases 1 & 2) carried out for the Proposed New Pentlands Dam, Empangeni, KZN. Search for Dam Construction Material. Investigation of dam foundations, drilling of boreholes and insitu packer testing. Laboratory testing. Analysis of dam stability conditions. Report on borrow materials, dam foundations, dam wall stability analyses and dam foundations. Client: Mr Dave Bell of Pylon Park, Empangeni, KZN. 2019/20
- Geotechnical investigation to evaluate the feasibility of refilling Dam A at De Zalze Winelands Golf Estate in Stellenbosch, Western Cape. Carry out test pitting, boreholes and installation of piezometers. Seepage analysis. Analysis of dam stability conditions. Report on feasibility of re-filling dam. Home Owners Association of De Zalze Winelands Golf Estate. 2019
- Geotechnical investigation for the proposed storage dam and head race tunnel for the Pavua Hydro-Electric Power Scheme near Inchope in central Mozambique. Drilling of geotechnical boreholes, geophysics, test pitting, insitu testing, rock and gravel quarry evaluation. Report on fieldwork. 2017. (Client: Electra/ MWH Engineers UK)
- Geotechnical investigations for the proposed storage dam and headrace tunnel for the proposed Hydro-Electric Power Scheme at Mpatamanga (central Malawi) and Lower Fufu (northern Malawi). Drilling of geotechnical boreholes, geophysics, test pitting, insitu testing, rock and gravel quarry evaluation. Report on fieldwork. (World Bank Project). 2016
- Geotechnical investigation for the proposed storage dam and headrace tunnel for the Hydro-Electric Power Scheme at Batoka Gorge on the Zambezi River between Zambia and Zimbabwe. Drilling of geotechnical boreholes, geophysics, test pitting, insitu testing, rock and gravel quarry evaluation. Report on fieldwork. (World Bank Project). 2016
- Geotechnical investigations for the storage dam and headrace tunnel for the proposed Hydro-Electric Power Scheme on the Kagera River at Kakono in northwest Tanzania (Client: Norconsult) 2015
- Evaluation of geotechnical issues for Dam Safety Inspection for two large dams, Tiga Dam and Challawa Gorge Dam, part of the Hadejia-Jam'are Komododugu Yobe (HJKY) Basin near Kano, north-central Nigeria in 2015 (client: Royal Haskoning DHV):

- Evaluate effect of blasting on excavation for new hydro-electric turbine tailrace tunnel at base of existing dam wall – Tiga Dam. Conduct inspections of box cutting and lateral support proposed by contractor. Conduct stability check on downstream wall embankment.
- Conduct stability checks on dam wall – Challawa Gorge Dam. Evaluate causes of erosion and beaching adjacent to upstream wall.
- Geotechnical investigation for proposed Concordia Dam – Knysna. Carry out drilling investigation to evaluate founding conditions of 40m high earthwall dam. Report on suitability of dam site and engineering construction requirements. 2014 (Client: WorleyParsons).
- Geotechnical investigation for the new Shire Barrage structure at Liwonde – Norconsult (World Bank project/Norway).2014
- Geotechnical investigation, design of geotechnical issues and supervision of Mvutshane Dam (25m high earthwall off-channel storage dam) for Umgeni Water in Maphumulo, central KZN (2012 - 2014). Client MBB Engineers
- Geotechnical investigation and design of lateral support measures to unstable rock cuttings above the Headrace Canal for the Neusberg Hydro-Electric Power Scheme at Kakamas in the Northern Cape, RSA. 2014. (Client: Pennyfarthing Geotechnical Contractors
- Geotechnical investigation for Barrage over Shire River for Augmentation of the Upper Shire Hydro-Electric Project, Liwonde, Republic of Malawi – Norconsult (World Bank project/Sweden). Investigations for borrow areas, drilling of boreholes for position of new barrage structure. 2011
- Geotechnical investigation for proposed new Tulbagh Dam (Waverenskloof Dam) at Tulbagh, Western Cape. Investigations for borrow areas, test pitting, drilling of boreholes and insitu Lugeon testing. Carry out dam stability evaluation and breach analysis. Client SSI Engineers. 2011.
- Barrage over Shire River for Augmentation of the Upper Shire Hydro-Electric Project, Liwonde, Republic of Malawi – Norconsult (World Bank project/Sweden). Investigations for borrow areas, drilling of boreholes for position of new barrage structure. 2011
- Geotechnical investigations for the canals, holding dams and power station buildings. Augmentation of the Upper Shire Hydro-Electric Power Supply Scheme. 2009

Powerlines, Substations, etc

- Geotechnical investigation for mast foundations for 132kV line between Dieprivier and Kareedouw, Eastern Cape. Conduct foundation investigations and provide recommendations for the founding of masts and associated anchors. Trans-Africa Projects. 2017
- Geotechnical investigation for mast foundations for 132kV line between Hotazel and Eldoret, Northwest Cape. Conduct foundation investigations and provide recommendations for the founding of masts and associated anchors. CVG Engineers. 2017
- Geotechnical Investigation for the Upgrading and Refurbishment of the Ulco-Holsdam 132kV Powerline in the Kimberley District, Northern Cape. CVG Engineers.2017
- Geotechnical investigation for 142 mast foundations for 66kVa line between Elliot and Cala, Eastern Cape. Conduct foundation investigations and provide recommendations for the founding of masts and associated anchors. 2000
- Carry out feasibility study for 400kV line 540km in length between Vredendal and Oranjemund (Namibian border). Airphoto interpretation, review of available information and terrain mapping.2010
- Geotechnical investigation for mast foundations for 132kV line between Grassridge and Melkhout (120 kms) in Eastern Cape. Conduct foundation investigations and provide recommendations for the founding of masts and associated anchors.2012
- Geotechnical investigation for mast foundations for various 110kV lines in Maputo, Mozambique. Conduct foundation investigations and provide recommendations for the founding of masts and associated anchors. 2012
- Geotechnical investigation for 190 mast foundations for the 110kV line between Mopeia and Caia, Sofala Province Central Mozambique. Conduct foundation investigations and provide recommendations for the founding of masts and associated anchors.

- Geotechnical investigation conducted specifically for three mast foundations for 110kV line between Mopeia and Caia crossing over the Zambezi River Sofala Province Central Mozambique. 2002

Gas and Oil Pipelines and Related Infrastructure

- Geotechnical investigations for access roads, airstrip and pioneer camp laydown areas for Anadarko Area 1 (Cabo Delgado Province). Provision of QA/QC laboratory for site improvement contracts and offshore marine sediment sample testing. Provision of onsite construction management personnel. Client: WorleyParsons SA, principal client Anadarko. 2012
- Supervision of Onshore Geotechnical investigations for Afungi site area: Anadarko Area 1 (Cabo Delgado Province). Provision of supervision staff, interpretation of fieldwork and laboratory results, provision of factual and interpretive reports. Client INTECSEA (principal client Anadarko) 2011
- Geotechnical Investigation for the road, river and rail crossing locations of Nation Multi-Product Pipeline between Umlaas Road and Jamestown (450km). 2008
- Investigation of gas pipeline line (600km) between Temane and RSA. Geotechnical investigation for Gas Platform, Drilling Wells. Stability investigation of dolomite/limestone sinkholes. General materials and hard rock quarry investigation. 2005
- Geotechnical investigation for upgrade of Multi-Product Pipeline for CPMZ (Mozambique), between Beira and Zimbabwe. 2009
- Geotechnical Investigation for the ROMPCO gas transfer loop line Temane (Mozambique) and Secunda (South Africa). 2014
- Geotechnical investigation for Gas Power Plant FEED MEGPP for Sasol in Ressano Garcia, Southern Mozambique. Evaluation of founding conditions, earthworks resistivity profile, groundwater supply boreholes and materials. 2012 Client: Warstila.
- Preliminary Geotechnical investigation for Gas Power Plant for GigaWatt in Ressano Garcia, Southern Mozambique. Evaluation of founding conditions, earthworks resistivity profile and materials. 2011. Client: WorleyParsons.
- Gas Pipeline and Natural Gas Extraction Plant, Pande/Temane Gas Fields, Mozambique Investigation of line (600km) between Temane and RSA. Geotechnical investigation for Gas Platform, Drilling Wells. Stability investigation of dolomite/limestone sinkholes. General materials and hard rock quarry investigation. 2004.
- Geotechnical investigations for buried and submerged gas pipeline reticulation connecting Temane Gas Field with Bazaruto Island group. Client: WK Construceous Lda. 2004
- Geotechnical investigation for upgrade of Multi-Product Pipeline for CPMZ, between Beira and Zimbabwe. 2008. Client: CPMZ, Mozambique
- Geotechnical investigation work for the ROMPCO loop line upgrade of 100km of the LNG 600mm diameter pipeline between Temane Gas field and Ressano Garcia. 2014 Client; WorleyParsons

Tunnels

- Provision of geotechnical services for Gautrain South section of the Gautrain Rail project as part of DGS drilling consortium to client Bombela Consortium Joint Venture. 2009/2010
- Geotechnical investigation for proposed new 7 km tunnel section of railway line through mountain area in Southern Malawi: Moatize to Port Nacala Coal Line. 2006
- Geotechnical investigation, and preliminary design, for proposed Howick Raw Water Transfer Tunnel, Howick, Kwazulu-Natal. 2000
- Provide geotechnical services to the Durban Harbour Tunnel Consortium under lead contracting firm Hochtief in respect of contractual claim issues

Railways

- Geotechnical investigation and design work for construction of rail spur, Richard Bay Port area – Thomson & van Eck. Design of high cutting and stability evaluation of cut slopes with dewatering measures.
- Geotechnical investigation for new and rehab lines for the Moatize to Port Nacala Coal line. Investigation of line route, subgrade evaluation, bridge foundations and high fills and cuttings.
- Geotechnical investigation for proposed new 7 km tunnel section of railway line through mountain area in Southern Malawi: Moatize to Port Nacala Coal line
- Geotechnical investigation, monitoring and design of remedial measure for settlement problems with iron ore carriage tippler at Saldanah, South African Ports Authority
- Geotechnical investigation for proposed new Tippler Unit , monitoring and design of remedial measure for settlement problems with iron ore carriage tippler at Saldanah, South African Ports Authority
- Repairs/upgrade to flood damaged Limpopo Rail Link, Maputo to Limpopo River (225km) Mozambique – WK Construction (main client USAID). Total length 225 km. Conduct structural inventory of drainage projects, carry out underwater inspections of flood and mine damaged structures. Location of borrow areas and hard rock quarries for ballast supply. Materials evaluation for rail line layerworks.
- Provision of laboratory contracts for acceptance and process control of rail rehabilitation project. Limpopo Rail Link, Maputo to Limpopo River (225km). 2002/3. WK Construceous Lda (principal client USAID).
- Geotechnical Investigation for the BFS (2006), FEL1& FEL2 (2009), FEL3 (2009) and FEL4 (2011) stages of the new Coal Line between Moatize and Nacala Port in Mozambique, passing through southeastern Malawi (total length 980 km). Investigation of new and rehabilitation lines. Investigation of bridges, cuttings, materials and subgrade support. Provision of geological teams, logging, sampling and reporting.
- Preliminary geotechnical evaluation of Proposed Chingola-Solwezi-Lumwana Freight Rail Link (Zambia) 2015
- BFS geotechnical investigation for Ncondezi Rail spur amd Mine layout, Ncondezi, near Moatize, central Mozambique. Client: WSP/ Ncondezi
- BFS Phase 1 Geotechnical investigation for the ENRC Rail Line from Tete to Nacala. Supervision of drilling works off a jackup barge. 2012. Client: Geomechanics/ Mott Macdonald
- Geotechnical investigation for the ENRC Coal Conveyor Line between Moatize and Tete, including Conveyor Bridge over Zambezi River. Investigation of conveyor centreline and drilling from floating barge on river to confirm founding for breide piers in river. 2012 (August). Client: RMCE, principal client ENRC

Marine and Harbours

- Evaluation of stability and integrity of piers : strike craft berth in military harbour on Salisbury Island, Durban. Underwater inspection, review of as-built drawings and remedial solutions.
- Durban Harbour: various design input for piled foundations for different phases of Floating dry dock, and associated jetty dolphins.
- Richards Bay Harbour: investigations for the design of piles and caissons for harbour wall construction.
- Geotechnical investigation and geotechnical services to Transnet for Pier 1 and Pier 2 of the proposed Durban Harbour Berth Deepening Feasibility Study – 2008
- Evaluation of integrity of pier and jetty structures at Namibe Harbour, Angola. Underwater inspection, materials evaluation and remedial solutions.
- BFS Offshore Phase 1 Geotechnical investigation for Nacala Port development for the ENRC Rail Line from Tete to Nacala, Central Mozambique. Supervision of drilling works off a jackup barge. 2012. Client: Geomechanics/ Mott Macdonald

- Geotechnical investigation for Nacala Port development for the Nacala Rail Corridor project. Supervision of drilling works off a jackup barge. 2010. Client: Ausenco Sandwell
- Core logging and drilling supervision for the Beira Coal Terminal expansion project, Beira Port, 2010.
- Geotechnical and Materials investigation for Phase 1 and Phase 2 : Prawn Farm at Mocimbo do Praia, Pemba (Cabo del Gado Province). Client: Indian Ocean Aquaculture (2005)
- Preliminary Geotechnical and Materials investigation for Prawn Farm at Mecufi, Pemba (Cabo del Gado Province). Client: Indian Ocean Aquaculture (2006)
- Geotechnical and Materials investigation for Prawn Farm at Quelimane Harbour (2006). Client: Aqua Pesca Limitada.
- Evaluation of founding conditions for new Quay wall, Beira Nave Harbour. Client: Frankpile Mozambique.
- Investigation and design of new floating small craft Jetty for Indigo Bay, Benguerra Island, Bazaruto Archipelago. Client: Wk Construceous Lda
- Assessment of vessel impact damage and design of repairs to existing quay wall structures – Maputo Harbour. Client: WK Construceous Lda

Airports, Airfields and Aerodromes

- Geotechnical investigation for Runway Extension : PE Airport (ACSA). 2005
- Materials and foundations investigations for new landing pad and Hangar for heli-pad at South African Air Force base (Durban International Airport) Pavement evaluation of existing runway at Margate Airport, Natal south coast, Kwazulu-Natal. 2000
- Evaluation of subgrade conditions for private airfield at Kashobwe Village near Lake Mweru, Democratic Republic of Congo. Review of existing pavement design. Evaluation of runway requirements. 2000.
- Investigation and design of remedial measures to existing runways : Buenguerra Airfield, Indigo Airfield (Bazaruto Archipelago), Mozambique.

Municipal Infrastructure: Sewerage Treatment Works, Water Treatment Plants, Pipelines and Reservoirs

- **Mobeni Reservoir, City of Durban- Evaluation of Causes of Failure:** Appointed in 2019 to evaluate causes of cracking / failure of the Mobeni Reservoir. Client: Ethekeeni Water & Waste
- **New Raw Water Extraction Pumpstation on Umzimkulu River – Umzimkulu, KZN.** Carry out geotechnical investigation for new pumpstation. Drilling of boreholes. Submit geotechnical report giving recommendations for excavations, lateral support and dewatering. Design of lateral support measures, 2018 Client: MBB Engineers Pmb
- **New Phillipi Pipeline – Cape Flats.** Investigate 2.44km of pipeline. Test pitting, penetrometer testing and laboratory testing. Preparation of geotechnical report giving results of investigation and recommendations for earthworks, foundations, excavations, materials usage and subgrade preparation. 2017. Client: iX Engineers.
- **Port Desalination Plant and Associated Pipelines - Paarden Island.** Carry out Phase 1 geotechnical investigation. Test pitting, penetrometer testing and laboratory testing. Preparation of geotechnical report giving results of investigation and recommendations for earthworks, foundations, excavations, materials usage and subgrade preparation. 2017. Client: iX Engineers
- **Koeberg Desalination Plant and Associated Pipelines.** Carry out Phase 1 geotechnical investigation. Test pitting, penetrometer testing and laboratory testing. Preparation of geotechnical report giving results of investigation and recommendations for earthworks, foundations, excavations, materials usage and subgrade preparation. 2017. Client: iX Engineers.
- **Gordons Bay Reservoir.** Carry out and supervise test pitting, penetrometer testing and laboratory testing. Preparation of geotechnical report giving results of investigation and recommendations for earthworks, foundations, excavations, materials usage and subgrade preparation. 2017. Client: iX Engineers

- **Stellenbosch, Besaanskop and Veldrif, Reservoirs.** Designing the geotechnical investigations, siting trial holes, logging and sampling trial holes. Laboratory test results analysis and report writing with recommendations for the reservoir construction, and foundations. 2016 Client Worley Parsons
- **Stanford and Wellington WTW.** Designing the geotechnical investigations, siting trial holes, logging and sampling trial holes. Laboratory test results analysis and report writing with recommendations for the pipeline construction, and WTW foundations. 2016 Client Worley Parsons
- **GB2 Reservoir, Nongoma, Zululand.** Carry out geotechnical investigation for GB2 reservoir near Nongoma. Evaluation of general site stability. Inspection foundations and confirm depth of foundation. 2018 Client: Isimo Engineers.
- **Reservoirs 3-3 and 3-4, Umlalazi Municipality.** Carry out geotechnical investigation for reservoirs near Eshow, Zululand. Evaluation of general site stability. Submission of geotechnical report with foundation recommendations. 2019 Client: BJFC Engineers.
- **New Sewage Treatment Plant – Umzimkulu, KZN**
Carry out geotechnical investigation for underground treatment plant. Drilling of boreholes. Submit geotechnical report giving recommendations for excavations, lateral support and dewatering. Design of lateral support measures. 2015 Client: Loyiso Toyi Consulting Engineers

Cemetery and Burial Sites

- Detailed Geotechnical Investigation for Proposed Cato Ridge Cemetery (75Ha) 2020. Client: The Nile Trust. Mapping, test pitting, dynamic cone penetrometer tests, insitu permeability testing and laboratory testing. Submission of report giving findings and recommendations for development. Scoring of cemetery site attributes against recommended industry criteria
- Detailed Geotechnical Investigation for Proposed Gingindlovu Cemetery (10Ha) 2018. Client: Department of Works, Kwazulu-Natal. Mapping, test pitting, dynamic cone penetrometer tests, insitu permeability testing and laboratory testing. Submission of report giving findings and recommendations for development. Scoring of cemetery site attributes against recommended industry criteria
- **Cemetery Investigation | Louws Bos South site: Stellenbosch. | CK Rumboll Town Planners & Environmental Consultants | 2018**
Designing the geotechnical investigations, siting trial holes, logging and sampling trial holes. Dynamic Cone Penetrometer testing. Laboratory test results analysis and report writing with recommendations for the cemetery site.
- **Cemetery Investigation | Louws Bos site: Stellenbosch| CK Rumboll Town Planners & Environmental Consultants | 2018**
Designing the geotechnical investigations, siting trial holes, logging and sampling trial holes. Dynamic Cone Penetrometer testing. Laboratory test results analysis and report writing with recommendations for the cemetery site.
- **Cemetery Investigation | Calcutta site: Stellenbosch| CK Rumboll Town Planners & Environmental Consultants | 2018**
Designing the geotechnical investigations, siting trial holes, logging and sampling trial holes. Dynamic Cone Penetrometer testing. Laboratory test results analysis and report writing with recommendations for the cemetery site.

Highrise Buildings; Hospitals; University Buildings, Hostels & Social Housing, and Housing Projects

- Geotechnical Investigation for proposed New Hospital at Matatiele, Eastern Cape. 2021. Client: Green Door Environmental
- Report to GladAfrica on the Richards Bay Schools Upgrade Project: Development Bank of SA: Ntokozweni PS, Othobothino PS, OPhanzi PS, Northern KZN
- Report to Kantey & Templer on the Preliminary and Phase 1 Geotechnical Investigation carried out for the Shayamoya Township Upgrade Near Kokstad: 728 Sites. Reference No. 20-50R01. 2020. Client Kantey & Templer
- Geotechnical Investigation for Proposed Umkomaas Residential Development – No 1 Aquila Avenue Umkomaas. 2019. Client: Gateway Projects
- Report to Umsunguli Project Managers on the Results of Additional Percolation Tests carried out for Lions River Phase 3, KwaZulu-Natal Midlands. Project No.: 19-114R01. Client Umsunguli Project Managers
- Geotechnical Investigation for Low Cost Housing Project - Portions 26, 27 And 30 of Buffelsfontein 465 Jq – 194, Mooinooi, North West Province. 2019. Client: Simlab (Pty) Limited Report to Kantey and Templer on a Phase 1 Geotechnical Investigation for the Proposed Willowdale Residential Development
- Proposed Portion (of 1) of the Farm Melk Spruit No. 293, Kokstad, KwaZulu-Natal. 2018. Client Kantey & Templer.
- Report to Voigts Construction on a Geotechnical Investigation carried out for the Royal Albert Lodge, Albert Falls Dam, KwaZulu-Natal. Project No.: 18-156R01. Client Voights Construction
- Geotechnical Investigation for High Density Housing Development, Amanzi Heights, Amanzimtoti. 2018. Client: AlleyRoads Construction
- Report to iX Engineers on a Geotechnical Investigation for 200 Low Cost units – Greyton, Western Cape. 2019. Client iX Engineers
- Project No.: 18-169R01 Geotechnical investigation comprising site review mapping and walkover for Proposed Social Housing Developments at the Allenby, Eric Liberty and Plumer Sites: Witbank, Mpumalanga Province. Client: Social Housing Regulatory Authority. 2018
- Geotechnical investigation for the multi-storey extensions to the Students Union Building at Edgewood Campus, UKZN, Pinetown. The extensions to the building involved the addition of multi-storey components and enlargement of existing foundations to take on extra loading. (2018). Client Kantey & Templer
- Report to Kantey and Templer on a Phase 1 Geotechnical Investigation for the Proposed Willowdale Residential Development, Proposed Portion (of 1) of the Farm Melk Spruit No. 293, Kokstad, KwaZulu-Natal. Project No.: 18-169R01. December 2018. Client Kantey & Templer
- Report to Kantey and Templer on a Geotechnical Investigation for a Housing Development at Kokstad, KwaZulu-Natal. Reference : 11-050, dated : February 2011. Client : Kantey & Templer
- Enhlakahle Hostels – Greytown (2006). This project comprised the development of four 5-storey buildings to be constructed in Greytown, central KZN. Because of the deep weathering profiles developed from the insitu weathering of the dolerite and partially assimilated siltstone bedrock, several geotechnical boreholes were required to be drilled to confirm the founding conditions for piles. The piles used to support the buildings comprised Continuous Flight Augered (CFA) piles designed to support the foundation loads in bedrock. Client: CSM Consulting Services
- Kwezi Hostel Development, Estcourt. Carry out Phase 1 geotechnical investigation. 2006. Client CSM Consulting Services Pty) Ltd

- Klaarwater Station Housing Project Phase 1: this project comprised the development of a Hostel at Klaarwater. Geotechnical investigation was carried out in 2003. Client: Development Management Consultants
- Klaarwater Station Housing Project Phase 2: follow extensions to Phase 1 in 2005. Client: Development Management Consultants
- Enhlalakahle Township Development (492 sites) 2005 Carry out GFSH Phase 1 geotechnical investigation. Client: CSM Consulting Services.
- Remediation of 203 cracked hostel units (2003). Hostel units comprised single storey buildings which cracked as a result of collapse settlements occurring under poorly designed and constructed foundation raft slabs. Remediation involved the underpinning of houses using concrete pads and jacked piles as determined by site inspections and geotechnical investigation work.
- Merewent Hostels/Cluster Housing Infill. Carry out geotechnical investigation. 2002. Client: Arup (Pty) Ltd
- Geotechnical investigation for extensions G.J. Crookes Hospital near Scottburgh. As appointed by KZN administration. Geotechnical investigation involved the drilling of boreholes to confirm the depth to bedrock under site for the founding of piled foundations

SUMMARY OF EMPLOYMENT

2017 to present	Managing Director: Gondwana Geo Solutions (Pty) Ltd
2015 to 2017	Managing Director: MSJ Geotechnical Consulting Services (Pty) Ltd
2012 to 2015	National Geotechnical Manager RSA & Sub-Saharan Africa: WorleyParsons RSA
2011 to 2012	Managing Director: Moore Spence Jones (Pty) Ltd
2000 to 2009	Director: V3 Consulting Engineers (Pty) Ltd
1993 to 2010	Director: Moore Spence Jones (Pty) Ltd
	Director: MSJ Swaziland (Pty) Ltd
	Director: MSJ Mozambique Africa (Pty) Ltd
1991 to 1992	Associate Director: Moore Spence Jones (Pty) Ltd
1988 to 1991	Engineering Geologist: Bradford Conning & Partners
1986 to 1987	Business Analyst: Caltex Oil
1985	Full time Student: MBA: University of Cape Town
1982 to 1984	Engineering Geologist: Schwartz Tromp & Associates
1980 to 1981	Military Service: Engineer's Corps: South African Defence Force
1975 to 1979	Full time Student: BSc Hons: University of Witwatersrand

QUALIFICATIONS & AFFILIATIONS

- BSc (Hons) (Engineering Geology): University of Witwatersrand (1979)
- Master of Business Administration: University of Cape Town (1985)
- Member: South African Institute of Engineering Geology
Reg No 89/119
- Member: South African Council for Natural Scientists.
Pr SciNat Reg No 400148/88

CPD COURSES ATTENDED

- 2019: SAIEG / SAICE. Design of Basal Reinforcement, presented Maccaferri

- 2019: SAIEG/ SAICE: Foundation Design Course, presented by Department of Civil Engineering: University of Stellenbosch
- 2020: SAIEG; Construction materials
- 2021: SAIEG / SANIRE: Slope stability Seminar

CERTIFICATION

I confirm that the above CV is an accurate description of my experience and involvement with the various projects listed above as well as the qualifications given.




M V RICHTER
GONDWANA GEO SOLUTIONS (PTY) LTD

FIGURES

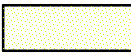


National Borehole ID	SADC Borehole ID	Latitude (WGS 84)	Longitude (WGS 84)	Depth (mbgl)	Water Level (mbgl)	Discharge Rate (l/sec)	Pump Type
2929BB00069	767633	-29.04188	29.79393	120.0	Unknown	Unknown	Blow
2929BB00031	767600	-29.02618	29.81223	66.0	Unknown	Unknown	Blow
2929BB00030	767599	-29.03338	29.79093	66.0	Unknown	Unknown	Blow

KEY :

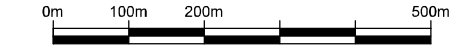


2929BB00069 (120.0)



Shale with Interbedded Siltstone and Sandstone. Estcourt Formation

Approximate position of Groundwater Borehole showing final depth in metres below existing ground level.



Graphic Scale
1 / 10 000
NB : Please note that the bar scale supercedes the verbal scale due to print sizes etc.

DRAWING DESCRIPTION

Hydrogeological Assessment Site Plan showing :
a.) Detailed Site Geology
b.) Groundwater Boreholes

Scale 1 : 10 000 (On A3 Original)

CLIENT

THE KLIPPLAATS FAMILY TRUST
PROJECT
Geohydrological Assessment for Wembezi PLS,
Portion 57 (of 1) of the Farm Klippaat Drift No. 1099



DATE
21/09/2021

DRAWN
A.S.

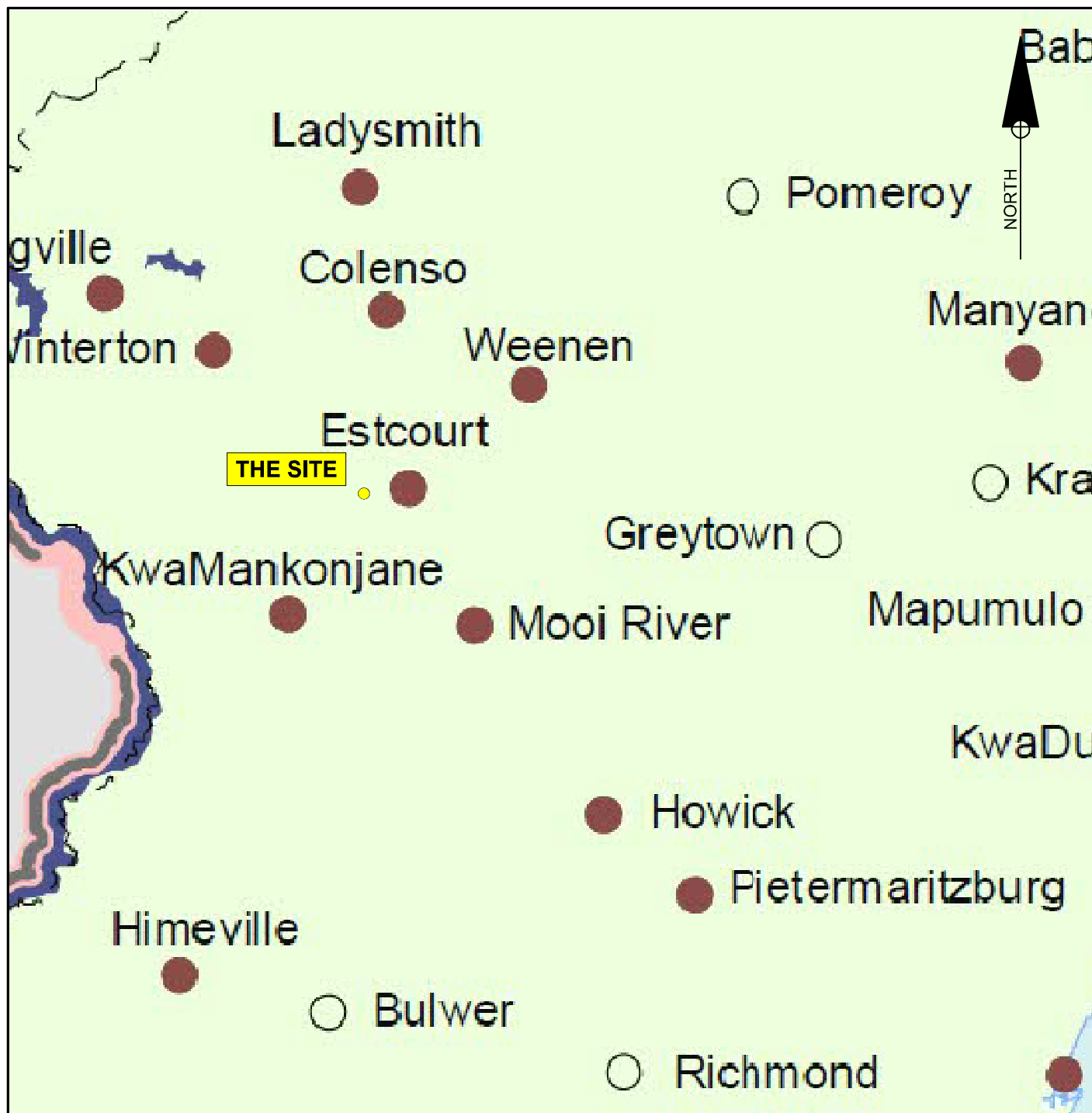
CHECK
M.V.R.

REFERENCE No.
21 - 030

FIGURE No.
1

REV.
0

Drawing prepared from Dwg. No. Lay4/Ver1/2020 Provided by Peter Jewell Consulting



LEGEND


Water Source

- Groundwater
- Combination : (Ground and Surface Water)
- Surface Water

Aquifer Classification

- Poor
- Minor
- Major

Drawing prepared from Aquifer Classification of South Africa provided by Dept. of Water Affairs SA

DRAWING DESCRIPTION <p style="text-align: center;">Locality Plan showing Aquifer Classification</p> <p>Scale 1 : 100 000 (On A4 Original)</p>	CLIENT <p style="text-align: center;">THE KLIPPLAATS FAMILY TRUST</p>		DATE <p style="text-align: center;">21/09/2021</p>
	PROJECT <p style="text-align: center;">Geohydrological Assessment for Wembezi PLS, Portion 57 (of 1) of the Farm Klippaat Drift No. 1099</p>		DRAWN <p style="text-align: center;">A.S.</p>
			CHECK <p style="text-align: center;">M.V.R.</p>
			REFERENCE No. <p style="text-align: center;">21 - 030</p>
		FIGURE No. <p style="text-align: center;">2</p>	REV. <p style="text-align: center;">0</p>



Susceptibility Matrix


AQUIFER CLASSIFICATION				
VULNERABILITY		Poor	Minor	Major
	Least	Low 1	Low 2	Medium 3
	Moderate	Low 2	Medium 4	High 6
		Medium 3	High 6	High 9

LEGEND

Water Source

- Groundwater
- Combination : (Ground and Surface Water)
- Surface Water

Drawing prepared from Aquifer Susceptibility of South Africa provided by Dept. of Water Affairs SA

DRAWING DESCRIPTION Locality Plan showing Aquifer Susceptibility Scale 1 : 1 000 000 (On A4 Original)	CLIENT THE KLIPPLAATS FAMILY TRUST	DATE 21/09/2021
	PROJECT Geohydrological Assessment for Wembezi PLS, Portion 57 (of 1) of the Farm Klippaart Drift No. 1099	DRAWN A.S.
		CHECK M.V.R.
		REFERENCE No. 21 - 030
		FIGURE No. 3
		REV. 0